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INFLUENCE OF SAW BOXING AND THEIR DISPLACEMENT IN THE INTER-GROOVE CLEARANCE ON THE GENERATION PROCESS

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Abstract: The results of research on determining the influence of saws' sailing and their displacement in the grate gap are presented. The relevance of the research is substantiated and a theoretical analysis of the fiber tension forces arising when the saw is located off-center in the grate gap is performed, it is indicated that as a result, the fiber tension depends on the grate wear and the position of the saw. At the grate, to which the saw is closer, the wrap angle increases, so the likelihood of fiber breakage also increases. The performed experimental studies have shown that the off-center position of the saw in the grate during ginning leads to the appearance of a lateral force acting on the grate. The magnitude of the force depends on the stiffness of the saw and, with its deformation by 1 mm, was at various points from 10.8 to 12.3 N. The maximum deformation of the saw under the action of a force of 10 N was 0.92 mm, and the minimum was 0.81 mm.

INTRODUCTION

Cotton fiber is the main raw material of the textile industry, and in this regard, the development of the cotton ginning industry is important, namely, the creation of new resource-saving equipment and technologies, which will ensure a reduction in the cost of production in the world cotton market.

The main machine of cotton ginning factories is gin, the main task of which is to separate cotton fiber from seeds, provided that its natural properties are preserved, and both the quality of the fiber and the production capacity of the plant largely depend on its work.

A modern saw gin (Fig. 1) is a high-performance, partially automated continuous-action machine, which consists of the following main units: a feeder 1, consisting of a splitter drum 2, feed rollers 3 and a perforated mesh4 and a weed auger 5. The gin also has a scraper 6 , short fiber conveyor 7, air chamber 8, saw cylinder 9, seed comb 10, grate 11 and working chamber 12 [1].

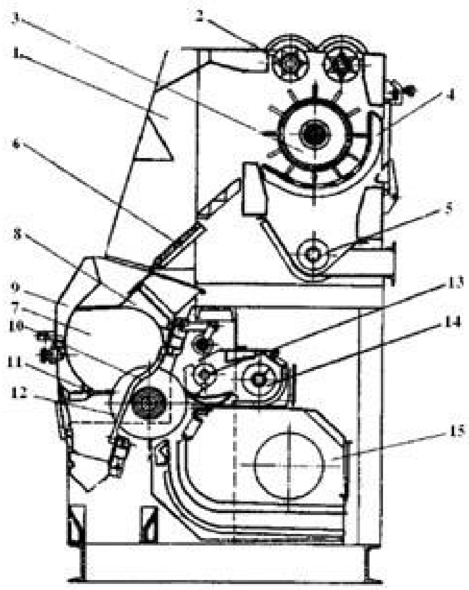

FIGURE 1. Saw gin

The works of a number of scientists are devoted to the issues of ginning, who have made valuable suggestions in the development of the theory and practice of ginning. Of the available works, a large number are devoted to the study of the operation of the saw tooth [2], the raw roller [3], the configuration of the raw chamber [4], the productivity of the gin [5], etc.

One of the important units of the gin working chamber is the grate, the state of health of which greatly affects the qualitative and quantitative indicators of the ginning process. However, in our opinion, scientific works on a comprehensive analysis of the influence of the grate or its elements on the indicators of the ginningprocess are still insufficient.

Based on the foregoing, this work presents the results of studying the interaction zone of the grate with the genie saw in order to reduce its wear. The wear of the grate in its working part will lead to disruption of theginning process and to the failure of the grate. A special place, from the point of view of grate wear, is occupied by the position of the saw in the grate gap, since its incorrect position leads to intensive wear of the working surfaces of the grate.

THEORETICAL FREQUENT

Figure 1 shows a diagram of an offset saw blade in relation to the grate gap. One of the important indicators of accuracy is the spatial error of genie and linter saws, estimated by the deviation from the plane, which, according to the established technical conditions, should not exceed 0.5 mm. In the manufacture of saws, the accumulated internal stresses lead to significant deformation and the non-flatness of the saws can reach 1.5-2 mm or more.

All this leads to an uneven tension of the fiber, which subsequently affects the formation of defects, such as an incision, damage, etc. Consider the force acting on the fiber during the ginning process, with the saw displaced in the grate gap.

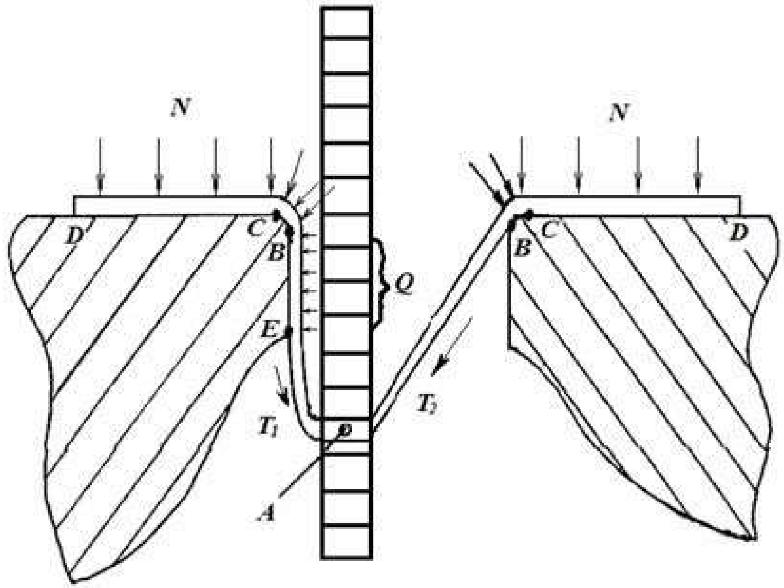

FIGURE 2. Fiber tension forces arising when the saw is off-center in the grate clearance.

In this case, the tension of the fiber is uneven, the fiber on one side is closer to the grate, and on the other hand, farther, the angle between the branches is different relative to the saw, as mentioned above, this can cause a defect in the fiber, and we assume that the fiber has already been torn off from the seed in the raw roller, but did not have time to pass through the gap, and therefore additional wear occurs from contact with the grate.

Let's compose the equation of fiber tension for this case. We will proceed from the fact that the fiber is pressed against the grate by a raw roller on one side with the force F' and on the other hand with the force F'', and the friction force between the saw and the grate is expressed as F'''. In this case, the tensile force on the fiber will be equal to the following:

$$T1 = F' + F'' + F''' \quad (1)$$

Let us express the friction force between the grate and the fiber as:

$$F_{тр1} = F_{тр2} = \square_1 P_0 L_1 \quad (2)$$

$$\square_1 P_0 L_2 \quad (3)$$

Where P_0- is the specific pressure force on the fiber;

$\square_1$ - coefficient of friction between grate and fiber and saw and grate; L_1, L_2- fiber length.

And the fiber tension can be expressed through the Euler equation:

$$F' \square F_{fr1} e^{\square 1 \square} \square p_0 L_1 e^{\square 1 \square 2}$$

$$F' \square F_{fr1} e^{\square 1 \square} \square p_0 L_2 e^{\square 1 \square 1}$$

(4) (5)

In view of the close distance between the grates, we will take it as 90^0, then in this case, (4) and (5)will take the form:

$$F' = F e^{\mu 1 \alpha 1} ... p L e^2 \quad \text{or} \quad F' = F e^{\mu 1 ...} ... L e ... \qquad (6)$$

$fr1\ 1 \quad 0 \quad 1 \quad fr2 \quad 1 \quad 2$

But the presence of the pressure force between the saw and the grate is expressed in the following form:

$F''' = \mu_1 Q$ (7)

where Q- is the lateral pressure on the grate surface, depending on the stiffness of the saw. Then equation (1) will take the form:

$$T = p_0 e^2 \ 11,34 L_1 \ L_2 e^2 \ Q \ \mu_1 \qquad (8)$$

The tensile force on the fiber must satisfy the following conditions:

$$\sigma_{вол} \le \sigma_{доп} = \frac{T}{S} \qquad (9)$$

where S- cross-sectional area of the fiber; $\sigma_{fib} \le \sigma_{perm}$ - permissible breaking load.

It can be seen from equation (8) and (9) that the tension of the fiber depends on the value of the wrap angle, which in turn depends on the wear of the grate and the position of the saw. At the grate, to which the saw is closer, the wrap angle increases, so the likelihood of fiber breakage also increases.

It is known that turning off the coordinates of the side surfaces of the saw and grate from the nominal positions cause the saw blade to shift in the grate gap. In this case, one-sided sampling of the gap to zero is possible, and at large displacements, the appearance of "interference", in which the saw bends when entering the grate slot, contacts the side surface of one of the grates and, as a result of rotation, wears it out.

Conducted theoretical studies on the assessment of contact pressures during the interaction of cotton fiber with the working edge of the gin grate showed that the tensile forces of the strand of fibers, with the central location of the saw in the interglass gap, is approximately 1.5 times less than with the off-center [6].

ARTICLE BODY

If the saw blade touches the side surfaces of the grate, a normal force will appear that pushes the saw blade off the grate and its value will depend on the stiffness of the blade. The off-center position of the saw blade in the grate-to-grate will also lead to the emergence of a wringing force of the disk during ginning, since the difference in the clearances between the opposite sides of the saw blade will lead to its squeezed out strand of fibers passing into the gap between the saw and the grate.

In this regard, it is of interest to study the dependence of the force acting on the grate on the deformation of the saw blade. Since the saw blade is warped and this leads to a change in the gap between the saw and the grate when the saw rotates, it is natural that the magnitude of the lateral force will also change depending onthe war page of the saw blade.

From this point of view, it is of great importance to study the value of the beating of the saw blade and the value of its deformation at various points under the action of a normal load. For this, a saw 1 was fixed ona special stand (Fig. 3) on the saw shaft 2.

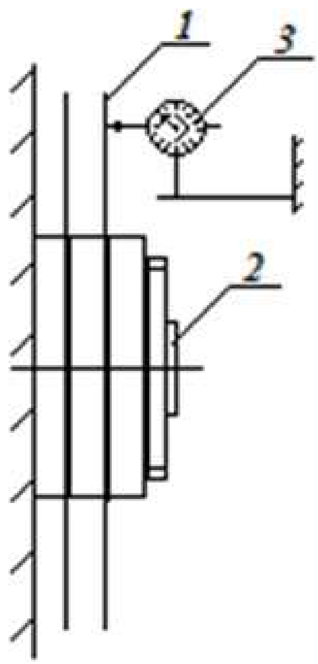

FIGURE 3. Installation for measuring the distortion of saws.
1-saw; 2-shaft; 3-indicator.

To study the runout, the circumference of the saw blade was divided into eight divisions. Indicator 3 was installed on a special stand, the measuring tip of which measured the end runout of the disk at the periphery. The deviations of the points of the lateral surface of the disc were measured and presented in Table 1.

TABLE 1. Experimental results

Points on the Pod. disc deflection	1	2	3	4	5	6	7	8
Saw blade run out, mm	0	-0,12	0	-0,43	-0,83	-0,89	-0,34	0,06

As can be seen from the table, the maximum deviation of the saw blade points was 0.95 mm. Accordingto the table, the curve of the saw blade war page is plotted, shown in Fig. 4. As you can see from the curve, the disk has three vertices, i.e. in one revolution of the disc, points on its surface approach and move away from the grate three times, i.e. for one revolution of the saw, the value of the load acting through the strand of fibers on the side surface of the grate changes three times.

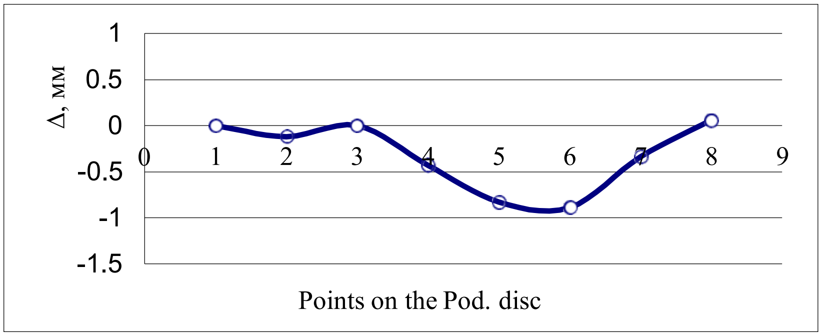

FIGURE 4. Saw blade warping

An alternating load can lead to a shift of the replaceable grate element. The magnitude and fluctuations of the load depend on the magnitude of the deformation of the saw blade.

The study of the dependence of the deformation of the saw blade on the load was carried out on a stand (Fig. 5), on which the saw was loaded with a load 3 and a thread thrown over a block 4. The value of the saw deformation was determined using an indicator 5 mounted on a special stand.

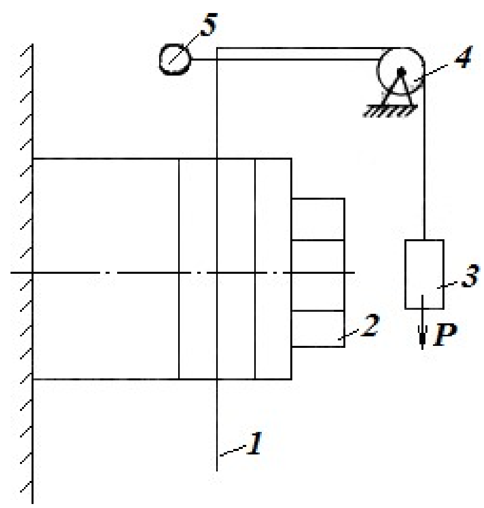

FIGURE 5. The scheme of the stand for studying the deformation of the saw blade from the load.

The amount of deformation of the saw from the load was determined at the same points at which the deviation of the points of the end surface from the nominal position was determined.

The starting point was taken the same point as when determining the war page of the saw blade. The research results are presented in table 2.

TABLE 2. Saw deformation under external load

Load, N.	Moving in points, mm		
	1	2	3
2	0,17	0,04	0,16
4	0,35	0,23	0,35
5	0,44	0,33	0,45
10	0,89	0,8	0,89

According to the research results, the stiffness of the points of the saw blade was calculated using the equation J □ P / □, N / mm, where P- is the load, □ - is the deformation of the disk under the action of the load P.

According to the table, graphs of the dependence of the movement of points on the surface of the saw on the load are plotted (Fig. 6).

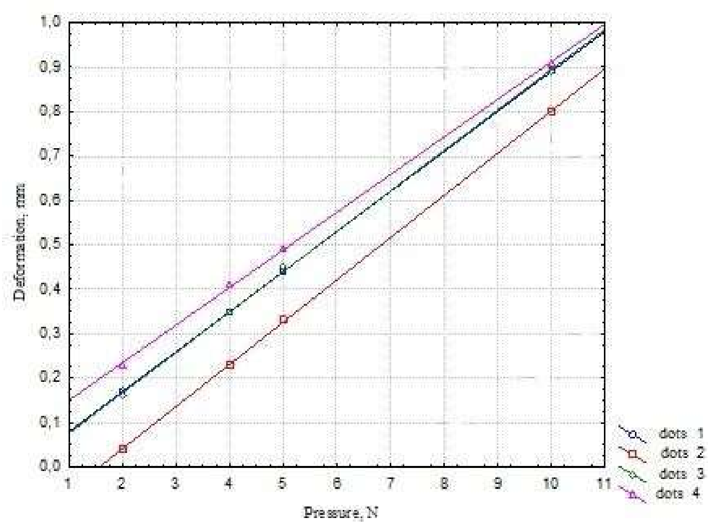

FIGURE 6. The dependence of the deformation of the saw blade on the load.

As can be seen from the data in the table and from the graph, the stiffness of the points on the saw surface (deformation) depends on the war page of the saw blade. This suggests that load fluctuations will increase due to the difference in the stiffness of the saw at different points, depending on the war page.

Thus, on the basis of the studies carried out, it has been established that the off-center position of the saw in the grate during ginning leads to the appearance of a lateral force acting on the grate. The magnitude of the force depends on the stiffness of the saw and, with its deformation by 1 mm, was at various points from 10.8 to 12.3 N. The maximum deformation of the saw under the action of a force of 10 N was 0.92 mm, and the minimum was 0.81 mm.

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