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Ways to increase the pulling force of the fiber by the knife in the roller gin

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ABSTRACT: The work is devoted to one of the urgent issues of the cotton ginning industry. The article discusses ways to increase the pulling force of the fiber. This method of solving problems is relevant since leads to the intensification of the ginning process.

KEY WORDS: roller gin, efforts of the working drum, knife, tightening

I.INTRODUCTION

It is known [1] that in order to increase the efficiency of the roller ginning process and the gin's fiber productivity, it is mainly necessary to use the instantaneous friction area of the working drum as much as possible per unit time. The completeness of using the friction area of the working drum depends on the rational and uniform use of the entire length of the knife's contact with working drum, as well as on the coefficient of slipping of the surface of the drum along the fiber of the genitated volatile drawn by the knife:

(1) $$\varphi_l = \frac{l}{s}$$

Where φ_l is a coefficient of the working drum along the fiber;
l - the length of the fiber bundle when tightening the volatile;
s is the distance passed by the surface of the drum during the generation of the volatile.

II. SIGNIFICANCE OF THE SYSTEM

Experimental studies [1] made it possible to establish that the value of the slip coefficient is in the range φ_l =0,3 -0,6. Our experimental studies, observations of the operation of roller gins during the ginning of new varieties of fine-fiber 9871-I, as well as medium-fiber varieties, such as An-6, 6524-C, etc., showed that this coefficient is even lower and amounts to 0.15 - 0.35. This explains the decrease in the effectiveness of ginning of thin-fiber and medium-fiber cotton of new varieties on existing roller gins. The reason for this is a higher strength of fiber attachment to the seeds, which causes the working drum to slip along the fiber pulled by the knife and violate the basic condition of the roller ginning process, which is determined by the expression: P3>Ppr, i.e. the pulling force P3 must exceed the force holding the fibers on the seed Ppr.
It is known [1] that the efficiency of the fiber separation process primarily depends on the intensity of pulling the fiber by the knife. The pulling force of the fiber is expressed by the following relationship:

(2) $$P_3 = BL\left[q_0 + \frac{K_1 K_2}{K_1 + K_2}\delta_0(1-\Delta\varepsilon)\right](\mu_1 - \mu_2)$$

From the expression (2) it follows that the tightening force depends on the frictional properties of the material of the working drum and knife $(\mu_1 - \mu_2)$ on the pressure of the preliminary pressing of the knife q on the rigidity of the surface of the working drum K1 and knife K2 as well as on the thickness of the pulled fiber bundle of volatiles. Analyzing expression (2) , it can be noted that the main measures to increase the pulling force are the increasing rigidity equivalent of the "working drum-knife" system, increasing the force of preliminary pressing the knife to the drum q and the coefficient of friction of the working drum material along the fiber.

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III. LITERATURE SURVEY

Increasing the rigidity equivalent of the system of "working drum-knife" will allow to increase the pulling force during the passage of the fiber bundle through the contact of the knife with the working drum. However, imparting excessive rigidity to the working drum is also impractical because of the possibility of damage to the fiber, therefore, the rigidity of the working drum should be optimized from the standpoint of treating the pulling force, increasing the durability of the drum material, the durability of the grooves and preserving the natural properties of the fiber.

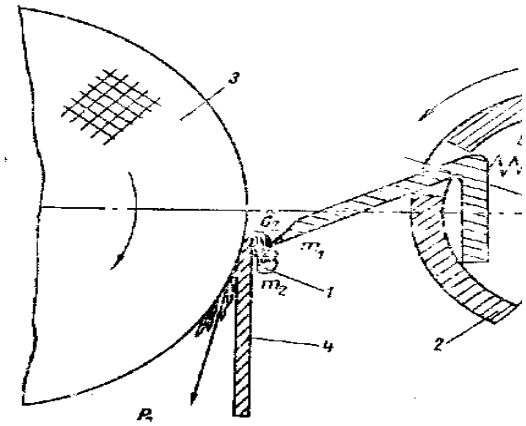

Figure 1: Scheme of the roller ginning process
where, 1-seeds of the volatile, 2-breaking organ, 3-working drum, 4-fixed knife

Studies conducted by R. Korabednikov [1] showed that with increasing pressure in the zone of knife contact with the drum the pulling force and productivity of the gin are increased. However, with an increase in the pressure of pressing the knife above the traditional value (q = 90 N / cm^2), the working drum quickly overheats and fails due to the failure of its material.

It should also be noted that the pressure of the knife during the roller ginning is limited by the allowable limit of the material durability criterion of the working drum [qv].

The search for ways to increase the pulling force of the fiber by the knife in the ginning zone led to attempts to use the vibration of the knife.

Works are devoted to the study of reducing friction of a fiber against a vibrating surface [1].

A study of the use of vibration of a previously fixed knife of a roller gin made it possible to establish the effect of reducing the time of volatile ginning.

The intensification of the process of roller ginning in gin occurs due to the use of periodic pressing of the knife with a maximum pressure that is twice the pressure of the statically pressed knife.

IV. METHODOLOGY

The use of such a periodic pressing of the knife with overload creates a friction field between the knife and the working drum with an average value close to the value of the friction field of the knife with static pressing. The pressure of pressing the knife to the drum during the oscillatory application of the load provides for a time approximately equal to the half-cycle of the value oscillation of the pulling force is 2 times greater than with the static pressing of the knife. However, developed DV carriages - it has been proposed by us to simplify the design of the vibrator in order to increase its reliability, as well as the ginning efficiency of new varieties of raw cotton. The experience of operating existing roller gins has shown that the ginning process is more effective if the fixed knife is pressed against the working drum with a certain effort. However, it is limited by the allowable qv criterion for the durability of the material of the working drum (for the material RCM-2 [qv] = 220-230 N.m / cm^2 s).

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V. EXPERIMENTAL RESULTS

Analyzing possible options, it can be noted that if we take it as a constant, then, in principle, we can vary the values of q and v (Fig. 2). An increase in the peripheral speed of the working drum of roller gin is over 2.3 m / s, as shown by TITLP studies, does not lead to an increase in gin productivity, due to the fact that the invariance of the [qv] value necessitates a decrease in pressure q. And the pressure of pressing the knife to the working drum is the most important factor determining the effectiveness of ginning, and its decrease leads to the efficiency of the ginning process.

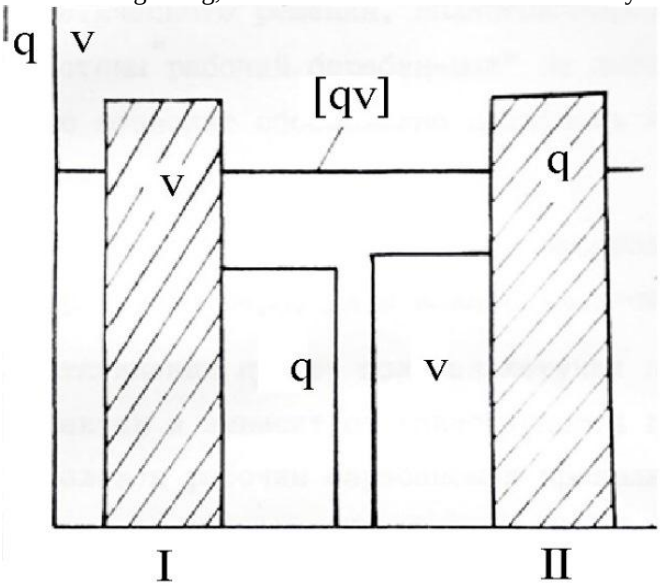

Fig. 2. Combination versions of q and v while ensuring acceptable values (qv) for material RCM-2

VI.CONCLUSION AND FUTURE WORK

On this basis it was concluded that it is advisable to study the possibility of reducing speed and increasing pressure. No similar studies have been carried out in this direction. Therefore, one of the questions of our research is the determination of the influence of the roller gin setting mode on the efficiency of the ginning process. Another important issue requiring a theoretical solution is the determination of the effect of the elastic working drum-knife system on the ginning fiber in dynamics that will allow you to reasonably assign the rigidity of the knife and the working drum.
Thus, it is possible to intensify the roller ginning process by acting on it by the correct selection of the elastic-stiffness properties of the "working drum-knife" system and by changing the ratio of the peripheral speed of the drum and the pressure of pressing the knife.

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