STUDY OF CONSTRUCTIVE AND TECHNOLOGICAL PARAMETERS OF SAWING MACHINES JINS AND LINTERS

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ABSTRACT

The main operations of the primary processing of cotton are ginning (separation of fiber from seeds) and lintering (separation of lint from seeds). It is necessary to develop an effective technology for the primary processing of machine-picked cotton, to reveal the scientific characteristics of fiber, linters and cotton seeds in the ginning and linting process, to identify and optimize the working parts involved in the separation of fiber and linters from seeds.

The article studies the principles of removing products from the surface of sawing cylinders, fiber and linters from cotton ginning factories. The pubescence of cotton seeds before linting was determined. The energy requirements of linter machines are studied in comparison with other equipment. The forces acting on the filament and lint in the ginning and linting processes have been determined. Presented is the removal of fibers and linters from the saw cylinder in different air flow pressures in the working chamber. The rational parameters of the air flow rate for the removal of fiber and linters from the saw cylinder have been determined.

A resource saving device for air removal of lint from saw teeth is proposed. In linters it is possible to use a reus that saves air removal devices to separate the linters from the saw teeth. To improve the class of fiber and linters, it is recommended to study the design and technological parameters of the working bodies of gin and linter feeders.

Key words: gin, gin feeder, linter, fiber, lint, take off, suction, performance, pressure, devices, air chamber, pulp, seeds, saw teeth, air, fiber and lint class.

INTRODUCTION

In modern conditions of market relations, the most important indicator of the production activity of an enterprise is the competitiveness of products, which should be determined by the minimum production costs and high quality, carried out using modern technology and technology [1].

Reducing the cost of manufacturing products can be achieved due to many factors, such as ensuring the preservation of the properties of raw materials, economical use of all types of material and labor resources, energy savings, etc[2].

In this regard, the cotton ginning industry faces the challenge of increasing the level of profitability while reducing production costs. It is important to carry out large-scale research work in order to improve the technique, technology and their scientific basis for the primary processing of cotton. In particular, the main operations of the primary processing of cotton are ginning (separation of fiber from seeds) and lintering (separation of lint from seeds). It is necessary to develop an effective technology for the primary processing of machine-picked cotton, to reveal the scientific characteristics of fiber, linters and cotton seeds in the ginning and linting process, to identify and optimize the working parts involved in the separation of fiber and linters from seeds. The gin-linter farm at the cotton plant is a technological line equipped with a large number of equipment [3,4].

In a regulated technological process, after ginning, a short fiber less than 16 mm in size remains on the seeds, which is called lint. According to the average statistical data, lint remains 10-15% of the initial fiber

content of raw cotton, in connection with which, at the ginneries, a technological operation is provided - linting of cotton seeds in order to obtain this product [5].

Fiber and lint is a valuable product for the textile, chemical and paper industries[6].

The dynamic and sustainable development of the cotton industry, the introduction of energy-saving modern equipment in the industry, an increase in the amount of cotton fiber, lint and short fiber products, as well as the production of natural products in the global cotton market are of great importance. In this regard, special attention is paid to the improvement of high-performance machines for processing cotton and the creation of resource-saving technologies in the global cotton industry[7,8].

In the world, it is important to carry out large-scale research work in order to improve techniques, technologies and their scientific basis for the primary processing of cotton. In particular, it is necessary to develop an effective technology for the primary processing of machine-picked cotton, to reveal the scientific characteristics of cotton seeds after ginning, to identify and optimize the working parts involved in the removal of lint.

Saw ginning - raw cotton entering the working chamber of the saw gin near the seed comb is captured by the teeth of the rotating saws, mounted on the shaft with between the saw strips, and is transported to the workstation of the grate. The cotton flaps captured by the saw teeth are connected with other cotton flaps and impart to them the movement received from the saw teeth. As a result, the entire mass of cotton in the working chamber rotates in the direction opposite to the direction of rotation of the saw blades. Thus, a rotating raw roller is formed, which ensures a continuous supply of cotton to the saw teeth, and, consequently, the continuous productive work of the gin [9].

The gin should have 80 - 90 saws on the saw shaft, the dimensions of its working chamber are larger than those of the previous gins, which allows increasing the productivity of the gin up to 12 kg of fiber per saw per hour or more (Fig. 1).

The gin is fed with raw cotton automatically and is regulated depending on the load current of the saw shaft drive. Raising and lowering the working chamber, dumping the raw roller from the chamber, shaking the chamber at the bottom are also automated. During the shaking of the working chamber, the grids in the upper part are cleaned by saws due to the presence of a double suspension of the chamber.

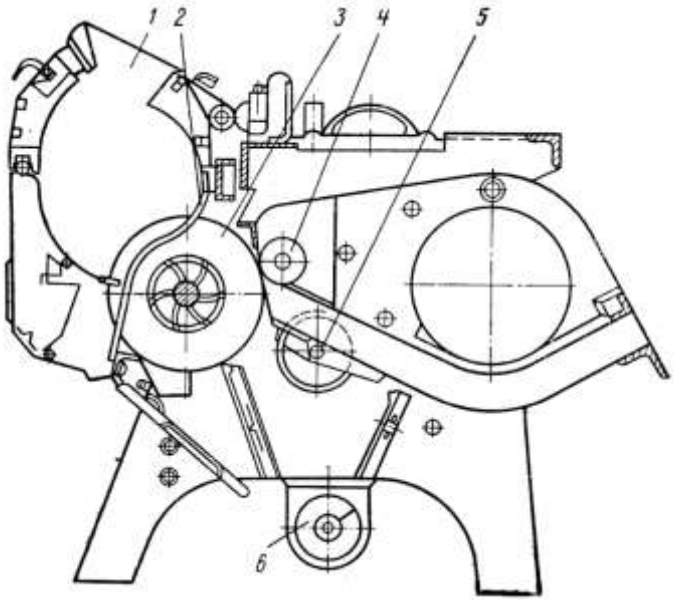


Fig. 1. Saw gin scheme.

1 - gin working chamber; 2 - grate; 3 - saw cylinder; 4 - mechanism for moving the removable device; 5 - mechanism for moving the ulyuchny visor; 6 - weed conveyor.

The strands of fibers captured by the saw teeth are pulled in the workplace by the grates, are torn off the seeds and transported to the pick-up device, where they are removed from the saw teeth by an air flow and are transported through the neck to the battery fiber outlet. The gap in the working area of the grate is 2.8 - 3.2 mm (less than the minimum seed size), so the seeds are held in this place and are carried away by the mass of the rotating raw roller until all the fibers are torn off.

After separating all the fibers, the seeds lose their connection with the mass of the raw roll and are sent from the gin down the grate. The drooping of the seeds emerging from the gin is regulated by changing the position of the seed comb.

Due to the difference in speeds between the raw roller and the saw cylinder (Vw << Vp), a rupture is formed in the raw roller, as a result of which the seeds do not accumulate, but fall out of the working chamber along the grate.

The saw speed is 12.2m / s, and the air speed is 65-70m / s.

For a steady ginning process, the theoretical gin productivity is determined by the formula:

$$\Pi = \frac{Q}{t_{cp}} \cdot A$$

Where: Q - is the mass of the raw roll (kg);

t-is the residence time of the fiber and seeds in the working chamber of the gin (s);

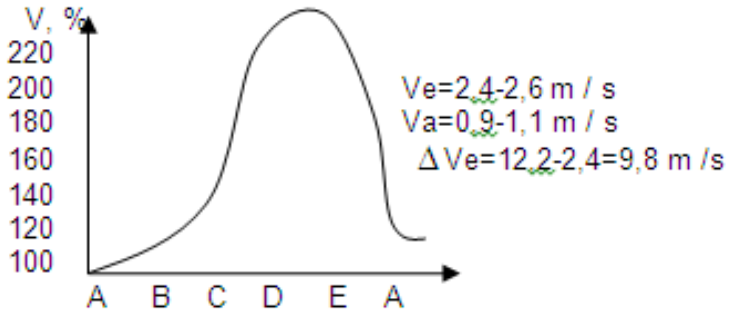
A-is a constant gin coefficient.

Practical performance of the saw gin:

$$\Pi = \frac{60 \cdot H \cdot k \cdot B \cdot t}{1000 \cdot i \cdot p}$$

Where: H-saw speed; B-number of saws on the shaft; k is the number of gin; t- is the number of teeth on each saw; I - is the number of fibers captured by one saw tooth; p-number of fibers in 1g.

Scientific research has also established the dependence of the distribution of speeds along the profile of the working chamber (Fig. 2). And if the speed of rotation of the raw roller behind the grates is taken as 100%, then in zone E, where it reaches its maximum, this value is equal to 220%.



Kinetics of rotation of the raw roller
in the working chamber of the gin

Fig. 2. The diagram of the dependence of the distribution of velocities along the profile of the working chamber.

In the first 50 seconds in the working chamber, more than 97% of the fiber is separated, and in the next 50 the remaining 2 - 3%. But at the same time, the content of crushed seeds is growing sharply.

The density of the raw roller during the operating mode of operation should be ≤ 550 kg /m^3

At a density of ≥ 550 - 650 kg /m^3, the raw roller stops. The average weight of a raw cushion usually reaches 40 - 60 kilograms.

After the ginning process, a fiber called lint remains on the seed. According to the selective and industrial grade of processed cotton seeds, after ginning, they remain in different quantities on the seeds, and in the seeds of medium-staple cotton 11-17%, in the seeds of long-staple cotton 2,4-5% lint.

The process of separating cotton linters is carried out as follows: after the sawing gins, the seeds are distributed to the linters with the help of elevators. They are installed in two lines of four, five or six. Lint from each line is sent to a condenser, which is then cleaned and pressed.

Before linting the cotton seeds, the residual fiber seeds are fed to the separating machines to remove the fiber onto the fiber.

Important technological indicators of gin and linter are the seed yield and the amount of lint. The main components of the linter are the feeder, housing, working chamber, saw cylinder, air chamber (Fig. 3).

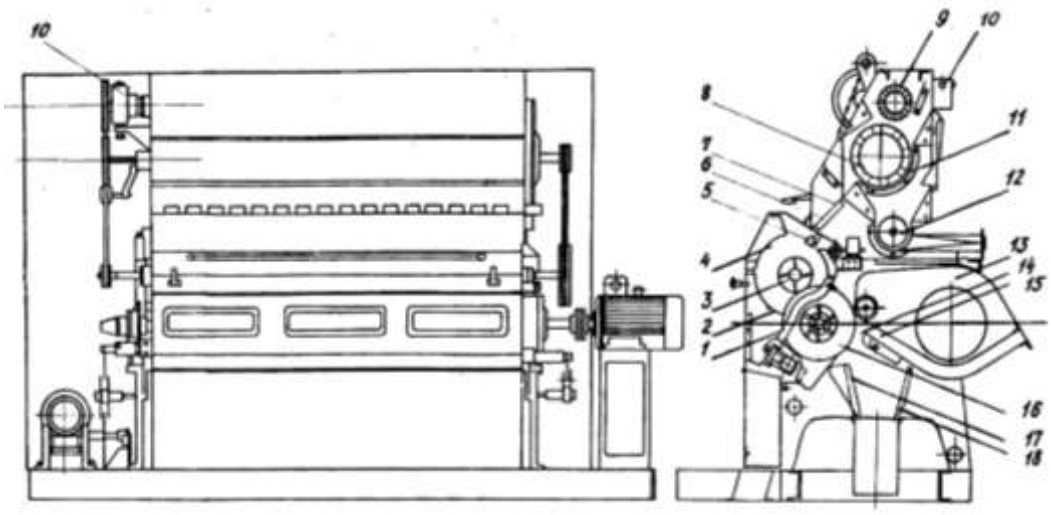


Fig. 3. Diagram of a 5LP linter

1-grate; 2-seeded comb; 3-turner; 4-working chamber; 5-valve density; 6-magnetic plate; 7-seed tray; 8-leveling drum; 9-feed drum; 10-linter feeder; 11-perforated mesh; 12-weed auger; 13-air chamber; 14-key visor; 15-neck; 16-saw cylinder; 17-small tray; 18-tray large.

The seeds are fed into the linter feeder shaft. The feed drum 9 picks up the seeds from the mine and dumps them onto the leveling drum 8, which drags them along the perforated mesh 11 and evenly feeds them into the working chamber through the chute. Under the action of centrifugal force and the air flow created by the drum slats, fine debris is released through the mesh. The separated litter is transported by the auger 12 to the mouth of the chute, from where it is sucked out by the pneumatic conveying system.

A rotating seed roller is formed in the working chamber under the influence of the agitator and the saw cylinder.

The saw teeth are removed from the seeds and dragged through the cracks of the grate. The lint is removed from the saw teeth by the air flow coming out of the nozzle of the air chamber and fed through the throat to the lint outlet and then to the condenser.

The theoretical productivity of the linter is determined by the formula:

$$\Pi_T = \frac{B}{t} \cdot K$$

Where: B-is the mass of seeds in the working chamber;

t-is the time spent in the working chamber;

K-coefficient characterizing the condition of linting.

Linter performance under production conditions is determined by the formula:

$$\Pi_Л = \frac{Q \cdot C}{100}$$

Where: Π_{JI} - linter productivity per lint (kg /h)

Q - seed flow capacity of the linter (kg /h)

C - percentage of lint removal.

At ginning and linting factories in ginning and linting, the pubescence and the class of seeds are determined as required by the standards O'zDst 596, O'zDst 601 and compared with the standards [9].

EXPERIMENTAL PART

The technology of removing fiber and lint in gins and linters is based on the mechanical action of the saw on the raw and seed shaft, where by tearing off the fiber and scraping the lint from the surface of the seeds, and then removing it from the saw teeth by air flow and transporting it by air to the condenser and separating it from the air.

The important technological parameters of ginny and linter are the productivity in terms of the amount of fiber and lint. It is known that in genies when removing fiber from saw teeth and linters when removing linters from saw teeth, one and the same air removal device is used (Fig. 2). This device consists of a linter tube with an adjustable air chamber tube. In this device, with the help of a ventilator, the VC creates air pressure, which is fed into the air chamber through the hole. At the same time, the linear air velocity is greater than the linear velocity of the cylinder, the fiber or lint from the saw teeth is separated and directed into the cavity. From there, it is sent to a common pipeline and delivered to the condenser.

When separating fiber from seeds from the saw teeth in the chamber, an air-removing device, pressure P = 3050 Pa and Q = 2.5-2.8 m^3/s, in six linter machines to create a pressure of 2560 Pa in the air chamber and Q = 2,3 -2.5 m^3/s air fan is used [10,11].

According to the calculation, the productivity of two gins is 2960 kg of fiber per hour, and the productivity of six linters is 310 kg. It can be seen that the linear performance of linters is 9,7 times lower than that of gins, and the air consumption is the same, which certainly indicates higher energy consumption and lower efficiency of linters.

In this regard, the study of the technology of the process of linting of cotton seeds requires solving a number of problems and, first of all, tasks related to the study of energy consumption and the efficiency of linter machines.

METHODS EXPERIMENTS

It is known that in genies, when removing fiber from saw teeth, genies and linters use the same air removal device when removing lint from saw teeth (Figs. 1 and 3). This device consists of a fiber tube and linter with an adjustable air tube[12,13].

In all saw gins and linters used in ginneries, in terms of fiber movement, we divide the direction of the air flow in two [14,15].

In the first part, the flow is partially compressed, and in the second part, the fiber is quickly separated due to the effect of the suction air flow. In this regard, we will consider the movement of the fiber in each part separately[16,17]. It is assumed that the conditions of continuous pressure along the line are satisfied within the boundaries of the two parts. In the compression section, we indicate the values of the fiber ρ_1, p_1, v_1.

Where: ρ_1 - density, p_1 – pressure, v_1 - air flow rate.

b_1 - zone width, v - speed, ρ - density, p – pressure.

v_{10} - speed, ρ_{10} - density, p_{10} - pressure.

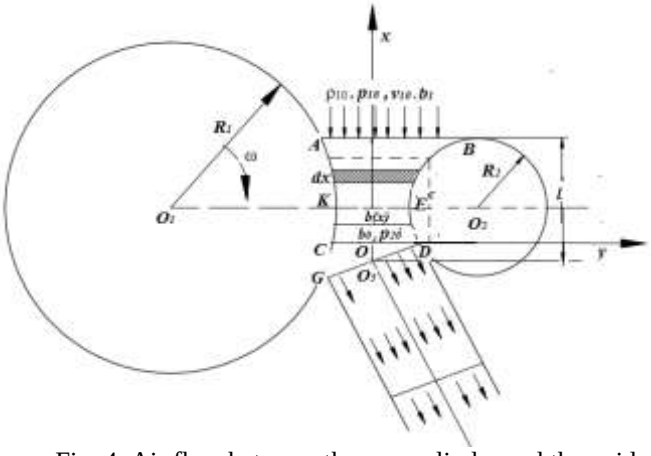


Fig. 4. Air flow between the saw cylinder and the guide.

$$в_1 = в_0 + \frac{l^2}{R_0}$$

The equation of stationary air movement in the compression zone

$$\rho \upsilon l \frac{dp}{ax} = -\frac{d(pb)}{ax} + \rho g b c + \rho(\sin\alpha \pm f\cos\alpha) \quad (1)$$

Where: ρ , υ , p – $ABDC$ density, speed, pressure at any section of the working area. Here $0 < x < l$, $tg\alpha = f$ - coefficient of friction, $l -$ total height of the working area, $b = b(x)$ width of this zone.

$$b = b_0 + \frac{x^2}{R};$$

$$R = \frac{R_1 R_2}{R_1 + R_2}$$ – suggested radius (2)

$O < x < c$, x_1 the + character is selected for the section, where ω the angular velocity of the air flow is greater than the angle of the saw, the section is selected $c < x < l$ x_2, where ω the angular air velocity is less than the saw angle b_o- $x = 0$ cross-sectional width. Equation (2) has three unknowns ρ , υ , p , and we use the equation of state of the environment to integrate them:

$$\rho = [1 + A(p - p_0)] \cdot \rho_0 \quad (3)$$

we obtain from the law the conservation of mass:

$$\rho_{10}\upsilon_{10}b_1 = \rho\upsilon b = Q_0 / L \quad (4)$$

Where, $b_1 = b_0 + l^2 / R$

A - unchangeable number obtained by experienced, $Q_0 = \rho_0 v_0 S_0$ - machine performance; ρ_0 , p_0 - flow rate and density of the mass passing from the compression zone; - longitudinal section of the outgoing branch pipe.

Equation (3) wa (4) showing velocity through pressure:

$$\upsilon = \frac{\upsilon_0 b_{00}}{b[1 + A(\rho - \rho_0)]} = \frac{\upsilon_0 b_{00}}{b}[1 - A(p - p_0)] \quad (5)$$

(2), (3) and (5) equations υ, p, b - showing the set equation (1), we obtain:

$$\rho\upsilon_0 b_{00}\left\{-\frac{\upsilon_0 b_{00} b'}{b^2}[1 + A(\rho - \rho_0)] - \frac{\upsilon_0 b_{00}}{b} A\frac{dp}{dx}\right\} =$$

$$-b\frac{dp}{ax} - pb' + p_0 gb[1 + A(\rho - \rho_0)] + \quad (6)$$

$$+ p(\sin\alpha \pm f\cos\alpha)$$

$\alpha << 1$ what, $\sin\alpha = \frac{x}{R}$, $\cos\alpha = 1$ consider;

$$\rho v в = \rho_0 в_{00} v_0$$

$$v = \frac{\rho_0 в_{00} v_0}{в \cdot \rho}$$

$$в_{00} = в_0 + \frac{h^2}{R}$$

$$v = \frac{Q_0}{h\rho в}$$

$\frac{dp}{ax}$ in relation to education (6), we solve the equation

$$\frac{dp}{ax} = pF_0(x) = F_1(x) \quad (7)$$

$$F_0(x) = \left[b^1 + \frac{\lambda b_{00}^2}{b^2} - \rho_0 gbA - \frac{x}{R} \pm f\right]\frac{b}{b^2 - \lambda b_{00}^2}$$

$$F_0(x) = \frac{\lambda b_{00}^2 b^1}{Ab^2}(1 + Ap_0) + \rho_0 gb(1 - Ap_0)$$

$$\lambda = \rho_0 v_0^2 \cdot A$$

(7) the equation $p(l) = p_{10}$ integrated into the context

The solution to the equation is expressed squared $p = e^{-Fr(x)}\left[p_{10} l^{F_2/l} - \int_x^l F_1(x) l^{F_2(x)} dx\right]$ бунда

$$F_2(x) = \int F_1(x) dx$$

Fibrous mass flow can be viewed $ABDCDG$ in the general area where $ABEK$ concentrations occur in the field, $EKDG$ partly due to the expansion of the zone - partly shows. In this case, the equation of motion of the mass over the sphere, the equation of mass is written as equation (1), where DG boundary condition along the line DC ED moves in a straight line, that is $-h < x < 0$ we accept. Where DC

along the line $p_{20}\cos\alpha_0$ wags pressure where p_{20} suction pressure, α_0 - DG cut and Oy the angle between the center (Fig. 1). Now the function $F_0(x)$ set the symbol in the formula.

$x=0$ the speed at the point of intersection of the saw is greater than the peripheral speed. For this reason, the friction force has a positive axis orientation and in the section of the fiber mass adjacent to this section + we accept the symbol. Another segment $x=l$ points ω R at a speed less than 1, friction is oriented towards the negative side of the axis - minus. Arran's speed was $x=c$ $(0<c<l)$ some middle sections with velocities serve as a separator for the two layers under consideration. in accordance with $x=l$ ва $x=0$ boundary pressure p_{10} and $p_{20}\cos\alpha_0$ they can play a role in the separation of the pulp from the transfer zone in various ways. In this case, $(0<x<l)$ within the interval $p\ (x)$ for function definition $p(0)=p_{20}cos\alpha$ where $0<x<c$ in the interval (+) sinval and $p(l)=p_{10}$ on condition $c<x<l$ in the interval we take sinval, it is necessary to integrate equation (7). If given p_{10} и $p_{20}\cos\alpha_0$ to extract the fibers under pressure, in this case $p_1(x)$ $(0<x<c)$ and $p_2(x)$ $(c<x<l)$ some points of the curves intersect with an abscess. This point is undoubtedly the limit of both sections.

After determining the coordinates $x=c$ и $v=\omega R_1$ the following ratio:

$$\omega\cdot R_1=\frac{Q_0}{L\rho(c)\cdot b(c)}$$

The average spreading speed of the feeder can be determined to obtain the required transfer capacity. Equation (7) is assumed to be a symbol in the interval x $0<x<c$ and the symbol is taken when integrating in the interval $c<x<l$, $p_2(x)$ и $p_1(x)$. For pressure, we obtain the following expression:

$$p_2(x)=F_{22}(x)\left[\frac{p_{I0}}{F_{22}(l)}-\int_x^{xl}\frac{F_1(x)}{F_{22}(x)}dx\right],$$

$$c<x<l$$

$$p_1(x)=F_{21}(x)\left[\frac{p_{20}\cos\alpha_0}{F_{21}(0)}+\int_0^x\frac{F_1(x)}{F_{21}(x)}dx\right]$$

$$-c<x<l$$

Where:

$$F_{21}(x)=e^{-\int F_{VI}(x)ax},F_{22}(x)=e^{-\int F_{V2}(x)ax},$$

$$F_{01}=\left[b'+\lambda\frac{b'b_{00}^2}{b^2}+p_0gbA+\frac{x}{R}-f\right]\frac{b}{b^2-\lambda b_{00}^2}$$

$$F_{02}=\left[b'+\lambda\frac{b'b_{00}^2}{b^2}+p_0gbA+\frac{x}{R}-f\right]\frac{b}{b^2-\lambda b_{00}^2}$$

$x=c$ the abscissi point is determined by the following equation:

$$p_1(c)-p_2(c)=0$$

$p_{10}(Па)$ on site compression Q_0(т/ч) performance and pressure for different values Ox the speed of the pulp along the center and p(Па) pressure distribution curve. The following values are accepted:

$p_0 = 5$Па, $v_{10} = 0.61$м/с, $v_{20} = 1.57 м/с$, $R_1 = 0.2$м, $R_2 = 0.1м$,

$x_0 = 0.05м$, $д = 0.154$м, $c = 0.09м$,

It can be seen that the compression section exerts the greatest pressure on the fiber mass at the cross-sectional width. For selected indicators $x = c$ questions at the focal point above $x = h$ cross section.

V. RESULTS AND ITS DISCUSSION

The study of the processes of ginning and linting shows that to improve the class of fiber and lint to determine the design and technological parameters of the working bodies of gin and linter feeders.

Gins and linters are not recommended to use the same air vent on gins and linters. For this reason, in linters, it is recommended to use an energy-saving air removal device to separate the linters from the saw teeth. Theoretical study of gin and linter air scraper devices, which allows us to approach the development of new effective elements of technological machines.

CONCLUSIONS

It has been established that it is not recommended to use the same air scraper device on gins and linters in the ginning and linting processes. In linters, you can use an energy-saving air scraper to separate the linters from the saw teeth. To improve the class of fiber and linters, it is recommended to study the design and technological parameters of the working bodies of gin and linter feeders.

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