ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 6, Issue 3, March 2019

Gin-Fiber Cleaning Unit for Producing Improved Fiber

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ABSTRACT: The article is devoted to the study of the modernized fiber cleaners in the technology of primary cotton processing. It contains a description of the design scheme, principle of operation, research methodology. Studies of the upgraded fiberglass were carried out as part of the production line of fiber cleaning. Research has shown that the cleansing effect of the production line with the inclusion of an upgraded fiber cleaner amounts to 51.8%.

KEYWORDS: gin, fiber cleaner, cotton, fiber, saw cylinder, grate, debris, cleansing effect, fibrous, waste, defects.

Cotton fiber is known to be a highly liquid product on the world market; therefore, at present, in world practice, great attention is paid to improving the technology and technology of primary processing of raw cotton in order to produce high quality fiber.

As well as all over the world, a large-scale scientific research is being carried out in the Republic of Uzbekistan on the development of highly efficient equipment and technologies for the primary processing of raw cotton, ensuring the production of high-quality products with low consumption of raw materials and energy.

There are great prospects for improving the produced fiber and seeds by improving the process of sawing and fiber-cleaning.

One of the principal components that have a great influence on the quality of the fiber produced is the working chamber of the saw-gin. We have proposed a working chamber of a round shape with a radius of 185 mm, in order to reduce the resistance to rotation of the raw roller and, consequently, to an increase in the speed of its rotation.

The new camera is proposed based on the results of theoretical studies. In the interaction of the raw roller formed in the working chamber of the saw gin with the saw cylinder, the ginned raw cotton is affected by a shock load, leading to a deterioration in the quality of the fiber. An empirical formula has been obtained for the calculation of the shock load acting on the bat from the side of the saw cylinder, which has the following form:

$$\tau = 2{,}943\left(\frac{5m}{4\beta}\right)^{2/5} V_0^{-1/5}$$

where:V0 - relative speed of the saw cylinder and raw roller;
m-mass of raw roller.

$$\beta = \frac{2}{3(1-\mu^2)} E \sqrt{\frac{R_1 R_2}{R_1 + R_2}}$$

where: E - the modulus of elasticity of the material;
μ - Poisson's ratio;
R_1, R_2- radii of the blades and the saw cylinder.

As can be seen from the above formula, one of the principal parameters affecting the magnitude of the shock load acting on the bat in the working chamber is the relative speed of the saw cylinder and the raw roller. Increasing the speed of rotation of the raw roller reduces the relative speed of the saw cylinder and the raw roller, which helps to reduce the impact load and, consequently, improve product quality.

Improved fiber quality contributes to and protected by a patent of the Republic of Uzbekistan. No. FAP 00726, a new two-cylinder fiber wiper (Fig. 1) containing an inlet nozzle, a fixing brush, saw cylinders (1; 6) and

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International Journal of AdvancedResearch in Science, Engineering and Technology
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demolition grids (7; 9), an adapter nozzle with an upper pivot wall (2) and a rotary axis (3) on which the upper wall is fixed.

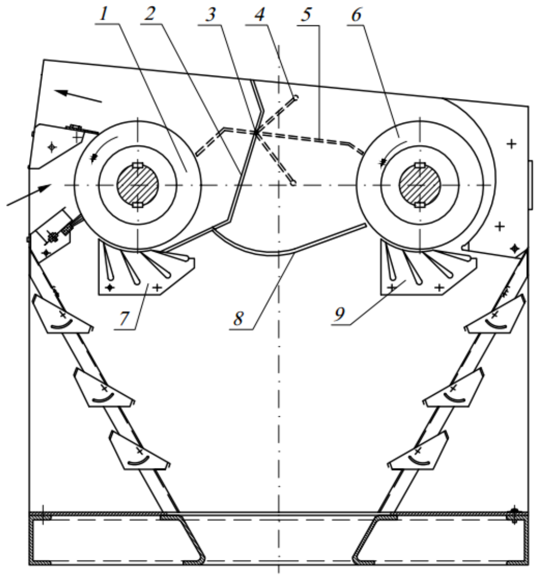

Fig. 1. Two-cylinder fiber cleaner.
1,6-saw cylinders; 2-rotary wall; 3-rotary axis; 4-lever of the upper wall; 5-upper position of the wall; 7,9 - rebound grate, 8-lower guide.

The fiber cleaner works as follows:

When cleaning fibers with a high content of defects and weed impurities, the upper, rotating wall, transitional pipe is placed in a horizontal position. In this case, the fiber with the air transporting it through the inlet nozzle enters the receiving saw cylinder, is captured by its teeth, fixed with a brush and torn through the grates, as a result of which the fiber is cleaned. After the grate zone, the fiber is transported to the second saw cylinder under the action of the air flow. Thanks to the special shape of the guides, a turbulent flow is created in the transition nozzle under the action of which the fiber strands turn over and are captured by the tooth of the second saw cylinder from the other side. Next, the fiber through the outlet, using air flow is transported to the condenser and then to the press.

In this way, the other side of the beam is cleaned in the second saw-cylinder, which increases the cleaning efficiency.

With a low initial fiber debris, the upper, rotating wall, transitional pipe is installed in a vertical position. In this case, the fiber with the air transporting it through the inlet nozzle enters the receiving saw cylinder, is caught by its teeth, fixed with a brush and torn through the grates, as a result of which the fiber is cleaned. Next, the fiber through the outlet, using air flow is transported to the condenser and then to the press.

The technological process in the gin-fiber cleaner unit (Fig. 2) proceeds as follows.

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International Journal of AdvancedResearch in Science, Engineering and Technology
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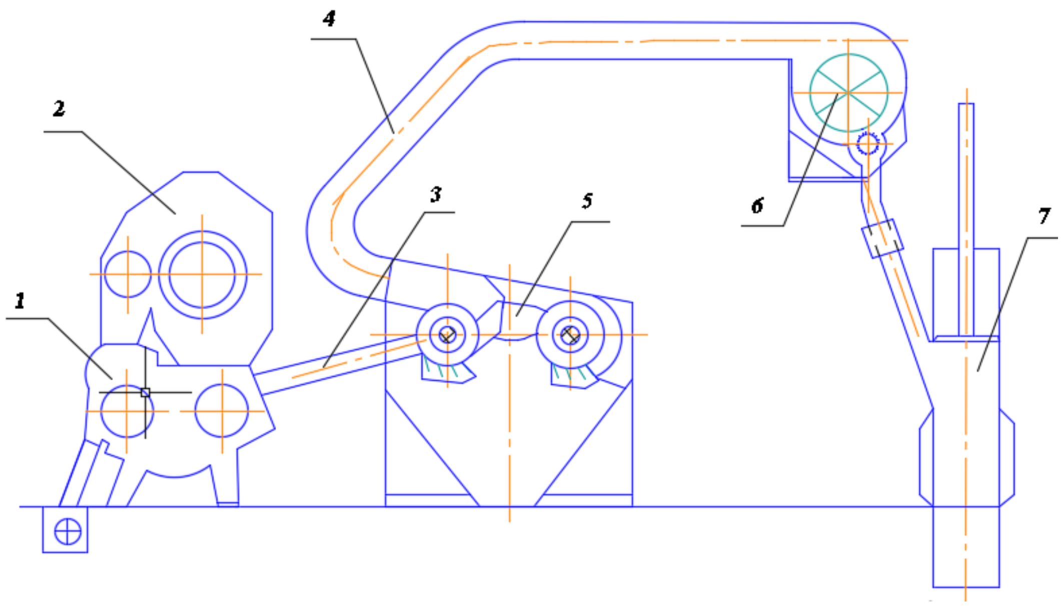

Fig. 2. General view of gino-fiber cleaning unit.

1-gin; 2-gin feeder; 3-connecting pipe; 4 outlet pipe; 5 fiber wiper; 6-fiber condenser; 7-press fiber.

After the grate zone, under the action of centrifugal force, the fiber begins to descend from the saw teeth and approximately at the bottom of the lower guide of the connecting pipe, having lost contact with the teeth, is discarded by the received pulse through the pipe to the second saw cylinder. Here the fiber is again captured by the saw teeth and the cleaning process is repeated. Purified fiber, through the outlet, enters the discharged yarn, through which it is transported to the place of pressing.

Released waste from the carbon chamber through the discharge window is removed from under the machine for transportation to the place of disposal.

Long-term observations of the movement of the air-fiber mass in the connecting tube showed that it is directed by an even flow to the 2nd saw cylinder. This circumstance excludes the impact of counter forces on the fiber and thus does not affect the flatness and length of the fiber.

In order to determine the effectiveness of the new genie-fiber-cleaning unit, comparative tests were carried out with those currently operating in the domestic technology.

The research consists of two stages. At the first stage, the aerodynamic characteristics of a gin aggregate with a fiber-cleaning machine were studied, with the definition of their operating mode. At the second stage, the technological parameters of gin with a fiber cleaner were determined.

As it is known, the main indicator of saw gin and direct-flow fiber cleaners is the static air pressure in the air chamber, in the connecting pipe and at the output of the fiber cleaner, the change of which can be adjusted by the technological parameters of the unit. Aerodynamic parameters of gin and fiber-optic cleaners are determined in its operating mode, during which the normal process of raw cotton ginning and fiber cleaning takes place.

In order to obtain comparative aerodynamic data, all measurements were also carried out on a serial gin in conjunction with a fiber cleaner brand 3OVP.

The results of aerodynamic measurements are shown in table 1.

Aerodynamic performance gino-fiber cleaning unit.

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Table 1.

Indicators	The new gin in the layout with a two-cylinder fiber cleaning	Serial gene in the layout with fiber cleaning 3OVP
Static air pressure in the air chamber, n/m^3	1500	2000
Air flow in the nozzle of the air chamber, n^3/s	0.40	0.55
Air flow through the second nozzle, n^3/s	0.40	-
Air flow after gin, n^3/s	0.90	1.20
Ginejection coefficient	0.20	1.2
Static air pressure at the outlet of the fiber, n/m^3	-70	-50
Air consumption after fiber cleaner, m^3/s	1.8	2.6
Fibercleane rejection factor	1.0	1.2
Total air flow before the condenser, m^3/s	7.2	10.4
Power consumption for fiber transportation, kVt.	42	69

As can be seen from the obtained comparative data (Table 1), the total air consumption after a two-stage wiper decreases by a factor of 1.45. The total air flow before the condenser after the new unit is 7.2 m^3/s, versus the serial 10.4 m^3/s, that is, the amount of air for transportation of the fiber is reduced by 3.2 m^3/s.

The amount of air drawn from the room, with the introduction of the new unit is reduced by about 2.0 times.

Thus, the aerodynamic regime of the experimental unit with a two-stage fiber cleaner is significantly better compared with the serial gin in the layout with the fiber cleaner 3OVP. This makes it possible to drastically reduce the amount of air for removal and transportation of the fiber, reduce the amount of air emissions and the number of cyclones, as well as the power consumption.

After determining the aerodynamic regimes of the unit, experiments were carried out under load in order to determine the comparative technological parameters of gin-fiber cleaners.

Tests of the new gin type and two-stage fiber cleaners were carried out in comparison with the existing genie in the layout with the 3OVP fiber cleaner.

The results are shown in table 2.

Table 2.

Indicators	Serial gin and fiberglass 3OVP	New gin and twin-cylinder fiber cleaner
Initial debris of raw cotton, %	8.0	8.1
Weed from a gin tray, %	1.18	1.20
Performance, kg drank an hour	9.6	9.5
The content of defects and trash after gin, %	5.34	4,44
The content of defects and weed impurities after the fiber cleaner, %	3.0	2.9
Fibrous waste after gin, %	28.1	25.3
Fiber waste after fiber cleaner, %	48.6	23.4
Gin cleansing effect, %	35.8	31,2

Cleaning effect of fiber cleaner, %	32,6	30.1
Cleaning effect of the unit, %	51.4	51.8

As can be seen from table 2, when processing raw cotton of breeding S-6524 of the second type of machine collection, the content of defects and trash in the fiber after the experimental gin is on average 4.44%, against a serial gin of 5.34%, that is, it decreases by 0.9% (abs.)

The waste fiber after the new and existing gin was at the level of 25-28%.

The cleaning effect of the new gin, compared with the existing gin, increases to respectively 31.2 and 35.8%. This is due to the change in the mode of ginning due to the introduced changes in the design of the working chamber.

The content of defects and weed impurities of the fiber purified on a two-stage fiber cleaner is on average 2.9%, on the fiber cleaner 3OVP 3.05%, that is, the quality of the fiber after both fiber cleaners is approximately at the same level.

At the same time, the fiber content of the waste after 2OVP is 23.4%, whereas after the existing fiber cleaner it was 48.5%, i.e. fiber waste is reduced by about 2 times, which makes it possible to increase the fiber yield by 0.15-0.20%. The cleaning effect of 2OVP is 30.1%, against the usual fiber cleaner 32.6%, this is due to the fact that only 2 saw cylinders are involved in cleaning the fiber.

The cleaning effects of the new gin aggregates with a two-stage fiberglass and gin with the 3ARP fiberglass are on the same level and constitute 51.8 and 51.4% respectively.

II. CONCLUSION

The new gin assembly in the layout with the 2OVP fiber cleaner, compared with the 3XDDM gin assembly in the layout with the 3OVP fiber cleaning, has the following advantages:

- more complete preservation of the natural properties of the fiber by reducing the mechanical effect on the fiber,
-reduction of strand fiber loss with waste,
-improving the aerodynamic regime and reducing the amount of air drawn in from the room.

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