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IMPROVING THE EFFICIENCY OF THE GINNING PROCESS TO ENHANCE FIBER QUALITY

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Abstract: It has been proven that the increase in the productivity of the gin machine necessarily occurs with an increase in the density of the raw material. However, with an increase in density, the productivity increases up to a certain limit, and then the productivity begins to decrease. In this article, the authors analyze the scientific work carried out to improve the quality of the fiber.

Keywords: Cotton, fiber, saw gin, density, colosnik, saw, drum, seed husk, seed, cotton.

Introduction. In ensuring an alternative approach to the ginning process, special importance is attached to studying the motion of the raw material roll, its mechanical properties related to composition, as well as its mechanical state. Certain properties of the raw material roll, including the laws governing velocity distribution on its surface profile, have been analyzed by Miroshnichenko G.I., Tillaev M.T., and others. The structure of the roll represents a complex medium, and its physical and mechanical properties have not yet been sufficiently studied. According to specialists, its structural composition consists mainly of bare or short-fiber cottonseeds, which occupy the inner zone of the roll. In contrast, seed cotton raw material predominantly moves within the outer shell of the roll. Thus, the raw material roll can be regarded as a non-homogeneous medium occupying a cylindrical volume. During ginning, the separation of fiber from the seed occurs under the action of saw teeth. This process takes place in the working chamber and results from the interaction of the saw teeth with the raw material roll and the gin ribs. Fiber separation from the seed is a sufficiently complex process that has not yet been fully investigated, and many of the problems arising in this area have not yet been completely resolved.

In the working chamber of a saw gin, a raw material roll is formed, the state of which has a significant influence on the overall course of the process as well as on the natural properties and quality indicators of the resulting products—fiber and cottonseed—obtained during ginning. The rotation and density of the formed raw material roll depend on the design of the working chamber, the feeding of cotton, and the discharge of cottonseed. Eliminating excessive compaction in the working chamber and improving the quality of the products discharged from it are among the most important tasks. To date, many professors and researchers have proposed various new concepts and approaches for saw gin machines. Based on their studies, numerous new working chamber designs have been suggested in order to bring the density of the saw gin working chamber to an optimal state.

In the new saw gin working chamber proposed by J. S. Ergashev, an additional element is installed in the central part of the raw material roll for the ginning of seed cotton (Fig. 1). This element is mounted longitudinally within the working chamber of the saw gin. It has a cylindrical shape and rotates in the direction opposite to that of the saw cylinder; the element consists of metal and rubber plates attached to a central shaft by means of springs. As a result of installing this additional device, a raw material roll is formed in the working chamber when a certain amount of seed cotton enters it. Owing to the variable diameter of the cylindrical additional

element, its diameter increases when the amount of seed cotton entering the working chamber is small, and decreases when the feed increases, and vice versa [4].

In the course of studies conducted by R. Muradov and co-authors, it was found that cottonseeds separated from the fiber accumulate in the central region of the raw material roll formed in the working chamber during fiber separation (Fig. 2). To remove these accumulated seeds, the authors proposed installing a drum-shaped cylindrical device at the center of the working chamber. The cottonseeds located within the raw material roll pass between rods mounted on an elastic element (base) at the upper part of the drum, then move along an inclined plate and are discharged through a pipe [5].

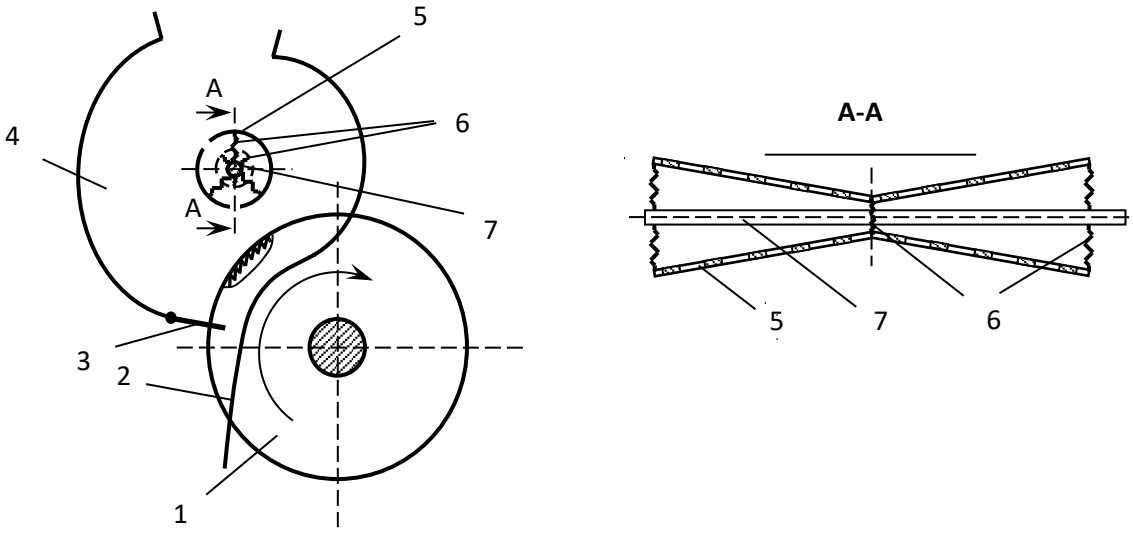
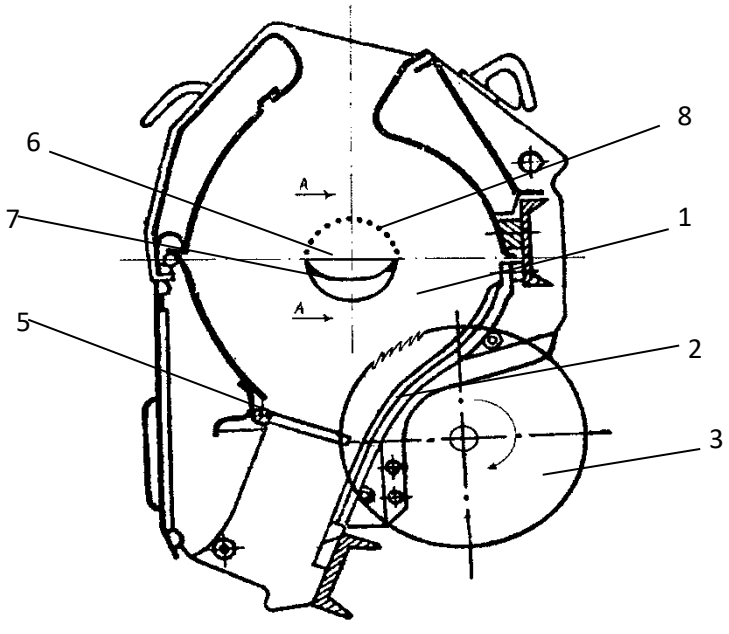


Figure 1. Cylindrical drum designed for the removal of cottonseeds

1 – Saw cylinder; 2 – Gin ribs; 3 – Seed cotton comb; 4 – Working chamber; 5 – Conical mesh drum; 6 – Springs; 7 – Shaft.



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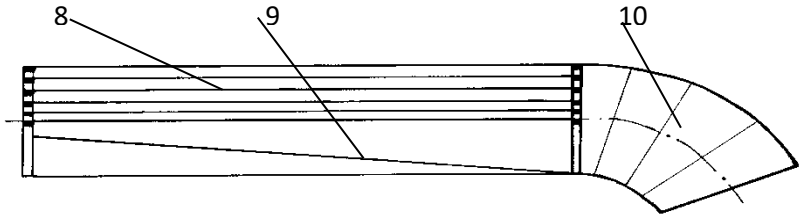

Figure 2. Cottonseeds in the raw material roll passing through rods mounted on an elastic element (base) at the top of the drum

1 – Working chamber; 2 – Gin ribs; 3 – Saw cylinder; 5 – Seed cotton comb; 6 – Cylindrical drum; 7 – Elastic element inside the drum; 8 – Rod; 9 – Inclined plate; 10 – Discharge pipe.

The aim of the scientific research conducted by X. T. Akhmedkhodjayev and co-authors is to develop a device that ensures uniform density of the raw material roll and incorporates grooves on the working surface of the gin ribs, thereby allowing cottonseeds separated from the fiber to exit the saw gin working chamber in a timely manner (Fig. 1.4). Cottonseeds separated from the fiber begin to move downward along the surface of the gin ribs under the influence of their own weight. Since the surface of the gin ribs is in contact with the raw material roll, the separated seeds can mix back into the roll without falling downward. In the proposed gin ribs with grooves, the separated cottonseeds fall through the grooves under their own weight [6].

According to the scientific findings of F. B. Ismoilov, the teeth of the saw directly affect the quality and quantity indicators of the complex fiber separation process. Primarily, they influence the retention of fiber clumps, the machine's productivity, the complete separation of fiber from seeds, the removal of fiber masses from the saw teeth, mechanical damage to fiber and seeds, the formation of defects in the fiber, and energy consumption. By modifying the geometric parameters of the teeth on the saw cylinder—the main working element of the fiber separation machine—Ismoilov proposed increasing the number of saw teeth from 330 to 380 in order to enhance the ability of the teeth to capture fiber during the separation process.

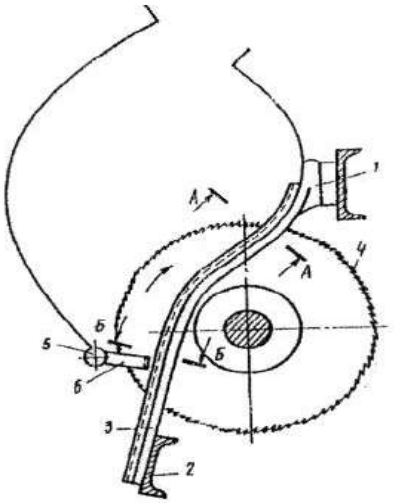

Figure 3. Working chamber equipped with a saw cylinder having 380 teeth

1 – Upper beam of gin ribs; 2 – Lower beam of gin ribs; 3 – Gin ribs; 4 – Saw cylinder teeth; 5 – Steel rod; 6 – Seed cotton comb

In the device proposed by R. Muradov and A. Sarimsoqov, the ginning machine is improved to increase productivity by accelerating the rotational movement of the raw material roll. For this purpose, the side section of the saw fiber separator's working chamber rotates around its own axis. Fiber attached to the saw teeth is separated from the seeds through the gin rib grid and begins to move downward under its own weight (Fig. 1.6). Special pins are installed on the surface of the side section to facilitate the movement of the raw material roll [9].

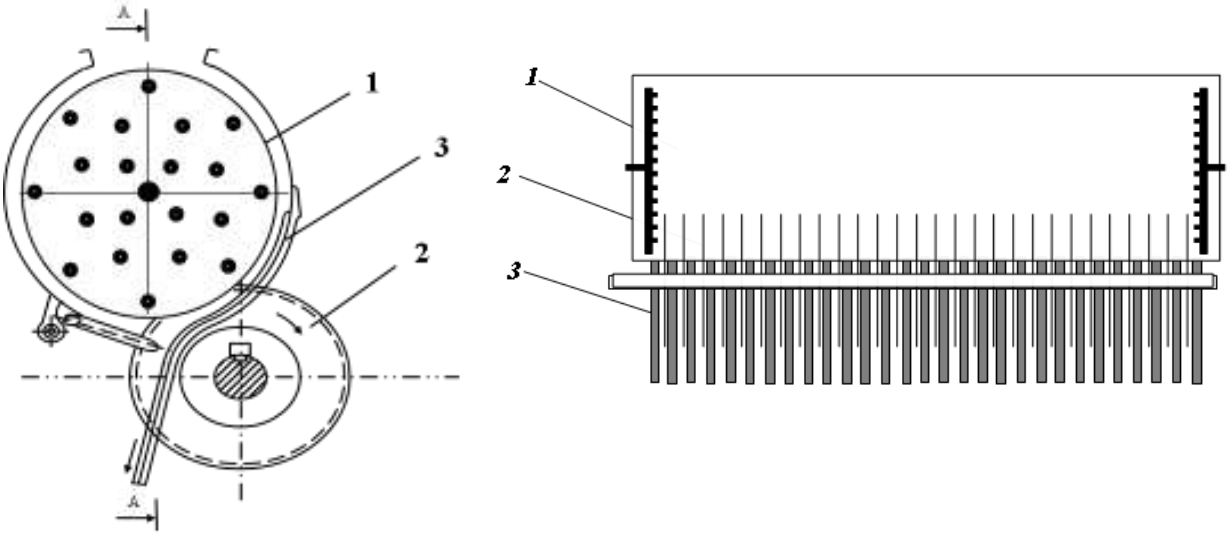

Figure 4. Accelerators installed on both side sections

1 – Working chamber with a side section rotating around its axis; 2 – Saw cylinder; 3 – Gin ribs.

Conclusion. To date, many professors and researchers have proposed various new ideas and improvements for the saw gin machine. In their studies, they have suggested numerous new designs for the working chamber of the saw gin to optimize its density.

Over the years, the process of separating fiber from seed cotton has rapidly advanced in all countries. The primary goal of these developments has been to preserve the natural properties of both the fiber and the seeds. Based on the review of the four American gins discussed above, the following conclusions can be drawn.

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