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Study of Possibilities of Increasing Wear Resistance of Working Bodies of Cotton Processing Machines

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Abstract: The article discusses the possibilities of increasing the wear resistance of quickly worn out working bodies of the main technological machines for the primary processing of cotton gin and linter. The materials of studying the methods of deposition of titanium carbide coatings and the processes occurring in this process are presented. It is indicated that such a coating should increase the wear resistance of saws and grates of gins and linters by 1.5-2 times

Key words: cotton raw, fiber, ginning, gin, grate, saw, wear.

For the primary processing of raw cotton, various technological equipment are used, a characteristic feature of some of them, for example, saw gin (machines for separating fiber from seed) and linter (machines for separating short fiber from seed) is the rapid wear of saw blades and relatively quick wear of the working parts of the grate. Fig. 1 shows drawings of saws and grates of gin and linter. Such wear leads to disruption of technological processes of ginning and linting, a decrease in the quality of products and an increase in material costs. In light of this, it is important to study the possibility of increasing the wear resistance of quickly worn working bodies of cotton ginning machines. [1]

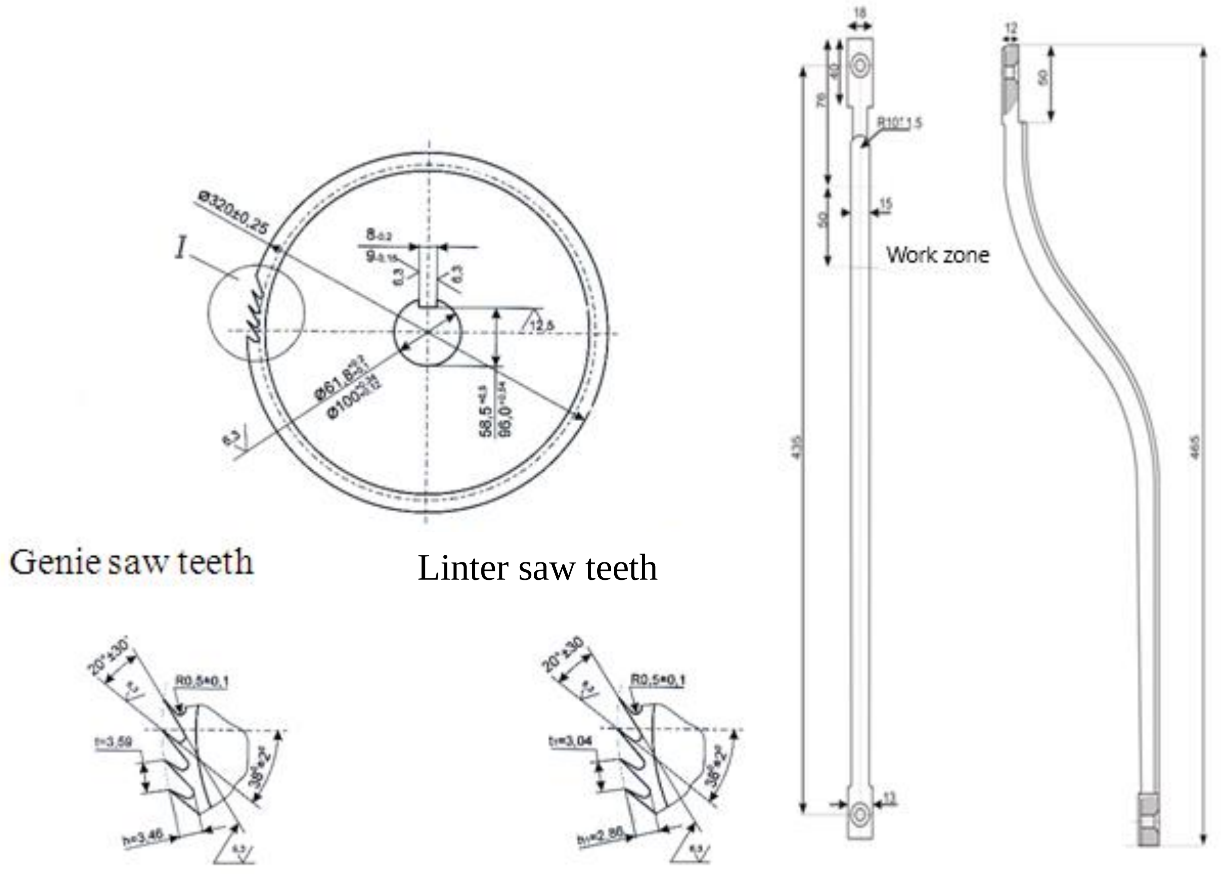

Fig-1. Genie-linter saws and grates

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At the same time, the overwhelming majority of the grate is intensively worn out from the direct contact of the saws due to their warpage and inaccuracies in the assembly of the grate. Thus, during operation, the wear of the grate leads to an increase in the grate gap in the working area and to the disruption of the ginning process [2].

On average, after 3 months of operation of the grate in a cotton mill, 70-80% of the grate gaps begin to exceed the permissible values. Therefore, the service life of genie grates ranges from 4-6 months, which necessitates their frequent replacement. If the permissible wear of the grates in the working area is exceeded, it is necessary to replace them with new ones, which consumes a lot of metal and time-consuming assembly [3]. Even in the case of correct assembly in a static position, during operation, due to the load, the shaft bends and an edge effect occurs, in which the side saws begin to touch the grates. Therefore, the design of a prefabricated grate was developed, in the working area of which a replaceable working plate made of wear-resistant material is fixed (Fig. 1). The replaceable plate is installed in the working area of the grate body in the milled groove. Fastening of the replaceable element to the grate is carried out using a screw and a wedge. This design of fastening the replaceable element on the grate allows you to remove and replace the replaceable element without unscrewing, but only by loosening the fastening screw.

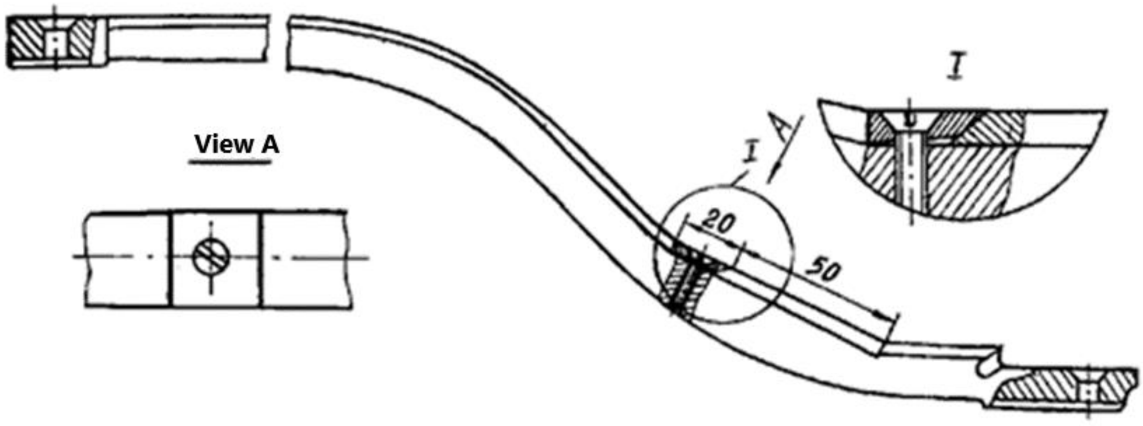

Fig. 1. Grate with replaceable element in the working area

The use of a grate with a replaceable element in the working area turns the grate into a stationary gin unit, where worn-out plates can be replaced, if necessary, without disassembling the grate, which allows: on the one hand, to save metal by reducing the consumption of grate, on the other hand, it reduces labor costs associated with the assembly of the grate when replacing worn grate [4].

It is known that the development of the most important branches of modern industry is impossible without the development and use of new resource-saving technologies. An important role in this belongs to technologies that make it possible to impart special properties to the surface layers. If there is any problem associated with insufficient life of a part, it is almost always possible to find or create a material that more closely matches the working conditions of a stressed part than the original material and therefore, it can be applied by spraying as a hardening surface coating. To the greatest extent, such requirements are met by applying refractory compounds to the steel surface: carbides, nitrides, borides, oxides, as well as hard alloys and composite materials based on them [5].

In the light of modern concepts, the process of formation of a strong adhesion between the coating material and the base is considered as a heterogeneous chemical reaction at the interface between phases that come into physical contact as a result of deformation and spreading of particles. The nature of the base materials and particles, their energy state at the moment of connection are the determining factors for the formation of a strong bond. The thermodynamic probability of chemical interaction is characterized by a change in the free energy of the system, and the kinetics is characterized by an energy barrier that must be overcome by atoms to pass from one stable state to another (by the interaction activation energy). In the limiting case, the activated state is the dissociation or breaking of the bond of surface atoms. Thus, for the implementation of chemical interaction between the materials of the base and the coating, it is necessary to create favorable conditions for the activation of the surface. The use of a self-propagating high-temperature synthesis process provides such opportunities. Based on the above, we can conclude that the features of the process in combination with high mechanical properties of refractory compounds are sufficient prerequisites for creating wear-resistant coatings. Specific combinations of compositions of refractory compounds as a base for coatings should be selected in relation to the base material and the operating conditions of the product.

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Depending on the type of particle heating energy, spraying spraying can be represented by various methods of implementation and equipment for coating. As practice shows, each method and technique has the right to exist, because for each type of coating, one or another method has the necessary characteristics in comparison with others [6].

It is known that titanium carbide (TiC) belongs to the group of synthetic, superhard, refractory, heat-resistant materials and is quite in demand for the production of metalworking tools, protective coatings and steel carbide, and can also be used in the cotton ginning industry, where the main factor of wear is abrasive dust. The advantages of TiC, which will allow the spraying process to proceed without critical deviations, are as follows: the ability to withstand sudden temperature changes; high strength; resistance to abrasive wear and aggressive operating media. However, the use of TiC in spraying technology is characterized by high porosity. Therefore, to solve this problem based on titanium carbide, it is proposed to select a mechanical mixture based on metals of the iron group. The addition of the binder metal is done in most cases by physical mixing. To date, coatings have found the greatest application, for example, the TiC-Ni system.

The use of titanium carbide spraying in the nodes of cotton ginning machines will extend their service life, especially in the case of spraying on the teeth of gin and linter saws, as well as on the working parts of the grate, since its hardness is higher than that of steel and cast iron. Another additional factor is that due to the brittleness caused by the high hardness of the steel, the hardness of the saws is HRS 35-40 and therefore the surface coating of titanium carbide can increase the surface of the working bodies of cotton ginners [7].

In other words, we can conclude that such a micro hardness of titanium carbide (1200-2300 MPa) should increase the wear resistance of, for example, a genie saw by 1.5-1.8 times.

At present, at the Department of Technological Machines and Equipment of the Tashkent Institute of Textile and Light Industry, preliminary experiments have been carried out to study the possibility of applying wear-resistant coatings based on titanium carbide on teeth of genies and linters, saws, working parts of grates, and the technology of such a process is being developed.

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