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Selection of saw material and preparation of experimental specimen samples of the couple "golden ring-disk" of the silver cylinder node of fiber-distribution machines

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ABSTRACT: In the paper, the reasons for the decrease in the reliability and durability of the saw cylinder assembly, the choice of the circular saw material, the methods for securing the steel experimental rings and their heat treatment, and the tooth slicing on new materials are given. Sequence of assembly, setting up a new assembly of the saw cylinder and its preparation for the production test.

KEYWORDS: wear resistance, heat treatment, reliability, durability of fiber separation, cotton, saw cylinder, randomization.

I.INTRODUCTION

Processing of raw cotton is carried out on technological machines and equipment, mainly manufactured in the USA, China and Uzbekistan. An important factor in ensuring the stability of the volume of cotton crop cultivation and increasing the competitiveness of raw materials on the world market is the production of high quality cotton fibers.

In our Republic, large-scale activities are being carried out, certain results have been obtained to develop highly effective techniques and technologies for the primary processing of raw cotton, which ensure the production of high-quality products. In this respect, it is possible to note the development of technology and technology that ensure the preservation of the quality of cotton products produced at cotton ginning enterprises, which make it possible to reduce the consumption of raw materials and energy.

In the world, actual tasks are the creation of new models of technology and the technology of saw fiber separation and seeds from cotton flys. At the same time, the implementation of targeted scientific research on the development of highly effective structures of the working bodies of the main technological machine of cotton-growing machines - sawing machines, the creation of methods for calculating parameters and driving regimes, which make it possible to achieve a significant increase in the productivity of machines with high humidity of raw cotton to produce high-quality cotton fiber, tasks of the industry [1].

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At the moment, in cotton processing plants, serial fiber separating machines of the DP type are operated, equipped with a knot of a saw cylinder with low reliability. It is known that the service life of the existing sawtooth cylinder designs of fiber separating machines is only 48 hours, then the grinding of the teeth is necessary, which creates a simple machine. The process of restoring the saw teeth for 96 hours is repeated twice, after which the service life of the saws ends.

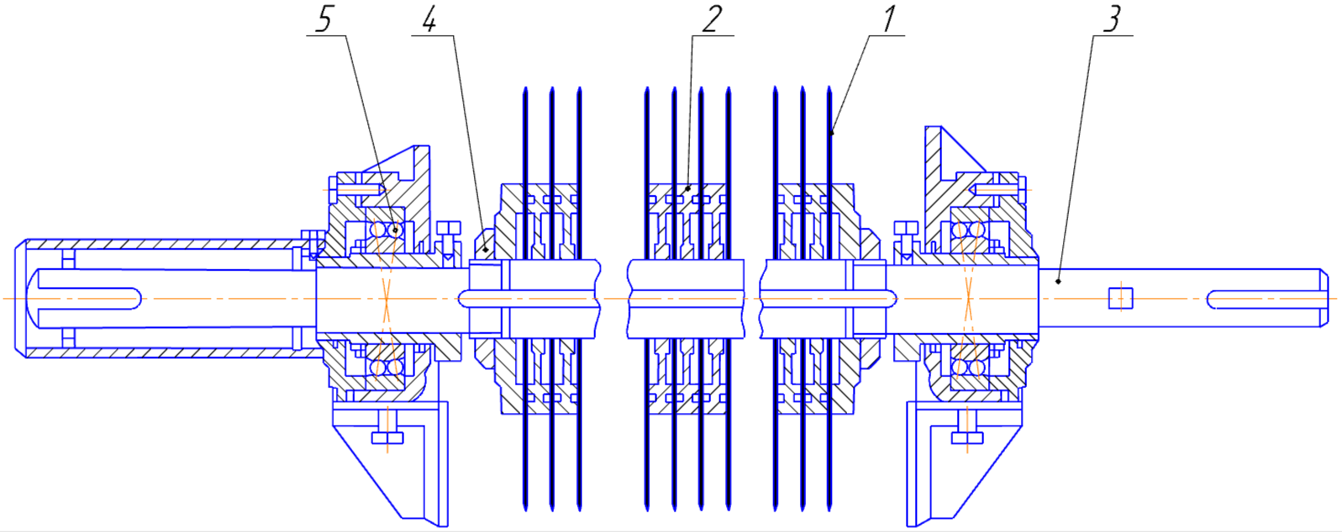

Fig.1. Design of the assembly of the saw cylinder of the fiber separating machine.

1 - a circular saw; 2 - a lining; 3 - saw shaft; 4 - the nut; 5 - support assembly of the saw cylinder.

Based on the studies carried out [3], we selected a saw material from four groups of steels, ten grades by the following heat treatment in three hardness variants: HRC 42-46, HRC 52-58, HRC 62-70, responsible for mechanical and physical properties, wear resistance and coefficient of friction correspond to the operating conditions of the system "tooth saw - raw roller - fly - grate" [2]. These selected steels have high strength, hardness, wear resistance and good compliance to heat treatment, and also have a high quench hardness (HRC = 62-67). It became the following groups: carbonaceous, high-speed, manganous and alloyed. It should be noted that carbon steels have a low heat resistance T_c = 200-250^{0}C, but this does not limit the wide use of U10A, U8A steels having good viscosity, the lowest coefficient of friction on the fiber, since the edge temperature of the tooth blade edge in the contact zone during fiber separation reaches 115^{0}C.

Rapid-cutting steel grade P6M5 is characterized by higher strength, heat resistance, and has the lowest coefficient of friction in the fiber.

Manganese steel 110 G13L, G13 contain 1-1,4% carbon and 11-14% M_n, belong to the austenitic class and have a high resistance to wear and deformation. Typical for them is that high wear resistance is combined with high strength and low hardness (σ_B = 1000 MN / m^2, HB 210).

Alloyed steel, having a sufficient viscosity, contributes to the reduction of the coefficient of friction. After a thorough analysis of the physical and mechanical properties and strength characteristics of the steels, we turn to the use of these steels as a saw of fiber separating machines, in order to choose the saw material that provides optimum performance.

The case of the experimental saw is made with a diameter of 280 mm from special sheet steel (carbon U85, GOST 2052-60), with a thickness of 0.95 ± 0.05 mm, hardness of HRC 32-35.

Samples of the ring with hardnesses HRC42-46, HRC 52-58, HRC 62-70 are made of the following groups of steels: carbonaceous - U10A; low-alloyed - ХВГ, ШХ-15; high-alloyed - 85ХФ, 8Х6НФТ, Х12М, ДИ-22, 55Х7ВСФМ; high-speed-P6M5; manganese - 110G13L.

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II. SIGNIFICANCE OF THE SYSTEM

Figure 2 shows the dimensions and nature of the specimen-rings subjected to friction. In order to identify the wear pattern of the selected steels under the same wear conditions, the specimen-rings were pressed onto the disc by the hot-stamping method in the stamping press.

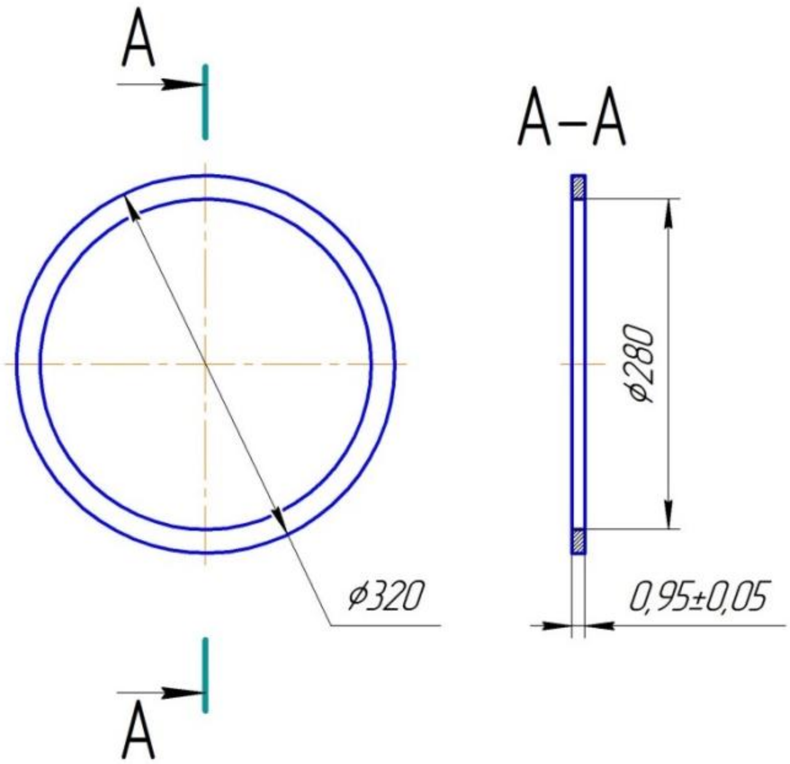

Fig. 2. Parameters of specimens-rings subjected to heat treatment.

With the purpose of revealing the relationship between the mechanical properties of steels and the modes of heat treatment of steel rings, prototype rings were processed under various regimes in accordance with the recommendations of [3]. For comparison, the regimes were adopted that provide the best and worst mechanical properties of selected steels for sample rings in the process of fiber separation and seeds.

Table 1 presents the hardness of steel rings after the final heat treatment.

Table 1.

№	Steel grade	Hardness options		
		HRC 42-46	HRC 52-58	HRC 62-70
1	55Х7ВСМ	45	56	62
2	8Х6НФТ	44	56	64
3	ШХ-15	45	59	62
4	У10А	45	58	62
5	ХВГ	42	55	67
6	Х12М	44	57	68
7	85ХФ	42	55	63
8	ДИ-22	46	58	66
9	Р6М5	45	58	70
10	110Г13Л	НВ 212	НВ 240	НВ 268

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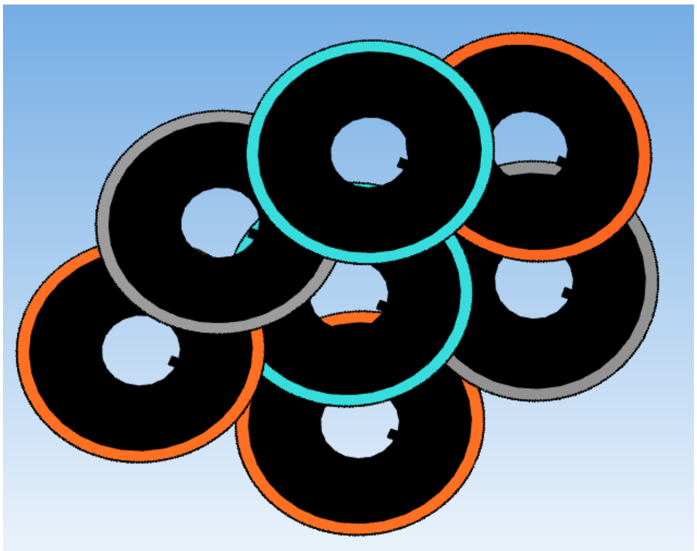

III. LITERATURE SURVEY AND METHODOLOGY

Fig.3. General view of specimens-rings subjected to heat treatment

The combination of the ring samples was carried out by the method of "diagonals" (with the introduction of the following letter symbols): St1-low hardness (HRC 42-46); St_2-medium hardness (HRC 52-58); T-high hardness (HRC 62-70).

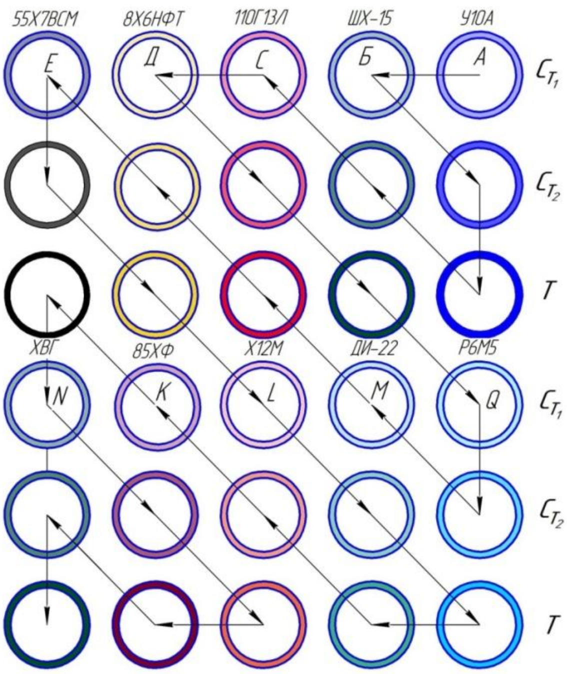

Fig.4. The scheme of randomization of ring samples by the method of "diagonals"

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Vertical columns mean the hardness of the material, and horizontally the steel grades (A, B, C, D, E, N, K, L, M, Q). Randomization of samples - rings made of steels 55x7 VSFPM, 8x6 НФТ, II0ГIЛ, ШХ-15, УIOA and installed on the saw shaft, looks like: C_{T1}A, C_{T1}Б, C_{T2}A, TA, C_{T2}Б, C_{T1}C, C_{T1}Д, C_{T2}C, TБ, C_{T1}Q, C_{T2}Q, C_{T1}M, TC, C_{T2}Д, C_{T1}E, C_{T2}E, TД, C_{T1}L, C_{T2}M, TQ, TM, C_{T2}L, C_{T1}K, TE, C_{T1}N, C_{T2}K, TL, TK, C_{T2}N, TN.

After pressing the sample rings on the base of the saw blade and eliminating the defect of slippage of the rings from the four points into the joint of the system, rivets 3 mm were produced. The finally machined discs with the cut teeth on the pylon-cutting machine acquired the appearance of a single finished product for exposure to a wear test. The studies were carried out on a fiber separating machine of the type DP serial production with a single saw blade capacity of 16.9 kg / h, with a raw roll weight of 80-90 kg and a machine capacity of 2200 kg / hr. For experiments, raw cotton was used in the Bukhoro-6 variant, Bukhoro-8.1 grades, manual collection, with an initial moisture content of 8-9%.

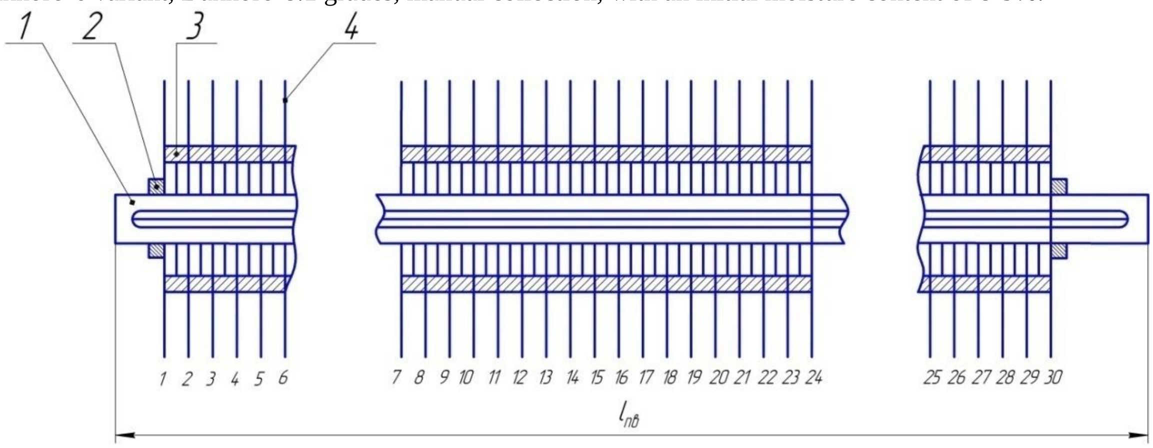

Fig. 5. Scheme of assembling a new design equipped with circular saws of the experimental unit of the saw cylinder.

1 - saw shaft, 2 - clamping nut, 3 - gasket, 4 - experimental circular saw.

Table 2 shows the successive arrangement of circular saws on the shaft of the experimental assembly of the saw cylinder.

Table 2.

№	Designation, material, hardness of the saw	№	Designation, material, hardness of the saw	№	Designation, material, hardness of the saw	№	Designation, material, hardness of the saw	№	Designation, material, hardness of the saw
1.	C_{T1}A У10A HRC45	2.	C_{T1}Б ШХ15 HRC45	3.	C_{T2}A У10A HRC58	4.	TA У10A HRC62	5.	C_{T2}Б ШХ15 HRC59
6.	C_{T1}C 110Г13Л HB 212	7.	C_{T1}Д 8Х6НФТ HRC44	8.	C_{T2}C 110Г13Л HB 240	9.	TБ ШХ15 HRC62	10.	C_{T1}Q P6M5 HRC45
11.	C_{T2}Q P6M5 HRC58	12.	C_{T1}M ДИ-22 HRC46	13.	TC 110Г13Л HB 268	14.	C_{T2}Д 8Х6НФТ HRC56	15.	C_{T1}E 55X7BCM HRC45
16.	C_{T2}E 55X7BCM HRC56	17.	TД 8Х6НФТ HRC64	18.	C_{T1}L X12M HRC44	19.	C_{T2}M ДИ-22 HRC58	20.	TQ P6M5 HRC70
21.	TM ДИ-22 HRC66	22.	C_{T2}L X12M HRC68	23.	C_{T1}K 85ХФ HRC42	24.	TE 55X7BCM HRC62	25.	C_{T1}N ХВГ HRC42
26.	C_{T2}K 85ХФ HRC55	27.	TL X12M HRC68	28.	TK 85ХФ HRC63	29.	C_{T2}N ХВГ HRC55	30.	TN ХВГ HRC67

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The preliminary experimental results of the technological parameters of the fiber and seeds were analyzed for the content of defects and weed impurities, as well as for mechanical damage in the conditions of the cotton ginneries laboratory.

On the basis of the theoretical and experimental studies carried out, the following conclusions can be drawn: The operated circular saw confirms that its service life and material do not meet the requirements of the technological process of fiber separation and seeds; physicomechanical and strength characteristics do not meet the laws of intensive wear of the saw tooth during the interaction of the "tooth-saw-fly-grate" system.

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