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Development of Efficient Construction and Results of Production Tests of the Grate Grid of the Cleaner of Fiber Materials

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ABCTRACT: The article provides an analysis of the existing designs of grate cleaners for fibrous materials. Presented their main disadvantages. The design scheme and the principle of operation of the developed grate design of the cleaner of fibrous materials are given. The results of the production tests of the recommended grate design are analyzed. The efficiency of the use of grates installed with a fitting gap between the ends of the teeth of the saw blades of the cylinder and the grate, both with metal and plastic grate

KEYWORDS: Cleaner, fiber material, grate, gap, rubber, cleaning effect, test, quality.

I.INTRIDUCTION

In the construction used in the production, the grate of a fiber material cleaner contains circular grate placed in arcuate sidewalls. The gap between the ends of the teeth of the saw blades of the cylinder and the grate is constant over the entire zone of cleaning of the fibrous material [1].

The disadvantage of this design is the low cleaning efficiency.

In another design, the grate bars are installed in arcuate sidewalls by means of elastic rubber bushings [2].

The disadvantage of this design is not a big effect of cleaning the fibrous material due to the same oscillations of the grates. In the initial cleaning zone, raw cotton will be less loosened, and at the end of the cleaning zone the cotton will be sufficiently loosened. Therefore, the same vibrations of the grate does not provide the necessary cleaning effect.

In the existing grate design [3] containing grates with a variable diameter, while the grates are installed in a sinusoidal sequence of changing the size of diameters. The gaps between the grates and the saw cylinder are made the same with the ability to change the pitch between the grates and the radius of installation of the grates relative to the axis of rotation of the cylinder. The disadvantage of the design is the big care of cotton bats in the drain.

Also known is the design of the grate, containing multifaceted grate with a flat working face. The number of grate faces along the dragging of the fibrous material varies according to a sinusoidal distribution law, in particular along a triangular distribution [4].

The disadvantage of this design is the low effect of cleaning cotton due to the insufficient effectiveness of shaking cotton when interacting with the grate bars. In this design, the cotton is also less loosened in the initial zone, and at the end of the zone it is sufficiently loosened. At the same time, the design does not provide a cleaning effect throughout the cotton dragging zone.

There is no need to shake cotton when interacting with the bars. It is sufficiently loosened. The design doesn't provide a cleaning effect throughout the cotton dragging zone.

The essence of the design lies in the fact that the grate of the fiber material cleaner contains grate bars installed in arcuate side panels with varying gaps between the ends of the teeth of the saw disks of the cylinder and the grate bars. At the same time, in the input part of the cleaning zone, the gap between the saw cylinder and the first grate is selected as maximum, and the gap between the saw cylinder and the second grate is minimal, their difference is the minimum seed size of the bat (3.5 ÷ 5.0) mm. The subsequent grate bars are installed in such a way that the gap difference Δ for neighboring grate bars decreases and at the end of the dragging zone this difference will be equal to zero.

The design of the grate is illustrated by the drawing, where, Figure 1 shows the general scheme of the grate.

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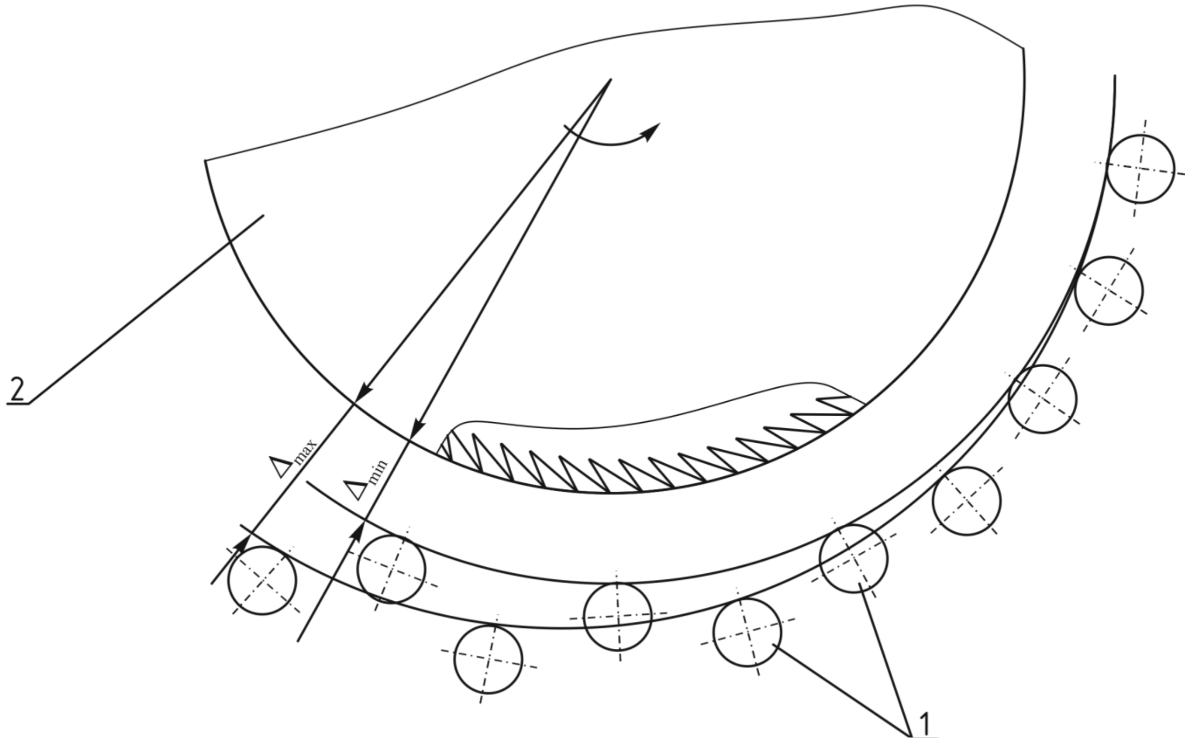

Fig.1. Grid grate of fiber material cleaner

The design consists of grates 1, which are installed in arcuate bars, (not shown in Fig.). Of a rotating saw cylinder 2 (included for the explained work of the proposed grate.

In the entrance zone of the fibrous material cleaning, the gap between the saw cylinder 2 and the first grate 1 has a maximum value of Δ_max, and the gap between the saw cylinder 2 and the second grate 1 has a minimum value of Δ_min. At the same time, the difference $\Delta = \Delta_{max}$-Δ_{min} (equal to the minimum seed size of the cotton buds). Further, the subsequent grates 1 with alternation have gaps between the saw cylinder 2 varying, at which the difference Δ between these gaps of neighboring grates 1 decreases and at the end of the cotton cleaning zone the difference of gaps between the saw cylinder 2 and the last grates 1 will be the same $\Delta = 0$.

The design works as follows. In the process, raw cotton (fibrous material) goes to the saw cylinder 2, the teeth of which capture cotton and pulls it through the grate 1. At the same time, the cotton hits the grate 1. At the same time, when interacting with the first and second grate 1, the impact force will change dramatically due to the maximum difference of the gaps between the first and second grate 1. A kind of loosening of cotton occurs. Raw cotton makes not only the progressive movement along the grate1, but also the movement along the vertical. This leads to a significant increase in the release of trash. When cotton is further pulled through the grate 1 (third, fourth, and so on), due to the difference Δ of the clearances between the grate 1 and the saw cylinder 2, the vertical vibrations of the cotton occur (shaking), which results in the release of debris deeply in the fiber.

Based on the results of theoretical and experimental studies of the recommended grate design [5, 6, 7, 8], a prototype of a fiber material cleaner was made. Comparative manufacturing tests were conducted.

Production tests are conducted in comparison with the existing design of the cleaner. The measurements of the quality indicators of the fibrous material obtained were made in parallel for the compared cleaners.

Figure 2 presents a section of the grate of the cleaner with the recommended scheme for the installation of grid bars. In this case, the grate bars were made of plastic (a) and metal (b). The results of production tests are shown in table 1.

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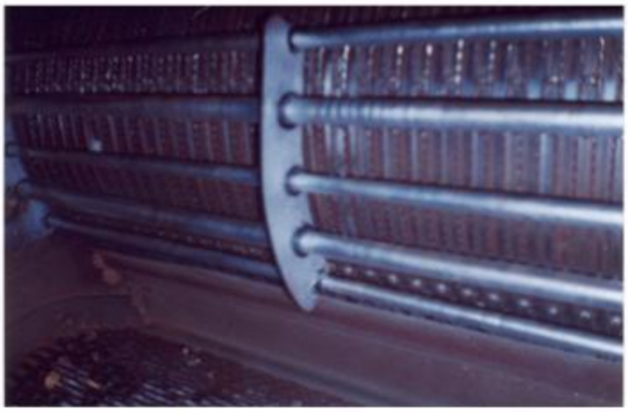
a – plasticgratebars



b – metalgrateand

Fig.2. General view of the grate zone.

The results of production tests of upgraded cleaners.

Indicators in%	After the upgraded section cleaners		After serial cleaner
	Metal grate	Plastic grate	
Raw Cotton - Raw			
Humidity	8,8	8,8	8,8
Debris	4,21	4,21	4,21
After cleaning cleaning effect	84,11	90,15	60,97
Raw cotton weed	1,32	1,09	1,87
Mechanical damage to seeds	2,16	1,97	3,21
Loose fiber	0,108	0,092	0,211

The above tests of the modernized design of the sawed section of the cleaning unit showed high efficiency and reliability in operation. The test results showed that the use of grates with a fits the gap between the ends of the teeth of the saw blades of the cylinder and the grates, both with metal and plastic versions of the grates led to a significant increase in the cleaning effect.

The cleaning effect on large litter compared with the serial version of the grate construction increased by 23.14% with metal grate and by 29.18% with plastic grate. Mechanical damage to seeds is respectively reduced by 0.95% for metal and by 1.24% for plastic grates. Free fiber is reduced by 0.13% for metal grates and by 0.124% for plastic grates.

Thus, the use of recommended grates in the cleaners of fibrous materials from coarse litter can significantly increase the cleaning effect, while maximizing the preservation of fibrous materials.

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