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**Международный научно-образовательный электронный журнал
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Название публикации: «DEVELOPMENT OF STRUCTURES AND THEORETICAL RESEARCH ON THE OPERATION OF THE PARAMETERS OF THE DEVICE FOR SORTING COTTON FLYS BY THEIR MATURITY»

Abstract. Development of designs for dielectric cotton separators in cotton cleaning. The use of electric field forces to improve various technological processes is one of the central directions of electron-ion technology.

The use of electric field forces to improve various technological processes is one of the central areas of electron-ion technology. The main issues of the theory and practice of separating materials in electrotechnological devices were resolved in the studies of A.I. Angelov, E.M. Balabanov, N.F. Olofinsky, I.P. Vereshchagin, V.S. Morozov and others.

A.M. Basov, F.Ya. Izakov, V.N. Shmigel, E.A. Kamenir, T.N. Lukienko, G.A. Yasnov and others made a significant contribution to the development of scientific foundations for sorting seeds of agricultural crops in electrostatic and electrocorona devices.

The search for effective ways of applying electric forces for sorting seeds led to the use of the dielectric method for this purpose, first proposed in the USA by H.S. Hetfield and showing high results in enriching mineral ores. Research by V.I. Tarushkin, V.S. Leonov, V.M. Bogoyavlensky, A.A. Niyazkulov, P. Shayimov, N. Dushamova and others showed that this separation method does not have the disadvantages caused by changes in environmental parameters and typical of the operation of electrocorona installations. This is due to the fact that in this case the particles of the sorted material directly contact the electrodes, forming an electric field and exerting a force effect on it. Известен диэлектрический сепаратор, включающий загрузочный бункер с вибрлотком, электроды, выполненные в виде проводов чередующейся полярности, размещенных на поверхности

диэлектрического барабана с образованием бифилярной обмотки, и приемники продуктов разделения [37]

The disadvantage of this separator is that the vibratory tray does not provide oriented seed feed between the electrodes, which reduces the clarity of separation. The productivity of this separator is not high, due to the low electrical force for pressing the seeds to the surface of the working element.

A device for sorting seeds of various agricultural crops is also known [38], containing a feeder, a horizontally located working element underneath it, mounted with the possibility of rotation and made in the form of dielectric bodies of revolution fixed on a common shaft with generators in the form of concave surfaces and electrodes of alternating polarity, installed between the dielectric bodies of revolution and connected to opposite poles of a high-voltage source, one of which is grounded, and receivers of separation products. In order to increase the efficiency of seed sorting and the productivity of the installation, the dielectric bodies of revolution are made in the form of two washers made of materials with different specific volume resistance, wherein the washer with the lower specific volume resistance contacts the potential electrode.

The disadvantage of the device is that the working element of the device must be assembled from many washers made of materials with different specific volume resistance, which leads to an increase in the material consumption of the device and an increase in its cost. In addition, expensive high-voltage sources are required to power the electrodes with alternating polarity.

A more efficient design is a dielectric separator, which includes a working element in the form of a drum with a winding of groups of insulated electrodes of alternating polarity, a loading hopper, a feeder, receivers of separation products and a guide rigidly attached to the wall of the loading hopper and installed above the drum in the zone where the seeds enter it [39]. In addition, due to the harsh impact of the cleaning brush roller on the cotton buds, damage to the fibers and cotton seeds increases.

The disadvantage of this design is that the guide does not provide uniform distribution of cotton buds (seeds), both along the length of the working element and along the feeding path of cotton buds due to the constant rigidity of the guide along its length. In addition, the design has low productivity due to the limited increase in rotation of the working element due to the low electrical force of pressing the seeds (raw cotton buds) to the surface of the drum. At the same time, the possibility of increasing the clarity of separation of seeds by their mass (maturity and geometric dimensions) is also limited. To eliminate these shortcomings, we recommend a new dielectric separator [40,41]. The design of the dielectric separator is explained by the drawing, where Fig. 2.1 is the general diagram of the dielectric separator, Fig. 2.2 is view A in Fig. 2.1, and Fig. 2.3 is section B-B in Fig. 2.1. The dielectric separator includes a loading hopper 1, a feeder 2, a chute board 3, a guide for the processed material 4. Under the loading hopper 1, a working element 6 is installed, made in the form of a dielectric drum 7 with a winding from a group of insulated electrodes 8 of alternating polarity, which are installed in curvilinear sinusoidal grooves 9 on the surface of the dielectric drum 7, and between the electrodes 8, parallel to their grooves 9, grooves 9 for placing seeds are also made on the surface of the dielectric drum 7. Under the working element 5, receivers of separation products 10 are installed, and in the output zone, in contact with the working element 5, a cleaning brush 11 is installed. The dielectric separator operates as follows. The seeds (raw cotton buds) from the loading hopper 1 through the feeder 2 and the chute board 3 fall onto the surface of the dielectric drum 7 into the curvilinear sinusoidal grooves 9 between the electrodes 8. When the dielectric drum 7 with the seeds rotates, the latter are aligned by the guide 4. In this case, the guide 4, due to the hinged connection of the upper end with the wall of the loading hopper 1 and the conical spring 5, performs reciprocating torsional oscillations, leading to the alignment of the seeds in the form of a single-layer flow. With an increase in the force of the seed flow on the surface of the guide 4, the deformation of the conical spring 5 decreases (variable rigidity), leading to the alignment and placement of seeds (cotton voles) in the curvilinear grooves 9 in the interelectrode space of the dielectric drum 7. Due to the curvilinear sinusoidal grooves

9 on the surface of the dielectric drum 7, the number of seeds located in these grooves 9 increases. In addition, due to the arrangement of the electrodes 8 in the curvilinear sinusoidal grooves 9 on the surface of the dielectric drum 7, the electrical force of pressing (retaining) the seeds in the interelectrode grooves 9 increases due to an increase in the total length of each electrode 8 along the perimeter of the dielectric drum 7. The seeds falling into the interelectrode grooves 9 of the dielectric drum 7 are polarized and, under the action of electrical forces, are attracted to the grooves 9 of the dielectric drum 7. Therefore, it is possible to increase the rotation frequency of the working element 6, which leads to an increase in the productivity of the separator.

Due to the different quality (maturity, weight) and heterogeneity of the seeds (cotton voles), the magnitude of the electrical force for different seeds is different. When the working element 6 rotates, the seeds are torn off under the action of gravity and centrifugal force and fall into the corresponding cells

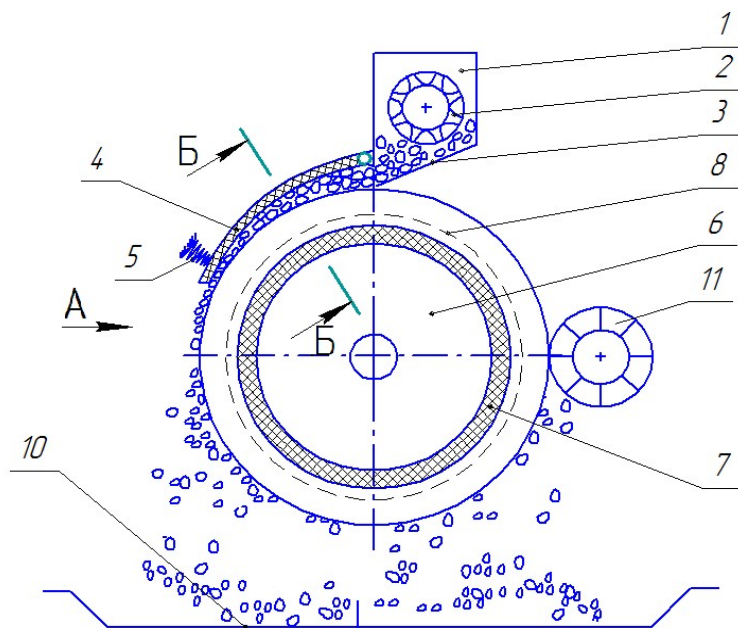


Fig.2.1. Dielectric separator

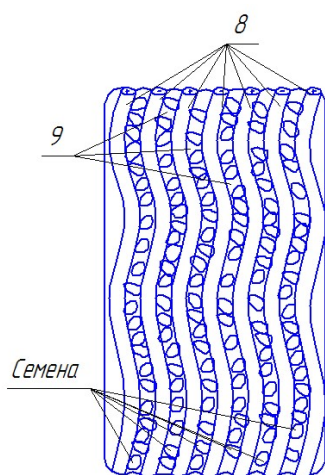


Fig.2.2. View A (enlarged)

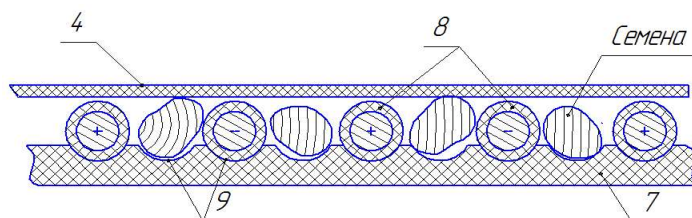


Fig.2.3. View B-B (enlarged)

receivers of separation products 10. Cleaning brush 11 serves to sweep away attracted seeds and other impurities. The proposed dielectric separator allows for an increase in productivity due to an increase in the pressing force of seeds (cotton flies) to the dielectric drum, as well as an increase in the clarity of seed separation by fractions. In another design proposed by us, the dielectric separator consists of a working element in the form of a drum with a winding from a group of insulated electrodes of alternating polarity, a loading hopper, a feeder, receivers of separation products (cotton flakes), equipped with an elastic guide installed above the drum in the area of feeding cotton flakes (seeds), made with a variable thickness, decreasing from the beginning of the seed feed by the guide to its cantilever end, and the working surface of the elastic guide is made curvilinear in a sinusoidal shape, and the amplitude of the sinusoid is made decreasing (fading) as the raw cotton flakes (seeds) are fed. The presence of an elastic guide with a decreasing thickness along the feed of cotton buds will allow the cantilever part of the guide to act on the cotton buds (seeds) with a greater amplitude and a lower frequency at the end of their feed to the working element, and with a higher frequency and a lower amplitude at the beginning of the feed of cotton buds by the guide, which facilitates the rapid orientation of the cotton buds in the initial feed zone and sufficient force of the guide's action on the cotton buds in its cantilever part (in the final feed zone), allowing the necessary pressing of the buds to the working element. The execution of the working surface of the elastic guide in the form of a

damped sinusoid allows for gradual alignment and ensuring a single-layer distribution of them along the interelectrode space of the working element. In this case, the amplitude and step of the sinusoid, based on the size of the fly (seeds), cotton are selected accordingly, the amplitude is 4.5 mm in the initial feed zone and 2.0 mm in the console part of the guide and the step of the sinusoid is selected within $(18 \div 20)$ mm. The design is illustrated by the drawing in Fig. 2.1. where a is the general diagram of the dielectric separator, b is the diagram of the design of the elastic guide of the separator, and c is the section A-A in Fig. 2.1. The dielectric separator contains a loading hopper 1, a feeder 2, a chute board 3. The loading hopper 1 is located above the working element 4, made in the form of a drum 6 with a winding of groups of insulated electrodes of alternating polarity 5, a cleaning brush 7, receivers of separation products 8, an elastic guide 9 and a power source (not shown in the drawing). The dielectric separator operates as follows. The seeds from the hopper 1 through the feeder 2 and the chute board 3 fall onto the surface of the drum 6 with the winding 5 and, moving together with the drum 6 due to its rotation, pass under the elastic guide 9, where they are placed with its help in the interelectrode space. The seeds falling into the interelectrode space of the electrodes 5 of different polarity are polarized and, under the action of electric forces, are attracted to the surface of the drum 6. At the same time, due to the decreasing thickness ($\Delta 1 > \Delta 2$) along the length of the elastic guide 9 in the direction of feeding the cotton buds (seeds), it is possible to act with a higher frequency and a lower amplitude (due to the greater thickness) with the guide 9 on the incoming flow of buds from the loading hopper 1 in the initial feeding zone. This results in fast orientation and single-layer feeding of cotton buds. In the output console section, the guide 9 oscillates with a higher amplitude and lower frequency (due to its small thickness), which results in its impact on the cotton buds with sufficient force to ensure their necessary pressing against the surface of the working element 4. The execution of the working surface of the elastic guide 9 in the form of a damped sinusoid allows for constant alignment and ensuring a single-layer distribution of the cotton buds over the interelectrode space of the working element 4 (Fig. 2.4). In this case, the amplitude and pitch of the sinusoid, based on the dimensions of the cotton buds (seeds), are

selected accordingly to the amplitude: 4.5 mm - in the initial zone of feeding the cotton buds and 2.5 mm - in the console section of the elastic guide 9, and the pitch is $(18 \div 20)$ mm.

Due to the heterogeneity and non-uniformity (maturity) of the cotton pods (seeds), the magnitude of the electric force for different seeds is different. When the drum 6 rotates, they are torn off from the surface of the working element 4 at different rotation angles and fall into the corresponding fractions in the receivers of separation products 8. The cleaning brush 7 serves to sweep away the attracted seeds and other light impurities. When large impurities or foreign particles get in, due to the elasticity of the guide 9, they pass freely under it, which eliminates the radial movement of the guide 9. This is also facilitated by the sinusoidal surface of the elastic guide 9. The proposed dielectric separator allows for an increase in the uniformity of the cotton seed feed, increases the clarity of the separation of cotton seed by maturity (by weight).

Sorting and calibrating seeds is performed in various ways: mechanical, liquid, electrical, electromagnetic and pneumatic. Seeds have such parameters as density, windage, dielectric properties, core filling, geometric dimensions. All of them, in turn, are indirectly related to each other and play a large role in the efficiency of sorting. Depending on the seed sorting methods, various methods and separating working elements are used: mechanical (rolling planes, sieves, indented drums), in an air flow,

in salt solutions, in water, using an electromagnetic field, and others.

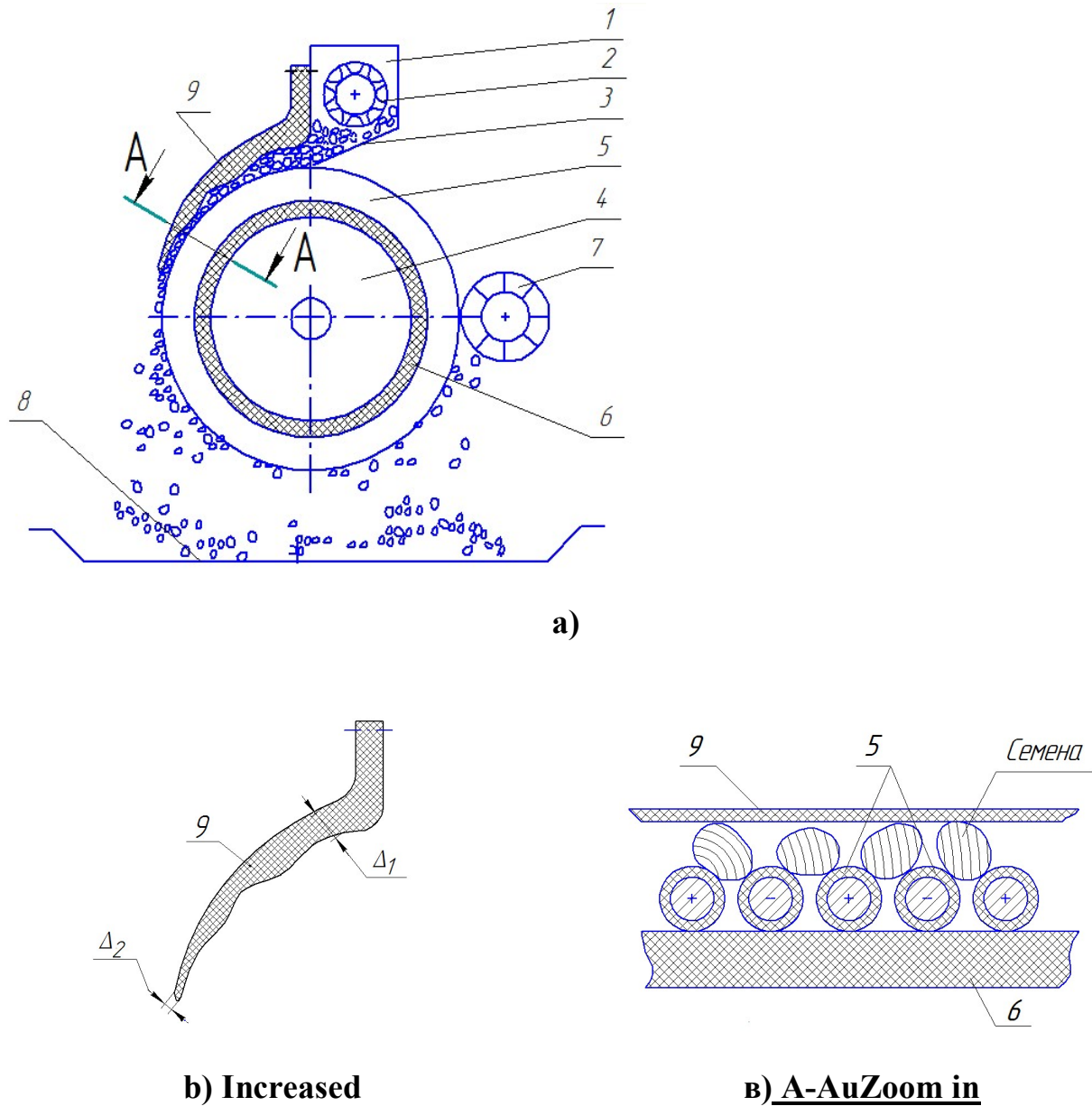


Fig.2.4. Dielectric separator

2.2. Pneumatic cotton filament separators

Currently, seed separation devices are mainly used, containing a system of alternating polarity electrodes, a loading hopper, receivers of separation products and a dielectric working element mounted on a shaft. The main disadvantage of these devices is that it is material-intensive and, due to the implementation of the working element in the form of coaxially located bodies of revolution with a groove cut in the form of a parabola on its surface, the seeds of small-seeded crops are poorly retained, which

has a negative effect on the quality of their separation and limits the functionality of the working element. In addition, expensive high-voltage sources are required to power the system of alternating polarity electrodes.

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