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IMPROVEMENT OF THE COLLECTOR OUTPUT DEVICE OF THE DISK SEPARATORS

Abstrakt

Disk separators operate on the basis of selective removal of a short fraction grain from a mixture with longer ones, for example, darnel grains and similar impurities from a mixture of wheat grains; or wheat grains from a mixture of wild oat seeds and other longer waste particles.

For this purpose, the working bodies of separators— cylinders or disks — are equipped with special cavities, so called "cells", which location, shape and size correspond to the technological operation.

In the flow lines of the grain cleaning workshops of high-performance flour mills, predominantly, disk separators, which construction and productivity are well-known from the scientific and technical literature, are used. In recent decades, the improved, so-called small-scale disk separators for wild oat, for example, A9-УТО-6 and some others, have been created and become widely used. Their specialties include, in particular, the lack of interdisciplinary trays in the pre-configured pre-fabricated input device (i.e., they are characterized by the use of unblocked WUAs).

Further improvement of an unblocked WUA is possible on the basis of "The grain mixture cleaning method", which involves the location of cells on the surface of the discs, which ensures that the short particles fall out of them with a compact beam at the same angle, regardless of the distance of the cell relative to the axis of rotation.

Therefore, the casting model of the disc should receive a more complex construction, which, unlike the present, mainly manual technology, is expedient to use with modern CNC milling machines.

Key words: *cell separators, disk separators for wild oat, collectors, collector-output devices of tray and unscrupulous types, zone of loss of co-particles from disk cells.*

Disk separators function on the basis of the selective extraction of short grain fractions from a mixture with longer ones, for example, darnel grains from a mixture of wheat grains, or wheat grains from a mixture of wild oat.

For this purpose, the working bodies of Disk Separator — cylinders or disks — are equipped with special cavities— cells, the shape and dimensions of which depend on the technological operation.

Used in the flow lines of the grain cleaning workshops of high-performance flour mills, predominantly, disk separators, which construction and productivity are well-known from the scientific and technical literature are shown on Fig. 1. Fig. 1a and Fig. 1b show the general view and functional scheme of the disk separator of previous decades, for example, ЗТО-5, for which the use of a collector-output device of tray type [1] is characteristic.

In advanced small disk separators for wild oat, for example, the model A9-УТО6 and some others WUA with no tray areused [2].

On Fig. 1, it is shown that in the working space of the disk separator the following occurs: for each turn of the disk rotor, the discs are sequentially re-framed by four conventionally separated zones. In zone I there is a slip on the surface of long grain discs and the filling of cells is mainly short grains. However, some cells capture the long particles which have an unstable position. Therefore, within the 2nd zone, they drop out of the cells and return to the layer of the product that fills the separator. Short grains located in cells are quite stable. Their fall occurs only within the III zone, after turning the disc to a certain angle $\alpha_в$, called

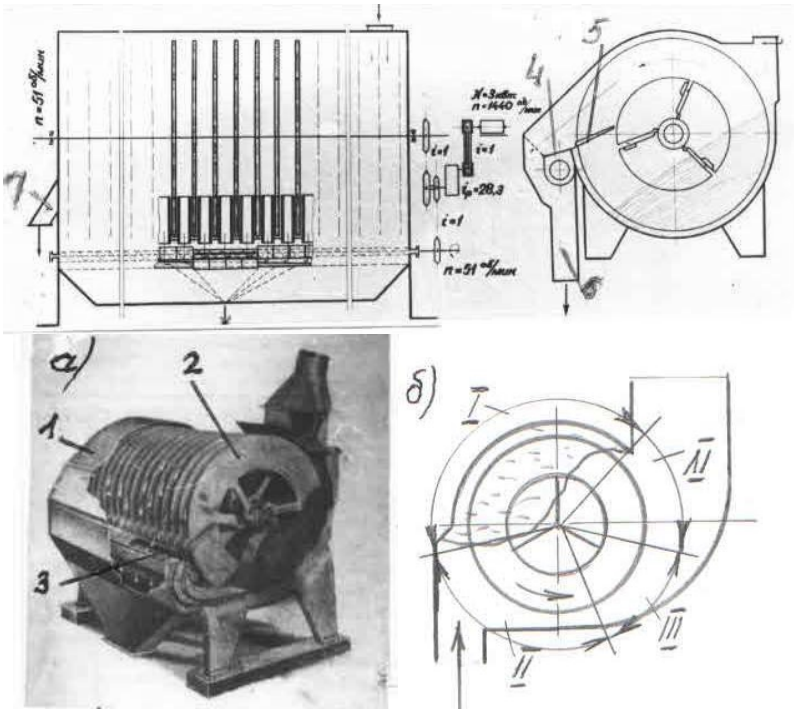

Fig. 1 – General view (a) and generalized functionals cheme (b) of disk separator:

1 - body; 2 – disk rotor; 3 - screw; 4 - flip-flap; 5 – interdisplay tray; 6 – grain mixing unit; 7 - a branch for a wild oat; c) the scheme of the workings pace of the disk separator: I – the zone of filling the cells; II – zone of loss from cell soflong particles; III – zone of loss of short particles; IV – zone of idlemileage of cells.

the angle of inclination.

Empty cells cross the IV-zone (idle run) and appearagain in zone I, so, the cycle is going to be repeated.

In [3] the equation is given

$$\cos\alpha_B \pm \frac{\cos(\beta+\varphi)}{\sin\varphi}\sin\alpha_B - \frac{\omega^2 R_i}{g} = 0,$$

where β is the angle of the guide face of the cell, hailstones;

φ - angle of external gravity friction on the cell surface, degrees;

ω - angular speed of rotation of a disk rotor, rad/s;

R_i -the radius distance from the centre of grains mass, located in the middle of the cell of the first line, to the axis of rotation of the disk, m.

Since the cells on the disk surface are located in concentric lines, the value of R_i varies in the range from $R_{вн}$ (internal) to $R_{зов}$ (external). Therefore, for β, φ, ω = const, the angle of incidence from the cells of the i^{th} row $\alpha_{вi}$ is a function of the radius R_i $\alpha_{вi} = f(R_i)$, that is, the drop of the short grain beads from the cells of different rows occurs at different angles. The consequence of this is the lack of compactness of the beam of the curves trajectories, whichis confirmed by the results of the calculation and experimental determination of their parameters, shown on Fig. 2

At the same time, it is obvious that one of the conditions for the efficient operation of a non-stacking power plant is the compactness of the loss zone, that is, the loss of short grains from the cells of all concentric lines at the same angle $\alpha_в$ (Fig. 3). This provides almost complete accessof the short grains being removed into the channel assembly and output device, contributes to the work of the separator with maximum and stable performance.

To solve this problem, it is necessary to take advantage of "The method for cleaning the grain mixture'' [4], according to which the location of the cells on the

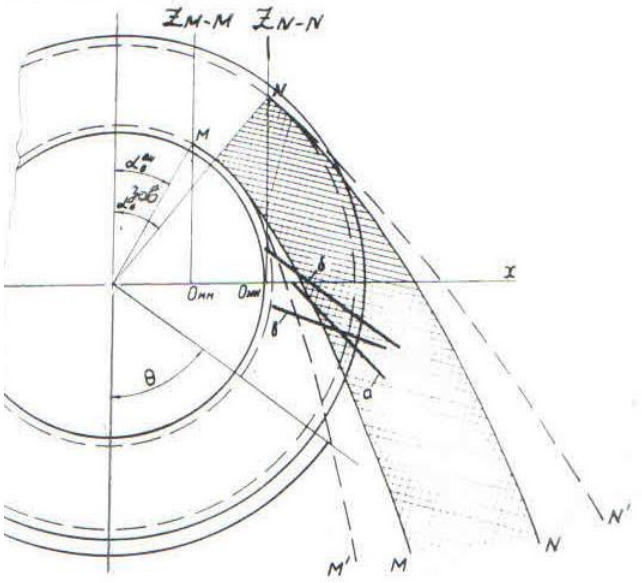

Fig. 2 – Graphical comparison of the parameters of the curves, constructed from the calculations (N-N; M-M) and experiments (N-N '; M-M');

a, b, c - inter-disk tray soft the most common types.

а)

б)

Fig. 3 – Experimental determination of the parameter soft helosszones of short zeros from the disk cells inconditions without tray WUA.

top of the disk should correspond to the pictured on Fig. 4. The angle of loss $\alpha_{ви}$ will be constant if the longitudinal axes of the cells of the i^{th} lines are oriented in a relation to the radius R_i at the angles ψ_i

$$\psi_i = \frac{\pi}{2} \pm \gamma_i \quad \text{degrees,} \qquad (1)$$

where γ_i is the angle of deviation of the longitudinal axis of the cell from the tangent passing through the intersection point of the dividing line of the cell row and the radius R_i.

The value of γ_i is determined by the expression

$$\gamma_i = arctg\left[\frac{\cos\beta\sin(\alpha_B-\varphi)+\cos\alpha_B\sin\beta\sin\varphi-\sin(\beta-\varphi)\frac{\omega^2 R_i}{g}}{\sin\alpha_B\cos\beta\cos\varphi-\cos\beta\sin\varphi\frac{\omega^2 R_i}{g}+\sin\varphi\cos(\alpha_B+\beta)^2}\right]$$

degrees, (2)

where $\alpha_в$ - the magnitude of the angle of drop of grain from the cells of all i-th lines, degrees. If as an example, consider the outer line of cells and take αv = 50°; β = 50°; φ = 37°; ω = 5.76 rad / s and $R_з$ = 0.305 m, then we obtain γ = 16 °.

In this way, the foundry model for the formation of a disk must be made so that the longitudinal axes of the casting marks on its surface were oriented in accordance with the results of calculations in expression (2).

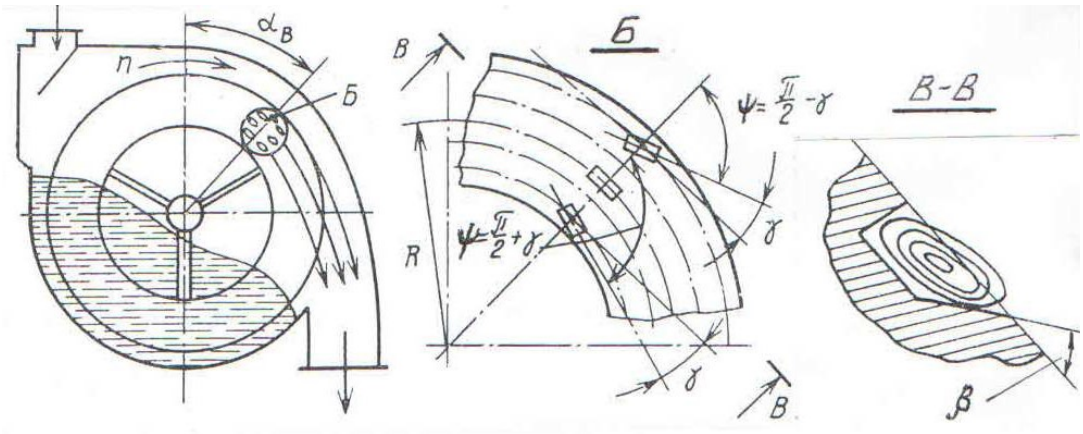

Fig. 4 – The location of the cells on the disk surface, which ensures the loss of short particles from the cellss pace dapart from the axisofrotation, at the same angle αV (in accordance with the invention No. 1579591).

Practical implementation of this proposal, with the existing technology of making foundry models, is quite expensive, because of it saccompaniation with hand-made manufacturing and picking signs on the model. Therefore, we consider to apply more modern methods. For example, using CNC milling machines. This will not only facilitate and speed up the production of the model, but will also provide the required precision of the size of the marks and their orientation in each line.

Such improvement of unassembled prefabricated and removable devices of small-volume disk separatorsforwild oat will further reveal the potential of their design and will also increase their distribution both in Ukraine and abroad.

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УДОСКОНАЛЕННЯ ЗБІРНО-ВИВІДНОГО ПРИСТРОЮ ДИСКОВИХ ТРІЄРІВ

Анотація

Трієри, або коміркові сепаратори, функціонують за принципами вибіркового вилучення зерна короткої фракції із суміші з більш довгими, наприклад, насіння кукіля і йому подібних домішок із суміші з зерном пшениці; або зерна пшениці із суміші з насінням вівсюга і інших більш довгих смітних частинок.

Для цього робочі органи трієрів – циліндри або диски- обладнують спеціальними поглибленнями – комірками, розташування, форми і розміри яких відповідають завданій технологічній операції.

В потокових лініях зерноочисних цехів високопродуктивних борошномельних заводів використовують, переважно, дискові трієри, конструкція і робота яких добре відомі з науково-технічної літератури. В останні десятиріччя були створені і набули поширення удосконалені, так звані малогабаритні дискові трієри-вівсюговідбірники, наприклад, А9-УТО-6 і деякі інші. До їх особливостей відноситься, зокрема, відсутність міждискових лотків у складі удосконаленого збірно-вивідного пристрою – ЗВП (тобто, їм характерне застосування безлоткового ЗВП).

Подальше удосконалення безлоткового ЗВП можливе на базі винаходу «Спосіб очищення зернової суміші», який передбачає таке розташування комірок на поверхні дисків, що забезпечує випадіння з них коротких частинок компактним пучком, тобто, під одним кутом, незалежно від відстані комірки відносно осі обертання.

Тому ливарна модель диска має отримати більш складну конструкцію, яку, на відміну від теперішньої, переважно, ручної технології, доцільно виготовляти з застосуванням сучасних фрезерних верстатів з ЧПУ.

Ключові слова: *коміркові сепаратори, дискові трієри-вівсюговідбірники, збірно-вивідні пристрої лоткового і безлоткового типів, зона випадіння коротких частинок з комірок дисків.*

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