Improvement of Structural Diagrams of Vibratory Separators with Electromagnetic Drive

Vitaliy Korendiy[1], Vladyslav Shenbor[2], Yurii Shenbor[3]

1. Department of Mechanics and Automation Engineering, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vitaliy.nulp@gmail.com

2. Department of Mechanics and Automation Engineering, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: vladyslav.s.shenbor@lpnu.ua

3. Department of Designing and Operation of Machines, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: yurii.v.shenbor@lpnu.ua

Abstract* – *The features of construction of structural schemes of vibratory separators based on vibratory conveyors with electromagnetic drive are considered. The structural diagram of the vibratory separator developed on the basis of three-mass oscillatory scheme with the possibility of transporting the mixture and the separated component by vibratory transportation in opposite directions is proposed, and the device operation is substantiated. The main criteria of separation efficiency are presented. The possible directions of effective implementation of vibratory separators are suggested.

Keywords – structural diagram, vibratory separator, armature, electromagnet, vibration angle, elastic system, separation efficiency.

I. Introduction

In a number of industries (packaging, food, woodworking, etc.) there is a great need for efficient means of separating lump and piece products. This is due to an increase in production volumes and underdeveloped means of production for these operations. As it is known [1], the separation of the mixture into components (two or more) is carried out mainly by two types of machines: passage separators and classifiers. These machines are vibration-type devices, which ensure that the product is sized in fractions by means of single- or multi-component vibrations. The simplest and the most effective structural scheme of the separator is presented in Fig. 1 [2]. It has been developed on the basis of two-mass vibratory conveyor with electromagnetic exciter of oscillations and directed oscillations.

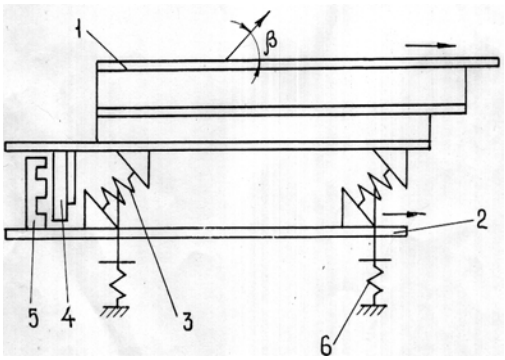

Fig. 1. Structural diagram of two-mass vibratory separator with single-directed transportation

The product is fed to the upper mass 1, which can be equipped with one or more sieves, and due to vibrations directed at the angle β and generated by the electromagnet 5 with armature 4 and by the elastic systems 3 is being effectively transported with throwing along the direction of vibrations. This ensures the effective separation into different size fractions and transportation into different containers (the arrow shows the direction of vibratory transportation). The lower mass 2 takes the smallest parts of the product and transports them into the container. Vibration isolators 6 ensure effective vibration isolation of the separator.

The separators developed on the basis the diagram (Fig. 1) may have a maximum overall size of sieves of 800x500 mm. In order to develop larger machines, it is necessary to use other structural diagrams.

II. Three-mass vibratory separators

The task of development of separators, in which the separated parts of the product are to be transported in opposite directions, is quite often set for engineers. In order to solve this problem, the structural diagram presented in Fig. 2 has been developed.

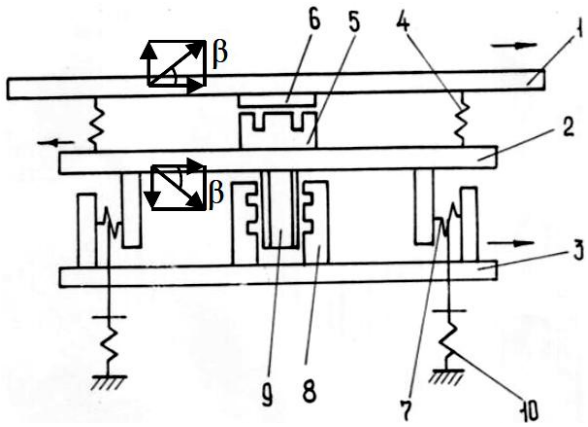

Fig. 2. Structural diagram of three-mass vibratory separator with opposite-directed transportation

The separator consists of three oscillating masses 1, 2 and 3, an elastic system 7 of horizontal oscillations and an elastic system 4 of vertical oscillations. Horizontal vibrations are excited by two-cycle exciter 8, 9 of horizontal oscillations. Vertical vibrations are excited by one-cycle exciter 5, 6 of vertical oscillations. Using the shock absorbers 10 mounted in the zones of the smallest oscillations of the elastic system 7, the separator is mounted on the base. Taking into account only horizontal vibrations, the reduced mass of bodies 1-2 and the mass 3 oscillate in the antiphase. Taking into account only vertical oscillations, the mass 1 and the reduced mass of bodies 2-3 also oscillate in the antiphase. After summing the vectors of oscillations, we obtain different directions of the angles of the vibrations of masses 1 and 2, which will ensure the vibratory transportation of parts by masses 1 and 2 in opposite directions. The product, which is fed to the sieve of the mass 1, will be transported in the direction opposite to the separated parts that will be sift

on the mass 2 (Fig. 2). This separator should be used to separate the mixture into two components, if it is necessary to transport them in different directions.

The efficiency of the vibratory separation depends on the mode parameter W [3], on the operating frequency of oscillations, on the overall dimensions and on the sieve parameters. The following conditions are the most effective for vibratory separation: the parameter W = 2…8; operating frequency of vibrations 50 Hz, 25 Hz, 16.7 Hz or 12.5 Hz. The smaller frequencies are used for large-sized separators (with sieve sizes of 1000x600 mm or more). The most widespread types of sieves are the sieves of bar-, hole- and string-type. The separation efficiency is characterized by the separation quality coefficient, by the mass separation quality factor, and by the separation productivity [4], which may be determined experimentally.

The implementation of the proposed devices may be especially effective for automated machines of vibratory treatment [1], since their design features require the distribution of abrasive processing elements and the machined parts into different zones, which will allow the use of devices for automatic charging of abrasive and transporting of machined parts.

Conclusions

The development of highly-efficient separators with feeding of separated parts in opposite directions will allow to use them in a variety of technological equipment for the mechanization and automation of production and for development of flexible production systems.

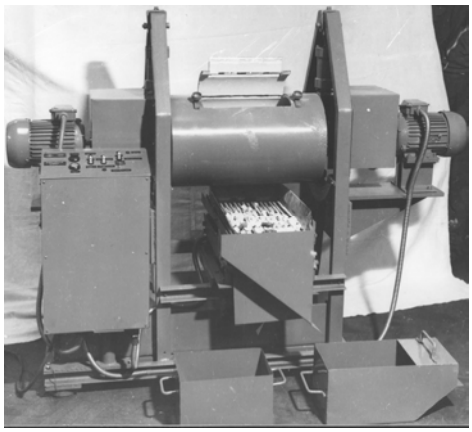

Fig. 3. Unbalanced vibratory machine with the separator and two drives

The unbalanced vibratory machine with the separator designed according to the diagram of Fig. 1 is presented in Fig. 3. This machine may be automated using the separator designed according to the diagram of Fig. 2.

One of the models of two-mass vibratory single-directed separator with electromagnetic drive, which has been designed and manufactured in the Department of Mechanics and Automation Engineering of Lviv Polytechnic National University, is presented in Fig. 4.

Fig. 4. The model of two-mass single-directed vibratory separator

References

[1] Ye. Ye. Lavendal, *Vibratsii v tehnike: Spravochnik v shesti tomah, Tom 4: Vibratsionnyie protsessy i mashiny*. (in Russian), Moscov: Mashinostroenie, 1981.

[2] A. L. Bespalov and V. S. Shenbor, “Deiaki rezultaty stvorennia i doslidzhennia vibratsiinykh konveieriv-separatoriv,” (in Ukrainian), *Avtomatyzatsiia vyrobnychykh protsesiv u mashynobuduvanni ta pryladobuduvanni*, vol. 39, pp. 39–44, 2005.

[3] V. O. Povidailo, *Vibratsiini protsesy ta obladnannia.* (in Ukrainian), Lviv: Vydavnytstvo Natsionalnoho universytetu «Lvivska politekhnika», 2004.

[4] V. M. Borovets and V. S. Shenbor, “Analiz chynnykiv, yaki vplyvaiut na efektyvnist ta produktyvnist separatsii pislia vibratsiinoho obroblennia,” (in Ukrainian), *Optymizatsiia vyrobnychykh protsesiv i tekhnichnyi kontrol u mashynobuduvanni ta pryladobuduvanni*, vol. 535, pp. 45–49, 2005.