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VIBRATORY FEEDERS

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***Abstract.** Some types of vibratory feeders used in the mining industry are considered in the article. The application areas of vibratory feeders are briefly described. The analysis of scientific articles relating to the vibratory feeder and the movement of cargo is carried out. The author of the article draws attention to the advantages and disadvantages of vibratory feeders. The ways of improving the designs of feeders are studied. It is concluded that vibratory feeders need some improvements in order to expand their application areas, increase their reliability and durability and improve the dynamic and economic performance.*

***Keywords:** vibratory feeder, material, bulk material, flow, feed, oscillation*

The vibratory feeder is used widely and in the course of the time it is gaining more and more popularity and expanding its scope. Vibrating consumers are used in various industries: pharmaceutical, glass and sugar industries, metallurgy, etc.

One of the most energy-intensive industries is mining. An increase in the consumption of natural resources is not only an increase in production volumes, but also a complication of the conditions for extraction and ore extraction, the introduction of environmental measures into the technological process.

The vibratory feeder can uniformly, regularly and continuously feed the massive and granular materials from the silo to the receiving device. In a stone

crusher plant, it can continuously and uniformly feed the materials for the crushing machine, and screening the materials. Vibrating feeder is widely used in industries of crushing and screening in metallurgy, coal mine, mineral processing, building materials, chemical industry, abrasive, etc.

The article [4] presents an analysis of vibrating feeders used in mining. Particular attention is paid to vibration feeders with a working body of low bending stiffness. The results of laboratory and numerical experimental studies are presented. It is concluded that the use of elastic support elements in the design of the vibratory feeder makes it possible to increase the intensity of oscillations of the loading section, thereby creating conditions for the efficient supply of bulk and cohesive materials.

Design schemes are presented in the article [5], which allows expanding the scope of existing vibrating feeders. The author of the article [5] propose to use additional elements (chains, ropes) to move difficult-to-transport materials (cohesive, sticky, hot) along the feeder. It is noted that all the presented schemes can be structurally combined in any necessary combination.

In this study we are taking a careful look at the kinds of vibratory feeders that are used in mining industry today. There are many types of mining feeders, such as vibrating feeder, electromagnetic vibratory feeder, bar feeder, belt feeder, apron feeder, screw feeder, trough feeder, pendulum feeder, disk feeder, etc. We are going to consider some of the feeders and their advantages and disadvantages.

1. Electromagnetic vibratory feeder

The electromagnetic vibrating mining feeder is a new type of quantitative feeding equipment, which can meet the requirements of continuous production. It is widely used in the production links of ore, metallurgy, coal, building materials, light industry, chemical industry, electric power, mechanical grain, medicine and so on. The feeding machine is used for quantitatively, uniformly and continuously

feeding bulk, granular and powder materials from a silo or hopper into a material receiving device.

It can be used as a belt conveyor, bucket elevator, screening equipment cement mill, crusher, grinder and various industrial departments of viscous granular powder feeding device. Through the process, which can be used for automatic control, the production process realizes automation.

2. Bar Feeder

The structure of the bar feeder is simple, which easy to use and maintain. Its excitation force is small, no wear-resistant parts. It is widely used in crushing and screening plants of mines, crushed stone fields, metallurgy, building materials, chemical industry, mineral processing, coal mines, and other industries.

3. Belt Feeder

The belt feeder has the advantages of large feeding capacity, simple structure and suitable for various materials. But the shape size is bigger, the sealing property of feeding is bad, and the accuracy of feeding is not high. The conveyor belt is easy to wear and not suitable for large particle size, dust, hot materials.

4. Apron Feeder

Apron feeders can bear the impact of materials, which suitable for wear, bulk materials, and high-temperature material bulk density. But the feeder has a complex structure, itself weight, and low feeding accuracy. So, it is not suitable for powdery materials.

5. Screw Feeder

Screw mining feeders are to use the spiral of rotating power to push the material in the conveyor movement feeding. The conveying trough is mostly tubular, with single and double pipes. Adjustment of the feeding capacity through can change the rotational speed of the screw. The precision of feeding quantity is high, and

the sealing feeding can be realized. The shape and size of the spiral feeder are small; parts are worn seriously, easy to crush materials. The utility model is suitable for powder granular materials with small viscosity and grindability.

6. Trough Feeder

The trough feeder can be mounted on the ground or mounted on the discharge opening of the ore bin. The width of the trough of the mine trough feeder is about 2-2.5 times the maximum grain size. The largest trough mining feeders can meet the size of less than 500 mm iron ore feed. The commonly used specification is 980 * 1240 trough feeder, its feeding size is 350-0mm, which suitable for 400 * 600 jaw crusher feeding equipment.

7. Disk Feeder

Disc feeder is feeding equipment that suitable for powder ore which under 20mm. The main function of a disk feeder is to feed material to other equipment, which allowing material to enter a device evenly, so that the next process can work normally, save labor, and protect the performance of equipment, extend the life of the entire production line equipment. Disc feeder is an indispensable accessory product of mineral processing equipment.

In the paper [6] the authors pay attention to the device for preventing the leakage of bulk material when the vibratory feeder is turned off. It is proposed to use a leaf or rotary shutter; both options do not greatly complicate the design and do not require any additional actions.

The authors proposed a vibratory feeder, the design of which provides for the division of the supplied mass into 3 flows, each of which has a 3 times lower intensity than the intensity of the total flow. It is noted that the application is possible in the construction, chemical and any other industries where it is necessary to supply small-sized and bulk materials when supplying separate flows [11].

In the paper [7], the author draws attention to the fact that an increase in the depth of mining in open pits leads to an increase in the volume of overburden moved. At the same time, the use of heavy-duty dump trucks on the lower horizons is difficult, and sometimes completely impossible due to the size of the working sites, due to the need to overcome large slopes. There is a need to use combined transport. The author proposes to use bunker transshipment points with vibration release of rock mass, noting that the use of two vibration exciters can increase productivity by 1.7-2 times.

In the article [1], the author talks about his experimental study of the operation of a prototype of a vibratory feeder on a combined parametric resonance. A significant decrease in parasitic oscillations has been proved, and the threshold for excitation of resonant parametric oscillations has been determined. It is noted that the use of this type of vibrator provides high stability and reduced energy costs.

The article [2] considers the technological features of cleaning tare cullet from paper labels. The design features of vibratory feeders with the possibility of removing light impurities during the supply of material are described.

The author of the article describes the advantages of using a vibrating feeder-doser in production in order to eliminate feed unevenness. Using a vibrating feeder, it is possible not only to achieve a uniform feed of the material but also to adjust the feed rate. [9]

The design of the vibrating feeder is described. The main components are indicated, the movement of the material during the feed is described. It is concluded that although modern vibratory feeders have fairly good technical and operational qualities, the development of feeders with increased productivity and maintainability is an urgent task [3].

The article [10] is devoted to the study of the vibrational movement of a layer of bulk material in vibratory feeders and the development of a mathematical model of their electromagnetic drive. The resonant frequency of vertical and longitudinal oscillations of the vibratory feeder tray is determined. Thanks to the mathematical model, it is possible to determine the required power and select the type of electric drive in terms of equipment energy efficiency.

The article [8] presents an analysis of the technical means used to improve the safety of work during the formation of dumps. The authors of the article propose the use of a vibratory spreader to improve work safety and eliminate the loss of human resources and expensive equipment in the event of landslides.

It is necessary to say that transfer systems significantly affect the cost of mining. The use of bunkers instead of combined transport increases the efficiency of the transshipment system. The authors of the article [12] note that the use of a bunker in the form of an «inverted obelisk» with a vibrating screen feeder is the most effective.

All in all, the use of vibratory feeders in various industries is an important direction in the development of technologies. In the article we have examined the typology of vibratory feeders, their advantages and disadvantages, as well as ways to improve them with the purpose to expand the application areas, increase their reliability and durability and improve the dynamic and economic performance.

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***Аннотация.** В статье рассмотрены некоторые типы вибрационных питателей, используемых в горной промышленности. Кратко описаны области применения питателей такого типа. Проведён анализ научных статей по темам, связанным с вибрационным питателем и перемещением груза. Авторы статьи обращают внимание на преимущества и недостатки вибрационных питателей. Изучены пути совершенствования конструкций питателей. Сделан вывод о необходимости усовершенствования вибрационных питателей с целью расширения областей их применения, повышения надёжности и долговечности, улучшения динамических и экономических показателей.*

***Ключевые слова:** вибрационный питатель, материал, сыпучий материал, поток, подача, колебания*

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