The main types of jigging machines structures

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Abstract. The article presents the results of the study and analysis of the main structures of depositors. Identified the strengths and weaknesses of individual models. Structurally, the jigs are divided into two groups: movable and immovable sieve. It is believed that jigging machines with movable sieve offer better performance, require less water, but outcomes for them are worse than the jigging machine with a fixed sieve. Given the technical characteristics of the diaphragm jigging machines. Illuminated the depositors technical characteristics with a conical pulsators. Most designs have a limited height undersize (running) part, which ensures machines compactness and ease of use in various conditions. A positive feature of the machine is the consistency of the diaphragm stroke, providing a "hard" mode pulsation environment.

1. Introduction
The numerous jigging machines designs development influenced the their application conditions variety. In the enrichment of ores and sands, diaphragm jigging machines and machines with a cone pulsator have become predominant, allowing the process to be carried out in a high-frequency oscillation mode, meeting the requirement of compactness for use in cramped conditions, for example, on dredges (table 1). In diaphragm jigging machines, water relative to the sieve moves in two directions-up and down, in pulsators – only up.

There are about 90 designs of jigging machines that differ from each other in their intended purpose, the principle of drive operation and unloading devices, the number of allocated products and other characteristics [1-8]. As the main defining feature for the classification of jigging machines, the drive type with the decoding of an additional difference, for example, the location of the drive in relation to the jigging sieve, is adopted. According to this classification, all known jigging machines are merged into seven classes: air-operated; with diaphragm actuator; with cone pulsator; with piston actuator; with movable sieve; with blade drive and hydraulic pulsator. Here are diaphragm jigging machine and jigging machine with cone pulsators.

Diaphragm jigging machines (Fig.1) – the most common design used in the enrichment of dispersed ore minerals. This is due to the relative simplicity of the device, its compactness, the ability to operate in the high-frequency mode and regulate them within the required limits [4, 9-14]. Aperture in various machines types arranged horizontally side jigging separators, horizontal and inclined under the sieve, vertically in the partition wall between adjacent treads or in the housing jig walls. Most designs have a limited height undersize (running) part, which ensures machines compactness and ease of use in various conditions. A positive feature of the machine is the constancy of the diaphragm stroke, which provides a "hard" mode of medium pulsations.
2. Jigging machines structures

In domestic practice, the enrichment of ores of non-ferrous and rare metals have spread machines with vertical diaphragms located in the side (NIM-5) or end (MOD-4 and MOD-2P) walls of machines below the jigging sieves. This class striking representative machine is jigging machine MOD-4 (Fig.2) used for enrichment of ores of size up to 30 mm. The machine body consists of four cameras that pairs constitute two step of the machine, separated by a threshold. The circular diaphragm configuration is located in the end walls of the each four chambers. They are connected to the body flanges the with flexible cuffs and are driven in oscillating motion from the drive through a system of longitudinal rods and conical traverse. Each pair of diaphragms is equipped with an individual drive. Screens have sieve slit size 3×22 mm. Sieve is installed with a slight slope in the direction of enriching material. Sieve fixed between the under-size and oversize frames (stencils). The over-lattice frame has cells for uniform laying on an artificial bed layer sieve. Jigging is carried out in the high-frequency mode [8, 15-18]. The heavy product (concentrate) is unloaded through an artificial bed and released in the lower part of the sublattice chambers through unloading devices with replaceable rubber nozzles. The light product (tails) is discharged at the end of the jigging sieve through a vertical drain threshold of adjustable height [19-22]. According to technological parameters jigging machine MOD-4 is on a par with the machine MOD-3 (Fig.3 and 4).

Jigging machine MOD-2P has two stages, separated by a vertical threshold. Pulsations in each stage are created by the vertical diaphragm of the end arrangement. An essential feature of the machine is the ability to work with an increased thickness of the enriched material layer, which increases the specific capacity twice as compared to the performance of the MOD-4. To remove heavy products from the sublattice chambers, hydroelevators are used, feeding the material to the dehydrating device to separate part of the water and feed it under the sieve of the jigging machine for reuse [17, 23]. The machine is more often used on dredges for primary enrichment of efels.

Jigging machine 2-OVM-1 with a vertical diaphragm in the partition between the two stages is designed for the enrichment of small ore classes (from 0.1 to 3 mm) in the mode of high vibration numbers (up to 850 Qty/min). Jigging sieves in both stages are equipped with grids for artificial bed grains [24-26].

![Fig. 1. Scheme jigging machines with diaphragm actuator: a) lateral diaphragm; b) with sublattice arrangement of the diaphragm; c) with a vertical diaphragm in the bulkhead; d) with vertical diaphragms in the outer walls](image-url)
Fig. 2. Jigging machine MOD-4

Fig. 3. Scheme jigging machines with cone pulsator: a) with conical bottoms-pulsators; b) with pneumatic cones
At the end of each stage there is a vertical, height-adjustable threshold. Vibrations are communicated to the dia-phragm from the drive mechanism through a hollow longitudinal rod, which in some versions of the ma-chine is used for the intake of sublattice water.

Heavy products (concentrate) are collected in pyramidal sublattice chambers and periodically discharged through a cork crane or other locking device (table 1).

**Table 1.** Technical characteristics of diaphragm jigging machines

| Indicator                        | MOD-4 | MOD-2P | 2-OVM-1 |
|----------------------------------|-------|--------|---------|
| Capacity, m³/h                   | up to | 26     | up to   |
| Maximum size of processed ore, mm| up to 30 | up to 30 | up to 3 |
| Number of cameras                | 4     | 2      | 3       |
| Working area of sieves, m²       | 4     | 2      | 0.18    |
| Chamber length, mm               | 1060  | 1060   | 300     |
| Traverse stroke, mm              | up to 75 | up to 75 | 0÷16    |
| Maximum ripple amplitude, mm     | 37    | 37     | 20      |
| Number of pulsations per minute  | 130÷350 | 197    | 400÷850 |
| Electric motor power, kW         | 2×2.2 | 2.8    | 0.6     |
| Overall dimensions, mm:          | 3196  | 3230   | 1220    |
|                                  | 2432  | 1520   | 646     |
|                                  | 1650  | 2950   | 1000    |
| Length                           | 2600  | 2016   | 240     |

Our NIM-5 is the lateral location of the vertical aperture and a separate actuator for the communication of high frequency fluctuations of the jigging sieve [22-24, 27-30].

To machines with cone pulsators (Fig.3) include the jig with a tapered bottom - a pulsator and less known design Mehanobr with pneumopuncture. They are characterized by simplicity and compactness, adjustable number of vibrations of the liquid.

**Table 2.** Technical characteristics of depositors with a conical pulsators

| Indicator                        | Conical bottom-pulsator | Pneumatic cone |
|----------------------------------|-------------------------|----------------|
|                                  | MOD-1 | MOD-2 | MOD-3 | MOBK-8S |
| Effectiveness, m³/h              | 6     | 10    | 14    | 70÷120  |
| Sieve width, mm                  | 700   | 1000  | 1000  | 2000    |
| Screening area, m²               | 1     | 2     | 3     | 8       |
| Number of pulsations per min.    | 130÷350 | 130÷236 | 164÷348 | 57÷71   |
| Air pressure, kH/m³              | -     | -     | -     | 3.5÷4.0 |
| Air consumption, m³/h            | -     | -     | -     | до 4000 |
| Electric engine power, kW        | 1.1   | 2.2   | 2×2.2 | 2.2     |
| Overall dimensions, mm:          |       |       |       |         |
| length                           | 1850  | 2450  | 3750  | 5610    |
| width                            | 1000  | 1260  | 1260  | 3270    |
| height                           | 1805  | 2000  | 2000  | 4140    |
| Weight, kg                       | 891   | 1460  | 2445  | 19000   |
3. Conclusion

Jigging machines MOD-1, MOD-2 (47B-OT) and MOD-3 (48B-OT) (table 2) designed for enrichment of ores and sands up to 15 mm. Machines MOD-1 and MOD-2 have two, and MOD-3 – three steps, separated by transverse partitions with a vertical threshold. Designs of all three standard sizes are similar, their device can be considered on an example of the MOD-3 machine (Fig.4 and tab.2). In the welding rectangular case of sheet steel jigging sieve is fixed between the undersize and oversize frames, ledges (in each successive step below the previous one) [25-26]. Each step in the lower part passes into a cone, to which a movable conical bottom with an unloading device at the top is attached through a flexible cuff to release a heavy product (concentrate). The bottom is fixed to the balance frame, which balances the static loads and transmits the reciprocating motion from the drive to the bottoms. In machines MOD-1 and MOD-2 drive and balancer frame common to the two bottoms, in the car MOD-3 one frame with the drive is connected to the first two bottoms (in the direction of the material). The third bottom has a separate drive and is attached to its balance frame.

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