June 28, 1938. A. C. DAMAN 2,122,028

ORE TREATING SYSTEM

Filed May 15, 1934 2 Sheets-Sheet 1

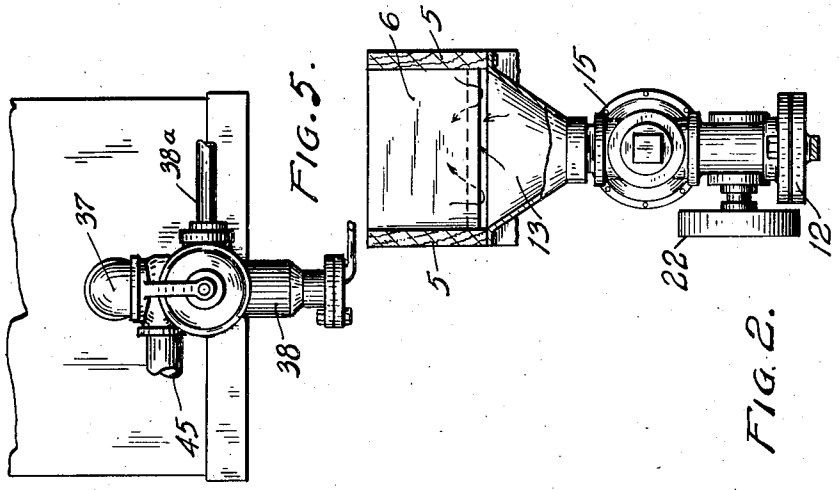


FIG. 5.

FIG. 2.

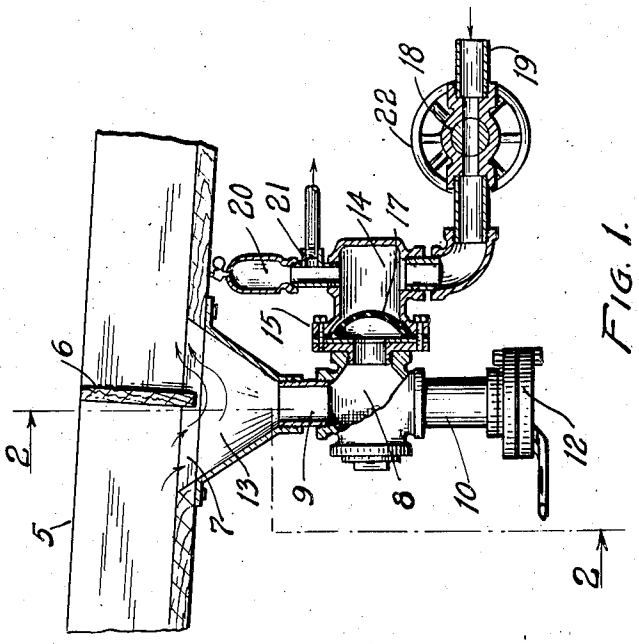


FIG. 1.

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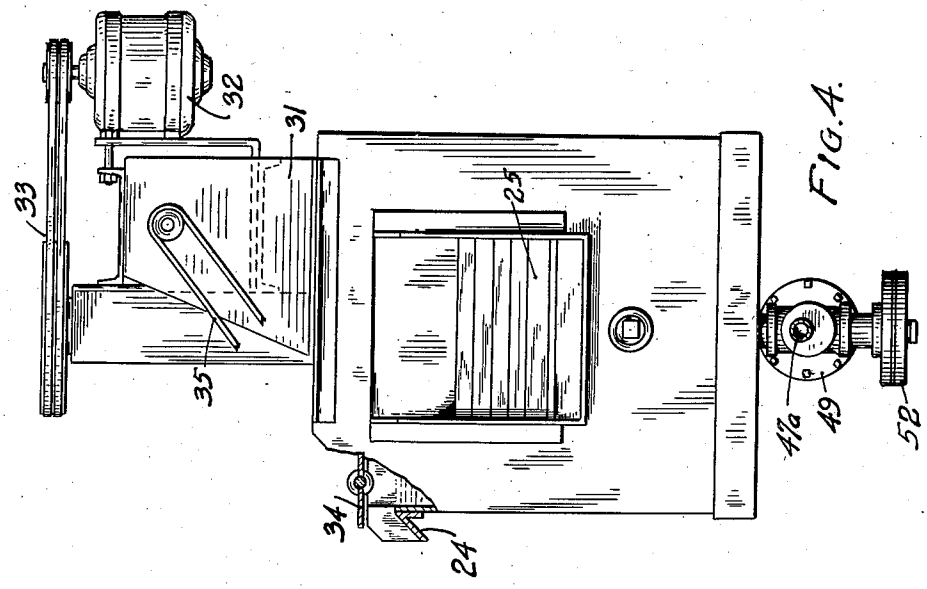


FIG. 4.

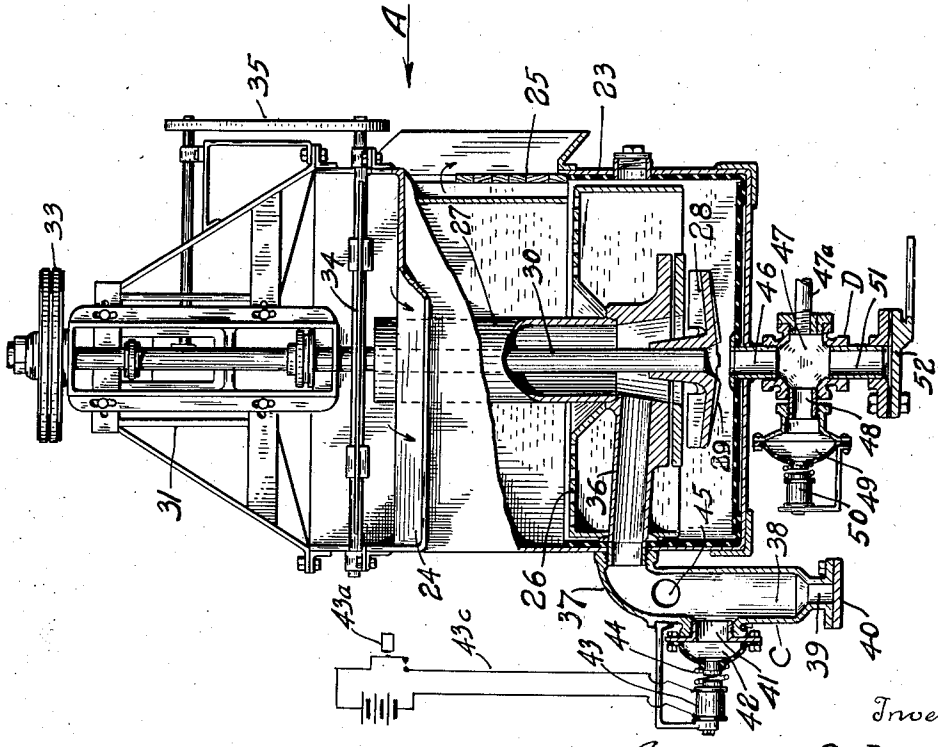


FIG. 3.

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UNITED STATES PATENT OFFICE

2,122,028

ORE TREATING SYSTEM

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Application May 15, 1934, Serial No. 725,746

17 Claims. (Cl. 209—18)

This invention relates to separators particularly adapted for the treatment of ores. It is an object of the invention to provide in cooperative association with ore-treating apparatus, one or more units operating for the separation of particles of difference sizes or weights in liquid suspension under the influence of a pulsating or jigging motion.

A further object resides in the provision of a separator of the above described character, per se, in which simplicity of construction is combined with practicability and efficiency in use, and another object is to be found in the association of one or more of the separators with an ore-treating machine of the so-called flotation type, for the preliminary separation of the material under treatment.

Still other objects reside in details of construction and in novel and advantageous combinations of parts, as will fully appear in the course of the following description.

In the accompanying drawings, in which like reference characters designate corresponding parts throughout the views,

Figure 1 is a sectional elevation of a separator according to the present invention, shown in association with a launder or sluice box of a type commonly employed in the treatment of ores,

Figure 2 is a section taken on the line 2—2 of Figure 1,

Figure 3 is a sectional elevation of a flotation unit, embodying two separating units according to the invention,

Figure 4 is a partially sectional elevation looking in the direction of the arrow A in Figure 3, and

Figure 5 is an enlarged elevation of one of the separating units of Figure 3, looking in the direction of the arrow B.

While the arrangement of the parts included in the separator is variable in accordance with the nature of the material to be treated or according to the construction of apparatus to which the separator is applied, it will be evident that the principle of operation of the invention is the same in each instance, and that the several forms of the separator, shown in the drawings and hereinafter to be described, merely involve different arrangements of parts, all within the scope and spirit of the invention.

It is further to be observed that while the invention resides primarily in the construction of the separator per se, the patentable novelty is to be found in its cooperative association with a flotation unit, as illustrated in Figures 3 and 4.

Referring first to Figures 1 and 2 of the drawings, the separating device has been shown in connection with an outlet of a launder 5.

A deflecting baffle 6 placed transversely to the flow of matter through the launder compels the material to pass through a narrow passage immediately above the outlet 7, thereby assisting in the separative action of the device.

The separator as shown comprises a chamber 8 having an inlet 9 in connection with the outlet of the launder, and having beneath the same a sump 10 to receive the heavier particles of the material segregated according to their varying degrees of specific gravity. The sump, which may be of any suitable depth, is provided with a rotary valve 12 for the discharge of accumulated solids into a conveniently located receptacle.

The connection between the outlet of the launder and the inlet of the chamber may be established through the medium of a conduit 13, partly of funnel shape to facilitate the settling action.

An air or water pressure chamber 14 is provided by a housing 15 which is bolted or otherwise fastened at a side of the chamber 8. An opening 16 between the two chambers is covered by a flexible diaphragm 17 capable of pulsation under alternately varying fluid pressures in the chamber 14.

In the construction shown in Figures 1 and 2, the means employed to subject the diaphragm to alternating pressure and suction impulses comprises a valve 18 in a conduit 19 which connects the chamber 14 with a source of fluid pressure. The fluid used for the purpose may be liquid or aeriform, and the source may be of any suitable character and located at any suitable distance from the device.

At the top of the pressure chamber 14 is an air-compression dome 20 having an overflow or relief port 21.

The valve 18 is preferably of the rotary type, and it may be connected by means of a pulley 22 with a motor or other driving agent to alternately open and close the conduit 19 in a continuous rotating motion.

In the operation of the hydraulic ram, thus constructed, fluid from the source with which the conduit 19 is connected is admitted to the pressure chamber 14 during intermittent periods.

The fluid rising in the dome 20 compresses a body of air in the upper portion thereof, which upon being released imparts an impulse to the flexible diaphragm. When the pressure is released, the diaphragm returns automatically to its original condition, in consequence of which, a pulsating or pumping action is produced which

imparts a jigging movement to the material fed into the separating chamber 8 through the outlet of the launder. As a result of this jigging treatment of the material, the particles thereof are separated according to their different specific gravities, the heavier particles settling in the sump 10 from which they are removed at suitable intervals by opening the valve 12.

In Figures 3 and 4 of the drawings two separating units have been shown at C and D, as applied to a machine for the separation of values from metaliferous ores by the well-known flotation process.

The flotation machine, as shown, comprises a tank 23 having an overflow provided by an apron 24. An adjustable weir 25 provides an outlet for tailings. A horizontal perforated partition 26 divides the interior of the tank to provide above the same a zone of comparative quietude. A vertical pipe 27 extending through the partition admits atmospheric air to the compartment of the tank beneath the partition, and a rotating agitator 28 in the lower portion of the tank beneath the outlet of the pipe 27 functions in the operation to throughly intermix the material under treatment with the air and with a flotation agent added thereto. The agitator may have radial vanes 29 at its under side to aid in imparting a jigging or pulsating movement to the material, and it is mounted at the lower end of a vertical shaft 30, which is suspended for rotation in bearings of a superstructure 31 supported on the tank. A motor 32 fastened on the superstructure has a driving connection with the shaft, through the medium of a multiple belt 33.

A rotary skimmer 34 aids in moving froth and other supernatant matter across the overflow, there being a suitable driving connection, such as shown at 35, between the motor 32 or the rotary shaft 30 and the skimmer.

The material to be separated is fed to the lower compartment of the tank beneath the perforated partition, by a pipe 36, through the intermediary on the primary separating unit which is connected at the end of the pipe through an elbow 37.

The unit, like that hereinbefore described with reference to Figure 1, comprises a separating chamber 38 above a sump 39 which receives the settling heavier constituents of the material and which has a valve 40 for the intermittent discharge thereof.

The chamber has a side opening 41 covered as before by a flexible diaphragm 42, but in this instance the pulsating movement is imparted to the diaphragm through the medium of an electromagnet 43, aided by a spring 44. The electromagnet may be intermittently energized by a make-and-break device 43a in its circuit 43c, and the spring aids in returning the diaphragm to its original position. It is to be understood without further illustration that the make-and-break device may be of any suitable design and that it may be operated by connection with the motor of the flotation machine or with any other source of energy.

The material is fed into the separating unit by a pipe 45 connected with a conveniently located source of supply. A second pipe 38a, shown in Figure 5, connects with the chamber 38 for the supply of additional water either for dilution or for added hydraulic effect.

The second separating unit is connected with the lower compartment of the flotation machine by a short nipple 46.

Like the other units hereinbefore described, it has a separating chamber 47 provided with an opening 48 covered by a flexible diaphragm 49. An electromagnet 50 imparts a pulsating movement to the diaphragm as in the primary separating unit. A sump 51 at the lower end of the separating chamber receives settling matter, and a valve 52 provides for the intermittent discharge of the contents of the sump. A pipe 47a in unit D performs the same function as that shown at 38a in connection with the unit C.

In the operation of the flotation machine, the material fed into the primary separating unit C is subjected to a preliminary separation of its heavier particles from the fines by a jigging action produced by the pulsating movement of the diaphragm.

Thus the flotation machine is relieved from treating a considerable percentage of the worthless constituents of the ore. However, after the material has entered the tank of the flotation machine from the primary separating unit, it is again subjected to a jigging action by the second separating unit D, aided by the rotating agitator, and this action removes still more worthless matter from the material, so that the material finally intermixed with the air and the flotation agent or agents in the lower portion of the tank is practically free from settling matter and may freely rise through the perforations of the partition to the liquid level whence it is discharged across the overflow. Tailings in this material are discharged from the machine at a determinate elevation across the weir 25.

What I claim and desire to secure by Letters Patent is:

1. In ore-treating apparatus for froth flotation, comprising a flotation tank having a pulp inlet near its bottom, and a froth overflow near its top, a separator located beneath the flotation tank and connected at its top therewith, said separator having means for subjecting the contents thereof to a jigging action, and means for producing an upward flow of liquid from the separator into the bottom of the flotation tank.

2. In a froth flotation machine comprising a tank having a froth overflow, a pulp overflow, an impeller located near the bottom thereof, and a feed conduit terminating above the impeller, a separator connected with the tank and comprising a substantially vertical hollow member having its upper end connected with the tank below the impeller and its lower end closed to form a sump, the wall of the hollow member having an opening, a diaphragm closing the opening, means for vibrating the diaphragm, and means for feeding liquid to the interior of the hollow member between the diaphragm and the top thereof.

3. Flotation apparatus comprising a tank, a rotary impeller in the lower portion of the tank, a chamber beneath the tank in communication therewith thru an opening in its bottom, for the reception of unfloated material moved into the same by the action of the impeller, an element acting on material in the chamber and being capable of pulsating movement, and means for imparting a pulsating movement to the element.

4. Flotation apparatus comprising a tank, a rotary impeller in the lower portion of the tank, a chamber beneath the tank in communication therewith thru an opening in its bottom, for the reception of unfloated material moved into the same by the action of the impeller, an element acting on material in the chamber and being capable of pulsating movement, means for im-

parting a pulsating movement to the element, and means for admitting a pressure fluid to said chamber.

5. Flotation apparatus comprising a tank, a rotary impeller in the lower portion of the tank, vanes on the under surface of the impeller for acting on unfloated material on the bottom of the tank, a chamber beneath the tank in communication therewith thru an opening in its bottom, for the reception of unfloated material moved into the same by the action of the impeller, an element acting on material in the chamber and being capable of pulsating movement, and means for imparting a pulsating movement to the element.

6. Flotation apparatus comprising a tank, a rotary impeller in the lower portion of the tank, a chamber beneath the tank in communication therewith thru an opening in its bottom, for the reception of unfloated material moved into the same by the action of the impeller, an element acting on material in the chamber and being capable of pulsating movement, means for imparting a pulsating movement to the element, and a valve-controlled outlet for the removal of settled material from the chamber.

7. Flotation apparatus comprising a tank, a rotary impeller in the lower portion of the tank, a chamber directly beneath the impeller and in communication with the tank thru an opening in its bottom, for the reception of unfloated material moved into the same by the action of the impeller, an element acting on material in the chamber and being capable of pulsating movement, and means for imparting a pulsating movement to the element.

8. Flotation apparatus comprising a tank having a feed inlet and a discharge outlet determining a liquid level in the tank, a chamber in communication with the feed inlet for the reception of a portion of the material entering the same, an element acting on material in the chamber and being capable of pulsating movement, means for imparting a pulsating movement to the element, a rotary impeller in the tank for acting on the entering feed, a second chamber beneath the tank and in communication therewith thru an opening in its bottom, an element acting on material in the last-mentioned chamber and being capable of pulsating movement, and means for imparting a pulsating movement to the latter element.

9. In ore-treating apparatus, a separator comprising a separating chamber having an inlet and a sump for settling matter therebelow, and mechanism to impart a jigging movement to material in the chamber, including a flexible diaphragm and means for imparting a pulsating motion to the diaphragm, including a pressure chamber having an intake for a pressure fluid, a valve to alternately open and close the intake, and an air pressure dome connected with the pressure chamber and having an outlet for pressure relief, the diaphragm sealing the separating chamber against the admission of fluids from the pressure chamber.

10. In ore-treating apparatus, a separator comprising a separating chamber having an inlet and a sump for settling matter therebelow, and mechanism to impart a jigging movement to material in the chamber, including a hydraulic ram, a flexible diaphragm cooperative therewith and sealing the separating chamber against the admission of fluids from the ram, and means, inclusive of the ram, for imparting a pulsating motion to the diaphragm.

11. Flotation apparatus comprising a tank having an inlet and an outlet, an impeller acting on material entering the tank through its inlet to promote separation of upwardly and downwardly moving solids, a device for subjecting the entering material to a pulsating action whereby to effect an initial separation of said solids, and a device for subjecting downwardly moving solids passing through the outlet to a pulsating action whereby to effect a final separation of said solids, each of said devices including a space to receive downwardly moving or settling solids.

12. Flotation apparatus comprising a tank having an inlet and an outlet, an impeller acting on material entering the tank through its inlet to promote separation of upwardly and downwardly moving solids, a device for subjecting material in the inlet to a pulsating action whereby to effect an initial separation of said solids, and a device for subjecting downwardly moving solids passing through the outlet to a pulsating action, whereby to effect a final separation of said solids, each of said devices including a space to receive downwardly moving or settling solids.

13. The combination with a flotation tank having a froth-collecting liquid level for the recovery of upwardly moving solids and having a discharge outlet and a feed intake, an impeller acting upon the material entering said tank through said intake to promote separation of upwardly and downwardly moving solids, of a device in said intake for subjecting material entering the tank through the intake to a pulsating action to subject the same to an initial separation of such solids and having a space to receive solids moving downwardly in said action.

14. The combination with a flotation tank having a froth collecting liquid level for the recovery of upwardly-moving solids and having a discharge outlet and a feed intake, an impeller acting upon the material entering said tank through said intake to promote separation of upwardly and downwardly moving solids, an overflow weir for fine pulp, of a device in said discharge outlet for subjecting downwardly-moving solids passing through the outlet to a pulsating action to subject the same to a final separation of such solids and having a space to receive solids moving downwardly in said action.

15. In the combination as described in claim 13 in which said device comprises a separator comprising a separating chamber having an inlet and a sump for settling matter, and an element to impart a jigging movement to material in the chamber, including a flexible diaphragm, and means for imparting a pulsating motion to the diaphragm, including a circuit, an electromagnet in the circuit having its armature disposed in operative relation to the diaphragm for flexing it in one direction, resilient means for flexing the diaphragm in the opposite direction, and a make-and-break appliance in the circuit.

16. The combination with apparatus for the treatment of an ore pulp, inclusive of means for subjecting the pulp to an upwardly impelling action, of a device for subjecting pulp, passing to the apparatus for treatment, to a pulsating action productive of a dispresing movement of collected solids of the pulp, and a conveying element disposed to receive the solids so dispersed and to deliver the same directly to the upwardly impelling means.

17. The combination with apparatus for the treatment of an ore pulp, inclusive of means for subjecting the pulp to an upwardly impelling

action, of a device for subjecting pulp, passing to the apparatus for treatment, to a pulsating action productive of a dispersing movement of collected solids of the pulp, a conveying element disposed to receive the solids so dispersed and to deliver the same directly to the upwardly impelling means, and a device disposed to receive solids of the pulp not elevated by the upwardly impelling means and to subject such solids to a pulsating action productive of a dispersing movement whereby to return a portion of the solids to be acted on by said upwardly impelling means.

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