June 2, 1931. L. E. BOOTH 1,807,823

FLOTATION

Filed Nov. 24, 1926

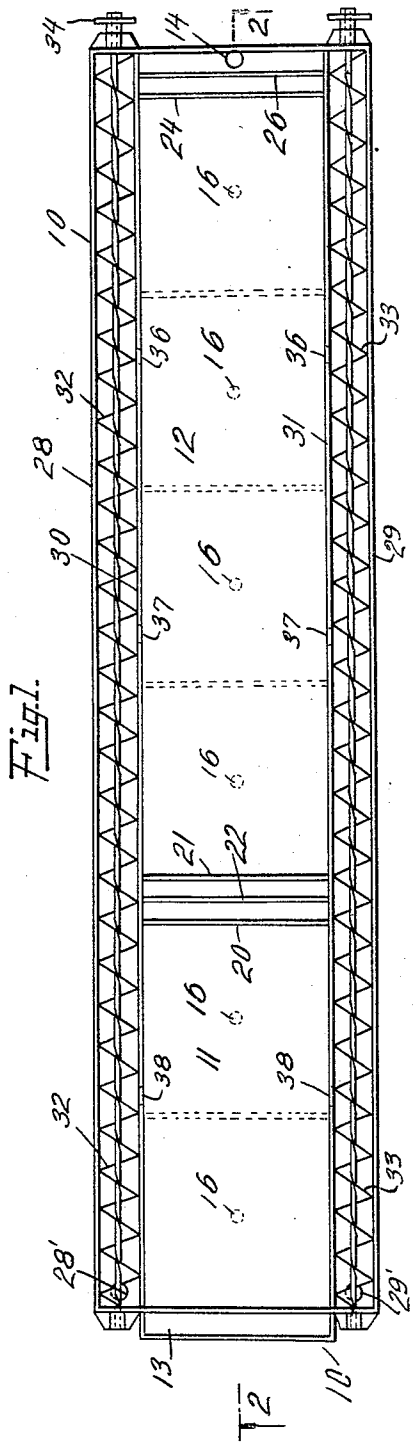


Fig. 1.

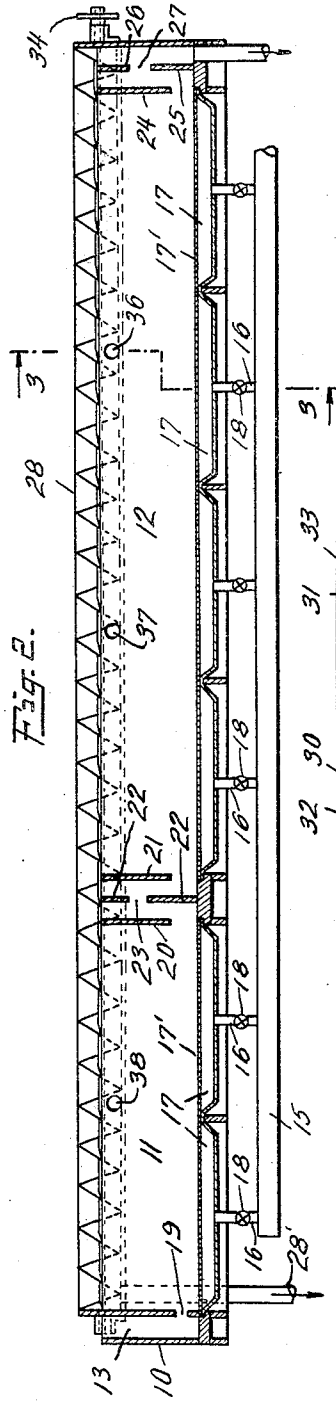


Fig. 2.

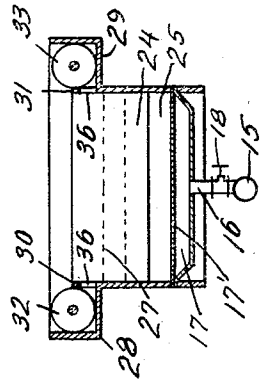


Fig. 3.

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UNITED STATES PATENT OFFICE

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FLOTATION

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This invention relates to flotation, and has for its object the provision of an improved method and apparatus for the concentration of ores by the froth flotation process.

There are at present three main methods of handling rougher, or middling, flotation froth for re-treatment or cleansing (i. e., separating the gangue from the metallic particles). According to the (1) first method, the rougher or middling froth from the primary machine, together with the wash water used to sluice the launders, flows by gravity to a second froth flotation machine for re-treatment. In this practice the re-treatment machine is placed at a lower level than the primary froth flotation machine, and, consequently, necessitates the return of the re-treatment machine tailing back to the primary machine. This is accomplished by means of a pump or elevator. According to the (2) second method, the rougher or middling froth from the primary machine flows by gravity to a pump or elevator which elevates the material to a froth flotation re-treatment machine set at a higher level than the primary flotation machine. In this case the re-treatment tailing flows by gravity to the primary machine for further treatment. According to the (3) third method, a portion of the froth from the primary machine is removed as a finished concentrate, while the balance of the froth flows by gravity to a pump or elevator which lifts the material back to the primary machine.

It is thus seen that in froth flotation processes as at present practiced, a means for lifting or elevating the rougher or middling froth, together with its accompanying wash water, must always be provided. This requires the use of pumps, pipes, power, etc. Two or more separate flotation machines, usually at different levels, are required. All this additional equipment and its maintenance contribute heavily to the cost of the operation. Moreover, it is to be observed that the unavoidable use of excess water to wash the froth from the launders unduly dilutes the body of pulp in the cleaner cell. This makes the ultimate recovery of rich mineral-bearing froth all the more difficult. In other words, the presence of the excess wash water reduces the efficiency of the operation. As a partial recompense for this loss an excess of flotation reagent must be added to the pulp in the attempt to get a richer froth. According to these methods the rougher or middling froth gets but one cleaning. This is frequently not sufficient to completely separate the entrained gangue from the flotable metallic particles. The so called concentrate froth from the cleaner cell, in fact, gets no additional cleansing whatever. Consequently, whatever gangue is initially entrained in the froth is carried away with the mineral ore concentrates. From the viewpoint of efficiency and cost of operation, it is seen that the present practices leave much to be desired.

According to my invention a method and apparatus are provided for concentrating minerals by flotation whereby a substantial part of the mineral-bearing froth is repeatedly taken from and returned to the main body of pulp undergoing flotation.

Unlike the present practices above outlined, I avoid the use of an excess of wash water. The mineral-bearing froth is alone taken from and returned to the main body of pulp for the cleansing operation. This is accomplished by keeping the cleaner and rougher cells, which preferably form one piece of apparatus, on the same level. The newly formed mineral froth overflows the lips of the cells into adjacently located launders, only to be conveyed a short distance along the lips of the cells, and then promptly returned to the main body of pulp for cleansing. In the practice of my invention the cleaner and rougher cells are placed on the same level. No pumps are employed, and the use of an excess of wash water in the launders is dispensed with. Moreover, the rougher (or, middling) and/or concentrate froths may repeatedly be subjected to a cleansing operation whereby the gangue particles may be effectively separated from the metallic particles. A rich and clean mineral-bearing froth is thus obtained at a maximum of efficiency and a minimum of cost.

My invention will be better understood by

reference to the accompanying drawings, taken in conjunction with the following description, in which:

Fig. 1 is a plan of a pneumatic flotation machine adapted to practice the invention;

Fig. 2 is an elevational section on the line 2—2 of Fig. 1; and

Fig. 3 is an elevational section on the line 3—3 of Fig. 2.

The flotation machine 10 is divided into two main cells 11 and 12, adapted to receive fresh pulp at the feed inlet 13 at one end thereof, and to expel the tailings through the outlet 14 at the other end thereof. An air supply pipe 15, located below the flotation machine, runs almost the full length of the apparatus. A series of individual feeders 16 connect with the main supply pipe 15 and the air chambers 17 in the bottom of the flotation machine. These connections are equipped with valves 18 to control the amount of air flowed into the air chambers.

The air chambers 17 are covered with a porous medium 17′, such as a specially prepared porous cloth or perforated rubber fabric and the like, adapted to cause relatively fine streamlets of air to enter into the main body of pulp within the cells 11 and 12.

The pulp feed inlet 13 has an orifice 19 located near the bottom of the cell so that the flow of pulp may be toward the bottom thereof. Cells 11 and 12 are separated by the walls 20 and 21 depending from the top of the flotation machine to not quite the bottom thereof. A division wall 22 extends from the bottom of the cell, between the walls 20 and 21, toward the top of the flotation machine, and forms with the division wall 22, extending downwardly from the top of the flotation machine, an orifice 23 adapted to convey pulp and tailings from cell 11 to cell 12.

The tailings end of the machine is similarly equipped to conduct tailings from the cell 12 to the outlet 14. A division wall 24 depends from the top of the machine to not quite the bottom of the same. A division wall 25 extends from the bottom of the machine upwardly toward the top, and forms with the wall 26, extending from the top of the machine downwardly, an orifice 27 between the division wall 24 and the end of the machine, and a conduit for the escape of tailings from the outlet 14.

Launders 28 and 29 extend throughout substantially the entire length of the machine, and are located just below the overflow lips 30 and 31 of the cells 11 and 12. These launders are equipped with screw conveyors 32 and 33 turned by the wheels 34 and 35 which are operated by a motor (not shown). Lips 30 and 31 are provided with a plurality of holes 36, 37 and 38, etc., adapted to transfer froth and any entrained pulp from the launders 28 and 29 back into the cells 12 and 11. Froth outlets 28′ and 29′ are located in the launders 28 and 29 near the feed end of the machine for the removal of concentrates.

The operation of the above described apparatus is as follows:

Fresh mineral-bearing pulp, containing appropriate amounts of flotation reagent, is fed into the inlet 13, when it passes through the orifice 19 toward the bottom of the cell 11. A sufficient amount of pulp is thus fed into the machine until cells 11 and 12 have been filled to their normal operating capacity.

Compressed air is then permitted to flow from the main supply pipe 15 through the feeders 16 into the air chambers 17. The air escapes from the chambers 17 through the porous or perforated medium 17′ so as to form innumerable small streamlets of air that escape into the main body of pulp undergoing the flotation process. Mineral-bearing froth is formed and gathers on the top surface of the main body of pulp until it reaches such a depth and height that the excess flows over the lips 30 and 31 into the launders 28 and 29.

During this time the screw conveyors 32 and 33 are kept in motion, so that the froth overflowing the launder lips beyond the openings 36 is conveyed to those openings and re-enters the cell 12, where it mingles with the pulp undergoing the flotation process for the initial cleansing operation.

Froth overflowing into the launders between the openings 36 and 37 is conveyed toward the openings 37, and there re-enters the cell 12 for a second cleansing operation. The entrained gangue is further separated from the concentrates.

Froth overflowing the launder lips between the openings 37 and 38 in the cells 11 and 12 is conveyed to the openings 38, where the froth enters the cell 11 for a third cleansing operation.

The froth overflowing the launder lips between the openings 38 and the feed end of the machine is conveyed through the launders to outlets 28′ and 29′. This froth is very rich in metallic concentrates.

The gangue materials collecting near the bottom of the cell 11 are gradually transported toward the orifice 23, between the division walls 20 and 21, where it enters the cell 12 to undergo further reaction in the flotation process. As the more valuable metallic parts from the gangue are lifted into the froth, the tailings gradually find their way toward the other end of the machine and are ultimately passed through the orifice 27, beyond the division wall 24, into the tailings outlet pipe 14.

According to the practice of my invention above outlined, it is seen that mineral-bearing froth can be repeatedly, simply, and economically cleansed in such manner as to obtain a final froth of high metallic content, and uncontaminated with an excess of wash water or pulp. This invention lends itself very read-

ily to the concentration of ores by froth flotation processes of any sort—pneumatic, agitation and the like.

I claim:

1. Flotation apparatus comprising a pulp chamber having a side wall provided with a plurality of openings therein adjacent the top thereof, a concentrate launder communicating with the interior of said chamber through the openings in the side wall, and concentrate conveying means associated with said launder.

2. Flotation apparatus comprising a pulp chamber having a side wall provided with a plurality of openings therein adjacent the top thereof, a concentrate launder communicating with the interior of said chamber through the openings in the side wall, and a screw conveyor positioned within said launder.

3. Flotation apparatus comprising a plurality of cells mounted at substantially a common level for receiving a body of pulp to be treated, a concentrate launder associated with said cells, one or more passages providing means of communication between said launder and one or more of said cells, and concentrate conveying means positioned within said launder.

4. Flotation apparatus comprising a plurality of cells mounted at substantially a common level for receiving a body of pulp to be treated, a concentrate launder associated with said cells, one or more passages providing means of communication between said launder and one or more of said cells, and a screw conveyor positioned within said launder.

5. Flotation apparatus comprising a cleaner cell and a rougher cell mounted at substantially the same level as the cleaner cell, a launder disposed adjacent said cells and adapted to receive concentrates produced by said rougher cell, a passage providing means of communication between said cleaner cell and said launder, and means associated with said launder for moving concentrates contained therein toward said passage.

6. Fotation apparatus comprising a cleaner cell and a rougher cell mounted at substantially the same level as the cleaner cell, a launder disposed adjacent said cells and adapted to receive concentrates produced by said rougher cell, a passage providing means of communication between said cleaner cell and said launder, and a screw conveyor for moving concentrates contained in said launder toward said passage.

7. Flotation apparatus comprising a plurality of cells mounted at substantially a common level for receiving pulp to be treated and each provided with an overflow lip over which froth is discharged, a launder associated with said cells for receiving froth overflowing said cells, one or more passages providing means of communication between said launder and one or more of said cells, and froth-conveying means positioned within said launder.

8. Flotation apparatus comprising a plurality of cells mounted at substantially a common level for receiving pulp to be treated and each provided with an overflow lip over which froth is discharged, a launder associated with said cells for receiving froth overflowing said cells, one or more passages providing means of communication between said launder and one or more of said cells, and a screw conveyer positioned within said launder.

9. Flotation apparatus comprising a cleaner cell and a rougher call mounted at substantially the same level as the cleaner cell, each provided with an overflow lip over which froth is discharged, a launder disposed adjacent said cells and adapted to receive froth overflowing said rougher cell, a passage providing means of communication between said cleaner cell and said launder, and means associated with said launder for moving froth contained therein toward said passage.

10. Flotation apparatus comprising a cleaner cell and a rougher cell mounted at substantially the same level as the cleaner cell, each provided with an overflow lip over which froth is discharged, a launder disposed adjacent said cells and adapted to receive froth overflowing said rougher cell, a passage providing means of communication between said cleaner cell and said launder, and a screw conveyer for moving froth contained in said launder toward said passage.

In testimony whereof I affix my signature.

LIONEL EARL BOOTH.