J. B. BROWN.

ORE FLOTATION APPARATUS.

APPLICATION FILED SEPT. 4, 1917.

1,351,155. **Patented Aug. 31, 1920.**

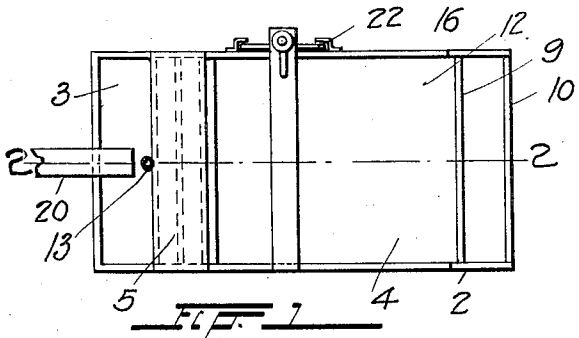


FIG. 1

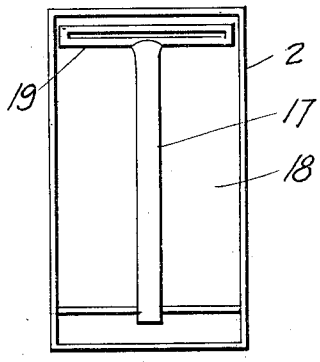


FIG. 4

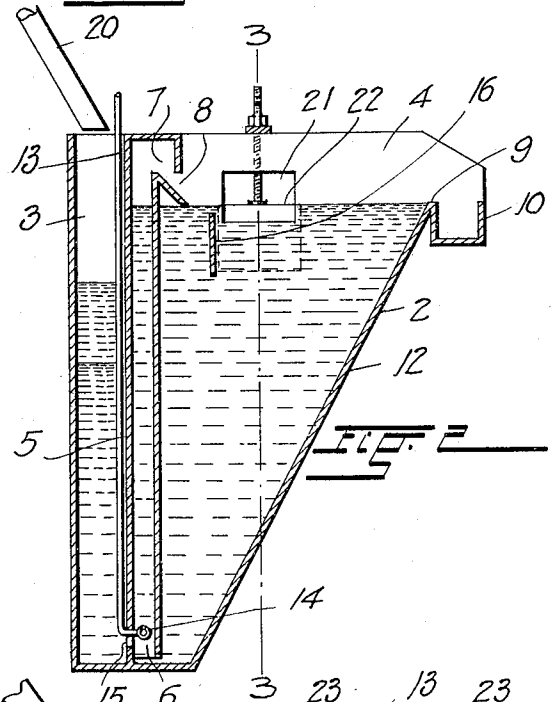


FIG. 2

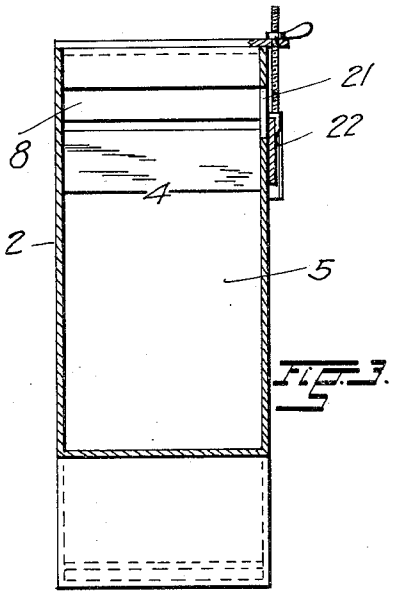


FIG. 3

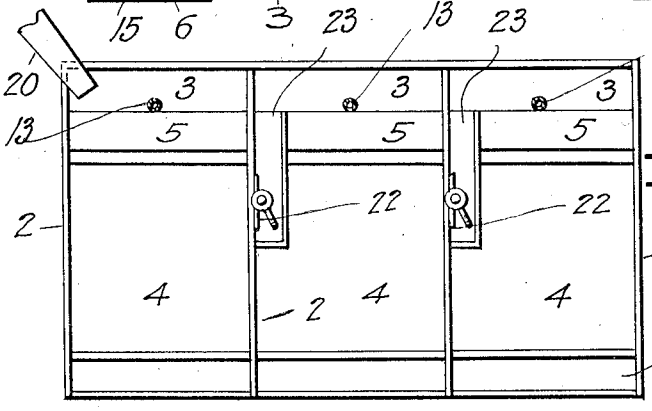


FIG. 5

INVENTOR
J. B. BROWN

BY

ATTORNEY

UNITED STATES PATENT OFFICE.

JAMES B. BROWN, OF DENVER, COLORADO.

ORE-FLOTATION APPARATUS.

1,351,155. Specification of Letters Patent. Patented Aug. 31, 1920.

Application filed September 4, 1917. Serial No. 189,568.

To all whom it may concern:

Be it known that I, JAMES B. BROWN, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Ore-Flotation Apparatus, of which the following is a specification.

My invention relates to new and useful improvements in apparatus for recovering valuable minerals by flotation, and more particularly in apparatus in which the agitation, aeration and emulsification of the ore-pulp with the oil or other selective agent, is effected by what is commonly known as an air-lift ordinarily composed of an upright transfer conduit through which the pulp is forced upwardly by the action of a jet of air under pressure.

It is the primary object of the present invention to provide certain improvements which increase the efficiency of an apparatus of the character mentioned, in the matter of capacity as well as of cleanness of separation and which by the simplicity of their construction reduce the cost of production, installation and operation.

With the above object in view, my improved flotation apparatus comprises a feed-chamber and a frothing chamber preferably produced by dividing a tank or cell into two adjoining compartments one of which has an overflow for supernatant matter.

An air-lift of suitable construction has its ingress opening in communication with both these chambers, while its egress opening is disposed to deliver the raised material into the frothing chamber.

A distinctive feature of the invention resides in constructing the air-lift so that the material raised thereby is spread in substantially sheet-like form across practically the entire width of the frothing chamber and directed toward the overflow of the same, for the purpose of increasing the capacity of the machine, facilitating and expediting the separative action of the same and obtaining the advantage of surface tension by which free sulfids are maintained in a floating condition upon the liquid surface.

The above and several other features of my invention, all of which will fully appear in the course of the following description, have been shown in their preferred form in the accompanying drawings in the various views of which like parts are similarly designated and in which—

Figure 1 is a plan view of a flotation cell in which my invention is embodied,

Fig. 2, a vertical section along the line 2—2, Fig. 1,

Fig. 3, a section taken along the line 3—3, Fig. 2,

Fig. 4, a section similar to Fig. 3, showing a modification in the construction of the air-lift, and

Fig. 5, a plan view of a series of cells which are coöperatively associated to subject the ore-pulp to repeated treatments for the complete separation of the valuable minerals contained therein, from the gangue.

Referring first to Figs. 1, 2 and 3 of the drawings, my improved apparatus comprises a tank 2 of rectangular section which is divided into a feed-compartment 3 and a frothing compartment 4 by a partition which in the preferred form of the invention consists of a narrow flue 5 of oblong section which extends across the entire width thereof.

This flue which in the operation of the invention constitutes the transfer conduit of an air-lift, has its open lower end disposed in spaced relation to the bottom surface of the tank to provide an opening 6 for the ingress of material from both the chambers produced by the division of the tank.

The flue has adjacent its upper end an egress-opening 7 which extends across its entire width and discharges onto a slanting apron 8 which delivers the raised material in close proximity to the surface of the liquid contained in the frothing compartment.

The tank has along the edge of its frothing compartment, which faces the outlet of the air-lift, an overflow 9 for supernatant froth in connection with an exteriorly disposed launder 10, and the corresponding side 12 of the tank slopes from the overflow toward the lower end of the flue to direct subsiding matter to the ingress-opening of the same.

A pipe 13 extending alongside the flue connects with a convenient source of air under pressure and introduces the air into the lower end of the flue through a perforated cross-pipe 14.

A cleat 15 on the bottom of the tank provides a baffle which opposes a direct flow

of material between the compartments underneath the flue, and a baffle-plate 16 extending across the tank at a point between the air-lift and the overflow, serves to bring the material discharged through the outlet of the flue to a comparative condition of rest.

In the construction shown in Fig. 4 of the drawings, the air-lift is composed of an upright pipe 17 fitted in a gap of a solid partition 18 and connected at its upper end with a longitudinally slotted transverse pipe 19 which spreads the material over the liquid contents of the frothing compartment in the same manner as that in which in the preferred form of the invention, it is delivered through the outlet of the flue.

In the operation of the invention, ore-pulp together with a percentage of oil or other selective agent is fed into the feed-compartment of the tank by means of a launder 20.

The air forcibly injected into the lower end of the transfer conduit of the air-lift through the perforated cross-pipe 14, draws the contents of the feed-compartment into and through the conduit in which it is thoroughly agitated and aerated and from which it is discharged in the form of a froth through the outlet 7.

The extent of the outlet across the entire width of the tank and its position with relation to the overflow causes the material delivered from the air lift to spread evenly over the surface of the liquid in the frothing chamber and to move in a straight course toward the overflow across which the supernatant froth and sulfid particles pass into the launder 10.

The baffle 16 brings the material to a comparative state of quiet, and the gangue and sulfid particles which were not entrapped in the froth or remained in a floating condition on the surface of the liquid, subside in the frothing chamber and are by the sloping side thereof directed toward the ingress-opening of the air-lift.

The compressed air constantly introduced into the flue draws the subsiding matter from the frothing chamber to the egress opening of the same, and the material being thus maintained in circulation, is repeatedly treated until all or nearly all of its sulfid particles have been entrapped in the froth and discharged across the overflow into the launder.

The cleat 15 placed across the bottom of the tank beneath the ingress-opening of the flue, prevents a direct passage of material between the two compartments and aids in directing the contents thereof in separate currents into the air-lift.

The advantages derived in the operation of a flotation apparatus constructed in accordance with my invention, will be readily apparent to those versed in the art to which the invention appertains.

The delivery of the material from the air-lift in sheet-like form across the entire width of the frothing chamber insures its uninterrupted and continuous movement in a straight course to the overflow and thereby promotes the clean separation of the subsiding matter from the values which remain in a floating condition upon the surface of the liquid.

The surface tension by which buoyant sulfid particles are retained upon the surface of the liquid, has in the operation of my invention its maximum efficiency by reason of the material being spread upon the liquid surface in a diffused condition and also owing to the fact that the free sulfid particles of the material which by reason of the extensive width of the conduit, are thoroughly impregnated with the air, are delivered in a substantially dry condition which enhances their tendency to float.

Another advantage of my invention resides in the automatic retreatment of the material subsiding in the froth chamber, and still another advantage is that the excess oil constituting the upper stratum of the material in the feed-chamber is prevented from entering the frothing chamber and disturbing the supernatant froth.

All of the distinctive features of my invention as herein explained and described, coöperate to promote and expedite the clean separation of the valuable minerals from the gangue in ore-pulp without the employment of mechanical agitating devices and other power driven mechanisms employed in many of the flotation apparatus at present in use.

The machine is automatic in its action and its capacity is limited only by the areal dimensions of the compartments into which the tank is divided.

In the construction shown in Fig. 5 of the drawings, a series of cells of the above-described construction are coöperatively associated to subject the ore-pulp to a succession of treatments for the complete recovery of its valuable mineral constituents.

Each cell in this form of my invention is provided with an outlet 21 for the discharge of material as shown, the flow through which is controlled by a vertically adjustable gate 22.

The outlet of each cell is by means of a launder 23 connected with the feed-compartment of the next adjoining cell and the material subsiding in the frothing compartments of the cells is thus repeatedly subjected to a separative action until practically all its valuable sulfid particles are recovered and separated from the gangue which is discharged from the last cell of the series.

The feed chamber in each form of the in-

vention has an outlet at the lower end communicating with the air lift conduit which also has a bottom opening communicating with the separating chamber and forming a passage of less area than the passage formed by the outlet of the feed chamber so that the air lift will deliver more pulp from the feed chamber than can pass through the bottom passage from the separating chamber. This will cause the level of the pulp in the feed chamber to be pulled down below the level of the material within the separating chamber as clearly illustrated in Fig. 2 of the drawing. As a result of this condition the units of the series of flotation apparatus such as shown in Fig. 5 of the drawing may be placed on one level thereby saving head room and simplifying the construction.

Other arrangements of cells made in accordance with my invention may be resorted to to adapt them for use in accordance with different circumstances, such as available floor space, head room, etc., and modifications in the construction and arrangement of the air-lift and the chambers, other than those herein mentioned, may be availed of within the spirit of my invention as set forth in the following claims:

1. In ore-flotation apparatus, a container divided into a feed chamber, a separating chamber provided with an overflow and a transfer-conduit which, adjacent its bottom, communicates with each of the chambers for the reception of material, and which has an outlet adapted to deliver material in sheet-like form onto the liquid level in the separating chamber, determined by the overflow, and means for introducing a gas into the lower part of the transfer-conduit.

2. In ore-flotation apparatus, a container divided into a feed-chamber, a separating chamber provided with an overflow and a transfer-conduit which, adjacent its bottom, communicates with each of the chambers for the reception of material, and which has an outlet adapted to deliver material onto the liquid-level in the separating chamber, determined by the overflow, a baffle disposed between the outlet of the transfer-conduit and the overflow and beneath the liquid-level, and means for introducing a gas into the lower part of the transfer-conduit.

3. In ore-flotation apparatus, a container divided into a feed-chamber, a separating chamber provided with an overflow, and a transfer-conduit which, adjacent its bottom, communicates with each of the chambers for the reception of material, and which has an outlet adapted to deliver material onto the liquid level in the separating chamber, determined by the overflow, the inner surface of the separating chamber opposite the transfer conduit, slanting toward the lower end thereof, and means for introducing a gas into the lower part of the transfer-conduit.

4. In ore-flotation apparatus, a container divided into a feed-chamber, a separating chamber provided with an overflow and with a regulatable outlet for material beneath the liquid-level determined by the overflow, and a transfer-conduit which, adjacent its bottom, communicates with each of the chambers for the reception of material, and which has an outlet adapted to deliver material onto the liquid level in the separating chamber, and means for introducing a gas into the lower part of the transfer-conduit.

5. In ore-flotation apparatus, a series of units each comprising a feed chamber, a separating chamber provided with an overflow and with a single outlet for settling matter, and an air-lift connected at its lower end with the first-mentioned chamber and with the outlet of the other chamber, and having at its upper end an outlet for the discharge of lifted material into the separating chamber, the separating chamber of each unit having below the level of its overflow, an outlet connecting with the feed-chamber of the next adjoining unit.

6. In ore flotation apparatus, a separating chamber having an overflow, an air transfer conduit having a top outlet for the discharge of material into the upper portion of the separating chamber and a bottom opening forming a passage connecting the air transfer conduit with the separating chamber, a feed chamber having a bottom outlet communicating with the air transfer conduit, and means for introducing a gas into the lower portion of the transfer conduit to form an air lift, the bottom opening of the air lift being of less area than the outlet of the feed chamber whereby the air lift is caused to maintain the level of the liquid within the feed chamber below the level of the liquid within the separating chamber.

7. In ore flotation apparatus, a separating chamber having an overflow, an air transfer conduit having a top outlet for the discharge of material into the upper portion of the separating chamber and provided also with a bottom opening forming a passage between the separating chamber and the transfer conduit, a feed chamber having a bottom outlet communicating with the air transfer conduit, and means for introducing a gas into the lower portion of the air transfer conduit to form an air lift, said bottom opening being of less area than the bottom outlet of the feed chamber for causing the air lift to maintain the level of the liquid within the feed chamber below the level of the liquid within the separating chamber and also produce a flow of the material from the lower portion of the separating chamber into the lower portion of the transfer conduit to cause a circula-

tion through the said bottom opening, whereby a continuous action on the material is effected.

8. In ore flotation apparatus, a separating chamber having an overflow, an air transfer conduit having a top outlet for the discharge of material into the upper portion of the separating chamber and provided also with a bottom opening forming a passage between the separating chamber and the transfer conduit, a feed chamber having a bottom outlet communicating with the air transfer conduit, and means for introducing a gas into the lower portion of the air transfer conduit to form an air lift, said bottom opening being of less area than the bottom outlet of the feed chamber for causing the air lift to maintain the level of the liquid within the feed chamber below the level of the liquid within the separating chamber and also produce a flow of the material from the lower portion of the separating chamber into the lower portion of the transfer conduit to cause a circulation through the said bottom opening, whereby a continuous action on the material is effected, and the said bottom opening being of less cross-sectional area than the cross-sectional area of the transfer conduit.

9. In ore flotation apparatus, a separating chamber, an air transfer conduit having a top outlet for the discharge of material into the upper portion of the separating chamber, the latter being provided at its lower portion with a passage for the flow of material from the separating chamber to the lower portion of the air transfer conduit and the flowing capacity of said passage being less than that of the said conduit, a feed chamber having a bottom outlet located at the lower portion of the air transfer conduit and forming a passage to the latter of greater flowing capacity than the passage of the separating chamber, and means for introducing a gas into the lower portion of the air transfer conduit to produce an air lift, the relative sizes of the said passages operating to maintain the level of the liquid within the feed chamber below the level of the liquid within the separating chamber.

In testimony whereof I have affixed my signature in presence of two witnesses.

JAMES B. BROWN.

Witnesses:
F. H. CUNO,
L. RHOADES.