J. HEBBARD.

APPARATUS FOR THE CONCENTRATION OF ORES.

APPLICATION FILED NOV. 20, 1917. RENEWED MAR. 26, 1921.

1,380,650. Patented June 7, 1921.

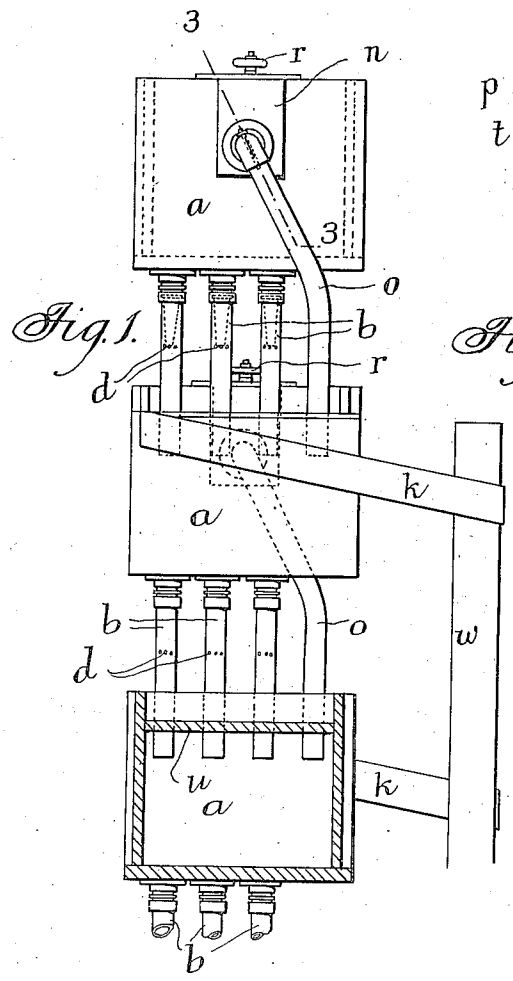


Fig. 1.

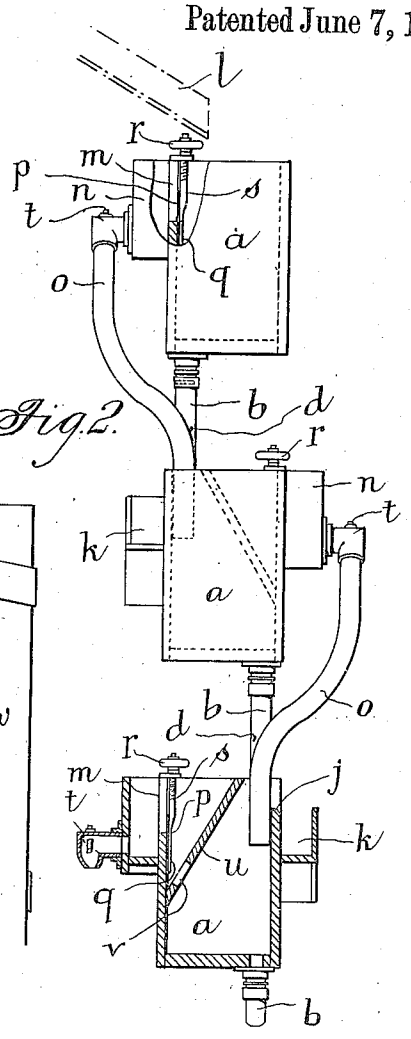


Fig. 2.

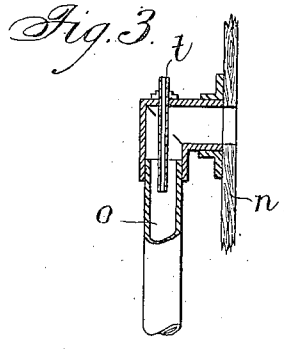


Fig. 3.

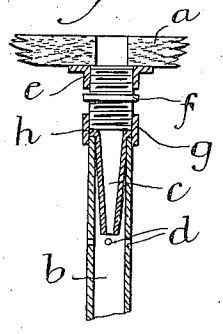


Fig. 4.

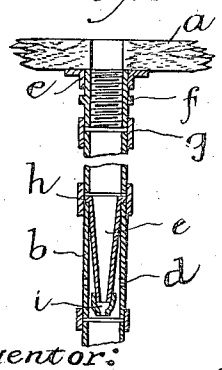


Fig. 5.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE CONCENTRATION OF ORES.

1,380,650. Specification of Letters Patent. Patented June 7, 1921.

Application filed November 20, 1917, Serial No. 203,024. Renewed March 26, 1921. Serial No. 455,980.

To all whom it may concern:

Be it known that I, JAMES HEBBARD, manager, a subject of the King of Great Britain, residing at Central Mine, Broken Hill, in the State of New South Wales, Commonwealth of Australia, have invented certain new and useful Improvements in Apparatus for the Concentration of Ores, of which the following is a specification.

This invention relates to improvements in apparatus for the concentration of sulfid ores by what is commonly known as flotation separation, in which the ores are subjected to aeration in an aqueous separating medium in the presence of a frothing agent, or in an emulsified aqueous medium, for the formation of a froth or scum of the metallic sulfids.

This invention is equally applicable to collective separation in which an indiscriminate float of sulfids is obtained, as well as to differential or preferential flotation in which a float concentrate of certain sulfids from other sulfids is obtained.

This invention is applicable to the treatment of ores, concentrates, tailings, slimes or other metallurgical products, and it will be understood that in this specification the term "ores" will include all such metallurgical products as well as the crude material.

The present invention is an improvement in or modification of the apparatus described in the British Patent No. 10666 of 1915, to Seale and Shellshear. In this prior patent the aeration of the pulp is effected by the flow of the material itself, by feeding or delivering the pulp through a tube or pipe which delivers into the separating vessel drawing in air therewith which is entrapped so that the aeration and emulsification of the mixture is effected by the flow of the material itself. In one modification of the apparatus described in the specification of the said prior patent the discharge pipe from one separating box to the next box in series is provided with a number of inlet holes for air so that the air is sucked in by the flow of the material itself.

In this aforesaid Patent Ser. No. 37350 an equalizing feed box is provided at the top of the series of separating vessels, and the flow is controlled and regulated by adjusting the size of the orifices in the outlet of each separating vessel by means of a removable hollow plug, additions of water or separating medium being made to each separating vessel to compensate for that removed with the float concentrates, whereby a constant level is maintained within the separating boxes. With this method of operation however an equalized and constant feed of pulp is necessary, and relatively continuous supervision is required.

An object of this invention is to provide means for controlling the flow of pulp through the apparatus and for maintaining a constant level within each separating vessel, independent of any variations which may take place in the original feed from time to time or the withdrawal of the float concentrates.

This is accomplished by providing means for maintaining a constant level within each separating vessel, comprising an overflow vent arranged at a lower level than the overflow for the concentrates, such overflow discharging into the next vessel or box in the series.

An apparatus of the class described, constructed according to this invention, comprises a series of separating vessels arranged one above the other, having a number of discharge pipes leading from the bottom of one vessel into the next separating vessel below it in series and delivering beneath the surface of the liquid therein, each of these said pipes having a series of holes or perforations therein in combination with an internal injector nozzle whereby the drawing in of the air through the said holes is assisted. Each of said boxes has an overflow lip at the top for the discharge of the float concentrates therefrom, a level-equalizing outlet or vent leading into an overflow compartment arranged on the side of the box below the level of the aforesaid discharge lip for the float concentrates, and a pipe leading from the said overflow compartment into the next separating vessel in series.

In order that the invention may be read-

ily understood reference will now be had to the accompanying sheets of explanatory drawings wherein—

Figure 1 is a view in elevation of an equalizing box and two superposed separating vessels forming part of a series, the lower separating vessel being shown in section.

Fig. 2 is a view in end elevation of Fig. 1, showing a portion of the feed box broken away and the lower separating vessel in section.

Fig. 3 is a view in sectional end elevation of part of Fig. 1 taken on the dotted line 3—3.

Figs. 4 and 5 are views in sectional elevation of details in the construction of the apparatus, hereinafter are fully described.

The apparatus comprises a number of boxes or separating vessels *a* of rectangular or other convenient shape arranged one above the other in superimposed series so that the flow of the pulp is from one vessel to the other, the distance between each being such that sufficient head is provided for effecting the necessary aeration of the pulp. The top box or vessel of the series is adapted for an equalizing feed box. Each box or vessel *a* is provided with a number of discharge pipes *b* leading from the bottom thereof and projecting beneath the surface of the liquid in the vessel or box next below it in series.

Each of the discharge pipes *b* is provided internally with an injector nozzle *c*, and with a series of holes *d* through which air is drawn in by the flow of the material. The discharge pipes *b* are connected to flanges *e* fitted to the bottoms of the feed boxes by means of screwed nipples *f* and coupling rings or collars *g*, the injector nozzles *c* having flanges *h* which are gripped between the upper ends of the discharge pipes *b* and the lower ends of the flanges *e*.

If preferred the discharge pipes *b* can be made in two or more parts connected by screwed ring couplings *g*, and the small ends of the nozzles can be provided with detachable reducing ends *i*, as shown in Fig. 5, whereby the nozzles can be readily and quickly removed and cleansed internally should they become choked or partially choked by any obstruction entering the same with the material being treated by the apparatus.

Each box or vessel *a* is provided with an overflow lip *j* discharging into a launder *k* for the float concentrates.

The pulp is fed by means of a chute or launder *l* (see dotted lines in Fig. 2) to the top box of the series, which constitutes an equalizing feed box, whence it flows by way of the discharge pipes *b* to the top separating vessel. When the flow of pulp to the equalizing box is greater than can be accommodated by the discharge pipes *b*, the pulp rises in the said box and passes through an overflow outlet *m* into a compartment *n* from which it is discharged by a pipe *o* which projects beneath the surface of the pulp within the separating vessel or box next in series.

The overflow outlet *m* is formed by making a hole in or by cutting away portion of the side of the box, and the height at which the pulp will flow through the said outlet can be regulated by adjusting the position of a plate or gate *p* fitted slidably over the said outlet. The slidable plate or gate *p* is provided with vertical guideways *q* and is raised and lowered by operating a hand wheel *r* working on a screwed rod *s*.

The upper end of the discharge pipe *o* is provided with an axially disposed pipe *t* the upper end of which is opened to the atmosphere (see Fig. 3) the object of which is to permit air to pass into the discharge pipe *o* to aerate the pulp passing therethrough.

The interior of each separating vessel is provided with a baffle *u* which inclines from that side fitted with the equalizing overflow outlet *m* to the top and near the opposite side of the said vessel as shown in Fig. 2. The inclined baffle *u* serves to crowd the float concentrates toward the lip *j* and facilitates its delivery to the launder *k*.

The lower part of the baffle is situated below the overflow outlet *m*, and a hole *v* is formed therein to permit the material when rising in the separating vessel to enter the equalizing compartment *n*.

The separating vessels *a* are all constructed as above described, and the float concentrates are delivered on opposite sides thereof, alternatively, into launders *k* which deliver to a common chute *w*, and the gangue or other residues are discharged from the lowermost separating box of the series.

The construction and arrangement of the separating boxes and their parts insure a constant level of material being always maintained therein without the necessity of adding water to compensate for the withdrawal of concentrates, and insures the flow of material being maintained with sufficient aeration for the formation of a froth or scum of metallic sulfids.

I claim—

1. Froth-flotation ore-separating apparatus of the class in which the aeration and agitation are effected by hydraulic action of a gravity flow of the ore pulp through successive separating vessels: comprising a level-regulating overflow for each vessel disposed at a lower level than its concentrates overflow, and each level-regulating overflow (except the last) discharging directly into the next separating vessel in the series.

2. Froth-flotation ore-separating apparatus of the class in which the aeration and agitation are effected by hydraulic action of

a gravity flow of the ore pulp through successive separating vessels: comprising a level-regulating overflow for each vessel disposed at a lower level than its concentrates overflow, and each level-regulating overflow (except the last) discharging into the next separating vessel in the series, and means for adjusting the height of each level-regulating overflow.

3. Froth-flotation ore-separating apparatus of the class in which the aeration and agitation are effected by hydraulic action of a gravity flow of the ore pulp through successive separating vessels: comprising a level-regulating overflow for each vessel disposed at a lower level than its concentrates overflow, and each level-regulating overflow (except the last) discharging into the next separating vessel in the series, and means for causing the flow of air with the overflow pulp during its passage from each level-regulating overflow to the next separating vessel.

4. In apparatus for the concentration of ores by flotation separation, a separating vessel having pipe discharge means in the bottom thereof, an overflow lip for the float concentrates at one side thereof, a compartment on the opposite side thereof, an overflow outlet leading from the vessel to the said compartment, an adjustable gate for regulating the height of such overflow, a discharge pipe depending from the said compartment, means for admitting air to the aforesaid pipe discharge means to flow with the pulp therethrough, and a baffle or deflecting plate in the separating vessel inclining toward the concentrates overflow lip.

5. Apparatus for the concentration of ores by flotation separation, comprising a series of vessels arranged one above the other, discharge pipes leading from one vessel to the next below it, for each vessel an overflow compartment also having a pipe delivering into the next vessel in series, and means for admitting air to the said discharge pipes consisting of air inlets in the said pipes with injector nozzles disposed within the pipes in position to induce flow of air through said inlets with the pulp.

6. Apparatus for the concentration of ores by flotation separation, comprising a series of superposed separating vessels each having discharge pipes leading to the next in series, overflow lips on the separating vessels for float concentrates, launders on the sides of the separating vessels to receive the float concentrates, overflow compartments on the sides of the said vessels and arranged in communication therewith, a discharge pipe depending from each compartment to the next separating vessel in series, and air inlets and injector nozzles in the said discharge pipes for inducing the flow of air with the pulp passing therethrough.

7. Apparatus for froth-flotation separation of the class in which the aeration and agitation are effected by hydraulic action of a flow of the pulp through successive separating vessels; comprising a concentrates overflow, a level regulating overflow and a tailings outlet for each vessel, each level regulating overflow (except the last) discharging directly into another separating vessel in the series.

8. Froth-flotation concentration apparatus of the class in which the aeration and agitation are effected by hydraulic action of a flow of the pulp through successive separating vessels; comprising a concentrates overflow, a level regulating overflow and a tailings outlet for each vessel, each level regulating overflow (except the last) discharging directly into another separating vessel in the series, and means for adjusting the height of each level regulating overflow.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES HEBBARD.

Witnesses:
G. McD. HUNTER,
G. A. ROBINSON.