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FLOTATION METHOD AND APPARATUS

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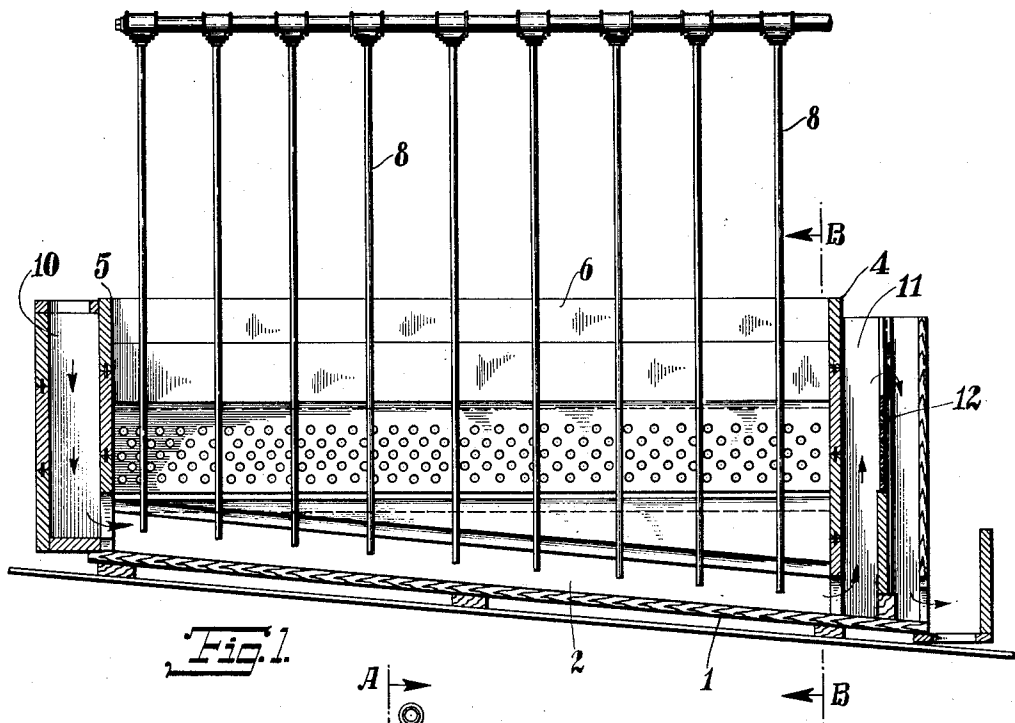


Fig. 1

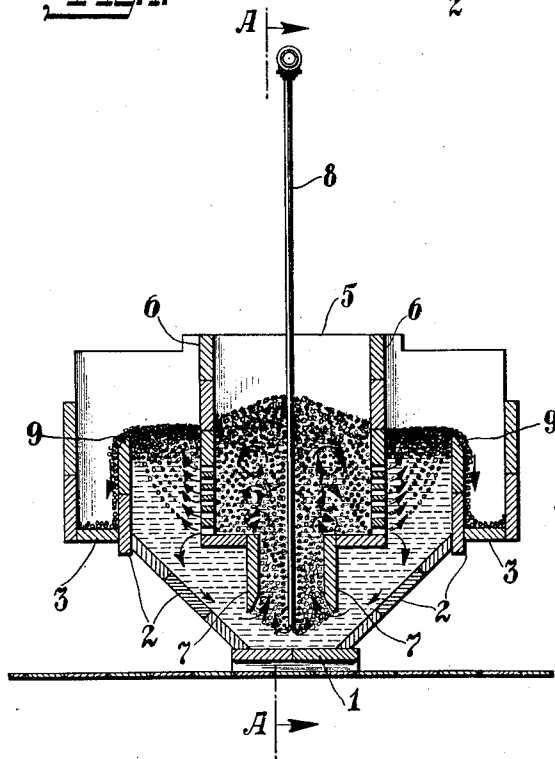


Fig. 2

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FLOTATION METHOD AND APPARATUS.

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My invention relates to improvements in apparatus for the concentration of the values from ores or other substances by what is commonly known as the flotation process, in which the ores or other substances are subjected to aeration in an aqueous separating medium in the presence of suitable agents for the formation of a froth containing the valuable portions of said ores or other substances, and thereby separating said values from the barren or rocky constituents thereof. An inherent characteristic of the apparatus is the novel method of producing the necessary aeration of the pulp.

The object of the present invention is to provide certain improvements in flotation apparatus which by the simplicity of construction reduce the cost of production, installation and operation.

The principle of operation and novel features of the invention will be better understood from the following description taken in conjunction with the accompanying drawing illustrating the preferred form of a flotation cell embodying the invention.

In this drawing:

Fig. 1 is a longitudinal section of the flotation cell, taken on line A-A, Fig. 2.

Fig. 2 is a transverse section of the flotation cell, taken on line B-B, Fig. 1.

Referring now particularly to the accompanying drawing, the apparatus therein illustrated is a flotation cell of the pneumatic type. As represented in the drawing the cell has a sloping bottom 1, and upwardly and outwardly inclined side walls 2, at the upper end of which are provided concentrate launders 3. The vertical end walls 4 and 5 complete the cell proper.

Within this cell are longitudinal partitions 6 and 7, which define an agitation chamber. The best results so far secured have been by the use of an agitation chamber larger in its upper portion than in its lower portion, and consequently the upper partitions 6 are shown more widely spaced than the lower partitions 7, there thus being an abrupt increase in the cross section of the agitation chamber, as clearly indicated in Fig. 2. The partitions 6 extend well above the froth overflow lips 9 and the space between them is open to the atmosphere. The partitions 6 are provided with slots or holes, arranged in a series extending the entire length of the partitions, and below the normal level of the pulp in the

tank. These openings are to permit the passage of the aerated pulp (as contradistinguished from froth) from the agitation chamber between the partitions 6 to the separation chambers which intervene between each partition 6 and the side walls 2 of the tank. The separation chambers also are open to the atmosphere.

The air is introduced through pipes 8, at or below the lower edge of the partition 7. These pipes may be, say, a half inch in diameter, and thus afford openings which are extremely large as compared with the openings of the porous media usually employed, and large as compared with the openings employed in those apparatuses heretofore proposed in which it is intended to inject jets of air under relatively high pressure.

The pulp, containing suitable flotation agents, may enter through the feed compartment 10, or it may be introduced directly into the agitation chamber.

The discharge end of the cell is provided with the usual type of weir discharge 11, which is provided with means 12, for regulating the pulp level in the cell.

The introduction of air through the relatively large openings of the pipes 8 produces a disturbance of the pulp in the agitation chamber that results in a rapid circulation of the pulp from the agitation chamber through restricted communications into the separation chamber and downwards, re-entering the agitation chamber in part and in part passing on into the tailing discharge. The air discharges from the pipes 8 in bubbles which are very large relatively to the bubbles in the resulting froth. The circulating pulp while tending to reenter the agitation chamber moves in directions due to its path of circulation and the direction induced by the position of lower partitions 7. The circulating pulp comes in contact with the entering air while moving in cross currents to that of the entering air and an agitation is so further induced. The tendency of the large bubbles is to raise the column of pulp through which they are passing and by the cross circulation of pulp they are sheared or pinched so as to produce subdivision or dissemination of the relatively large bubbles and their dispersion in the pulp in the size desired. The pulp passing into the separation chamber thus carries with it a considerable portion of the air introduced into the agitation chamber. This air having

been relatively finely divided is in a suitable condition to produce an effective froth on the surface of the pulp in the separation chamber.

6 The device thus involves an important operative characteristic, which is that air discharged at a rapid rate and in relatively large bubbles not only produces the circulation, but produces within the body of the
10 pulp itself an agitation so violent as to subdivide the bubbles and to develop, without the use of baffles and without any cascading action, a froth suitable for flotation separation of the mineral particles in the pulp
15 from the gangue. The circulation is induced in the first instance by large bubbles of air discharged below the entrance of the agitation chamber. From the sides of this chamber, at points relatively remote from
20 the zone of violent agitation, the fine bubbles developed by the agitation are fed away to the lateral chambers in which the flotation separation by the resulting froth occurs. The abrupt widening of the agitation chamber, at a point substantially below
25 the surface of the pulp, improves the result because of the improved agitation secured.

The advantages of the apparatus of this invention are apparent. No mechanical propellers or rotors are used to aerate the pulp
30 and no porous medium of any kind is used for introducing air into the pulp. Thus the power for, and the wear and tear incident to the operation of machinery usually employed to aerate the pulp, and also the
35 power required to force air through, and the wear and tear incident to the porous medium usually employed has been entirely done away with in the operation of the apparatus
40 of this invention. As the size of the openings in the pipes for air introduction into the pulp in the apparatus of this invention is large compared with the openings of the porous medium usually employed, the power
45 required is much reduced over that required by apparatus employing porous media. The apparatus of this invention has the further advantage over those employing porous media that the openings for air introduction
50 do not become clogged as do the openings in a porous medium. Blankets or other porous media become especially troublesome when lime is being used as a reagent, or when the ore being treated is coarse
55 or of high specific gravity.

While the apparatus illustrated and described has been found particularly advantageous, yet it will be understood that variations and modifications may be made therein
60 without departing from the spirit of this invention.

I claim:

1. The method of concentrating ores by flotation which consists in aerating a pulp by discharging air in large bubbles into the

same at a substantial depth below the surface thereof, directing coacting currents of pulp against said bubbles adjacent their point of entry, and causing circulation of the pulp through zones, one of violent agitation produced by the air and the other of approximate quiescence, the pulp in both zones being under normal atmospheric pressure; isolating said zones from each other and confining the flow from the first to the
75 second to a restricted approximately horizontal path below the surface of the pulp, and removing mineral-bearing froth from the zone of quiescence.

2. The method of concentrating ores by
80 flotation which consists in introducing large bubbles of air into and below the surface of a pulp freely open to the atmosphere; causing a circulation of the pulp to be set up; bringing the circulating pulp in directly intersecting impinging currents into coaction with the entering air above its point of entry to cause the air to be dispersed as bubbles of effective flotation sizes; conveying
90 the aerated pulp through communications below the pulp level to a separation chamber and collecting the resultant froth.

3. A flotation concentrator comprising in combination means forming a pulp container having an agitation chamber and a froth-separating chamber with froth overflow; means for permitting the circulation of pulp from one chamber to another, comprising
100 unrestricted communication between said chambers in the lower portion of the container through opposite sides of the agitating chamber, said agitating chamber being internally substantially unobstructed at the level of said communication, and agitation-confining means offering restricted communication at a higher level, but wholly beneath the pulp level, both chambers being
105 freely open to the atmosphere; and means for creating a circulation of the pulp upwardly through the agitation chamber and returning through said unrestricted communication in the lower portion of the container comprising an air pipe discharging
110 air in large bubbles directly into the pulp below the point of unrestricted communication of the chambers.

4. A flotation concentrator comprising in combination a tank for the retention of a body of pulp, having means for froth discharge; a partition structure defining within the tank an agitation chamber, unrestrictedly open at opposite sides at its bottom to the tank and at its top freely open to the atmosphere, said agitation chamber being substantially unobstructed at the level of
125 the pulp inflow, there also being restricted openings through said partition structure wholly below the pulp level; and means for creating a circulation of the air and pulp upwardly through the agitation chamber
130

and through the restricted openings therein, returning to the agitation chamber through the open bottom thereof, comprising means discharging air in large bubbles directly into the pulp below the lower end of the agitation chamber, through intersecting impinging currents of pulp, thus causing the air to be dispersed as bubbles of effective flotation sizes.

5. A flotation concentrator comprising in combination a tank having froth overflows; a partition structure extending above said overflows, and defining within the tank an agitation chamber unrestrictedly open at opposite sides at its bottom to the tank and at its top freely open to the atmosphere, said agitation chamber being substantially unobstructed at the level of the pulp inflow, there also being restricted openings through said partition structure wholly below the pulp level; and means for creating a circulation of the pulp upwardly in said agitation chamber and out therefrom through said restricted openings, comprising means discharging air in large bubbles directly into the pulp below the lower end of the agitation chamber.

6. A flotation concentrator comprising in combination a tank having froth overflows; a partition structure extending above said overflows, and defining within the tank an agitation chamber open at its top freely to the atmosphere and at its bottom to the interior of the tank, said chamber being relatively narrow at its lower end and abruptly enlarged at a substantial distance below said overflows, there being restricted openings through said partition structure below the pulp level and above the level of such enlargement; and means for discharging air in large bubbles directly into the pulp below the lower end of the agitation chamber.

7. A flotation concentrator, comprising in combination an elongated tank having lateral froth overflows; a pair of longitudinal partitions within said tank and near the bottom thereof, the space between said partitions being freely open around the lower edges of the partitions to the remainder of the interior of the tank; a pair of more widely spaced partitions extending from approximately the upper margin of the lower partitions to a point above the level of the froth overflows, the last named partitions being provided with openings below the pulp level in the tank through which aerat-

ed pulp may pass; and means for discharging air in relatively large bubbles below the lower ends of and between the first-named partitions and substantially throughout the entire length of the tank.

8. The method of concentrating ores by flotation which consists in aerating a pulp by discharging air in large bubbles into the same at a substantial depth below the surface thereof in quantity sufficient to maintain circulative travel through zones, one of violent circulative agitation and the other of approximate quiescence, the circulative travel being wholly below the pulp level and that from the agitating zone to the zone of quiescence being confined to a restricted approximately horizontal path, and removing mineral-bearing froth from the zone of quiescence.

9. The method of concentrating ores by flotation which consists in discharging air in large bubbles and in relatively large volumes into a body of pulp in the lower portion thereof and inducing simultaneous agitation and upward flow of pulp and air through an agitating zone, the upper portion of said zone being expanded to decrease the rate of upward flow of said pulp and air and cause agitative circulation therein, and causing flow of said pulp laterally through communications wholly below the pulp level into a separation zone, and collecting the resultant froth.

10. The method of concentrating ores by flotation which consists in providing an agitating zone and a zone of approximate quiescence in a body of pulp, the pulp in both zones being under normal atmospheric pressure, aerating the pulp by discharging air in large bubbles into the same at a substantial depth below the surface thereof in the first zone, causing agitative circulation therein, and inducing a flow of pulp from the second zone into the first zone in the vicinity of the point of entry of the air and causing flow of the air and pulp through the first zone accompanied by agitative circulation therein and thence into the second zone, the flow from the first to the second zone being confined to a restricted, approximately horizontal path wholly below the surface of the pulp, and removing mineral-bearing froth from the zone of quiescence.

In testimony whereof, I have signed my name to this specification this 21st day of July, 1925.

DAVID LAWTON FORRESTER.