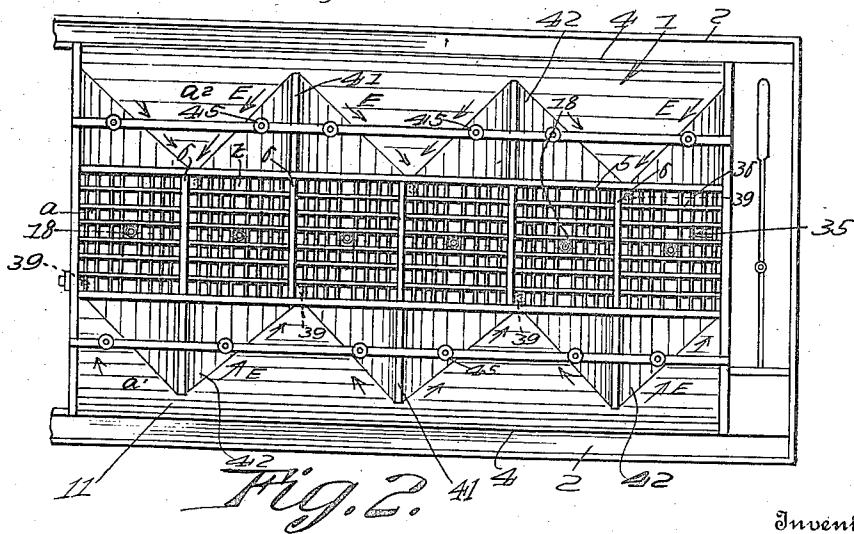
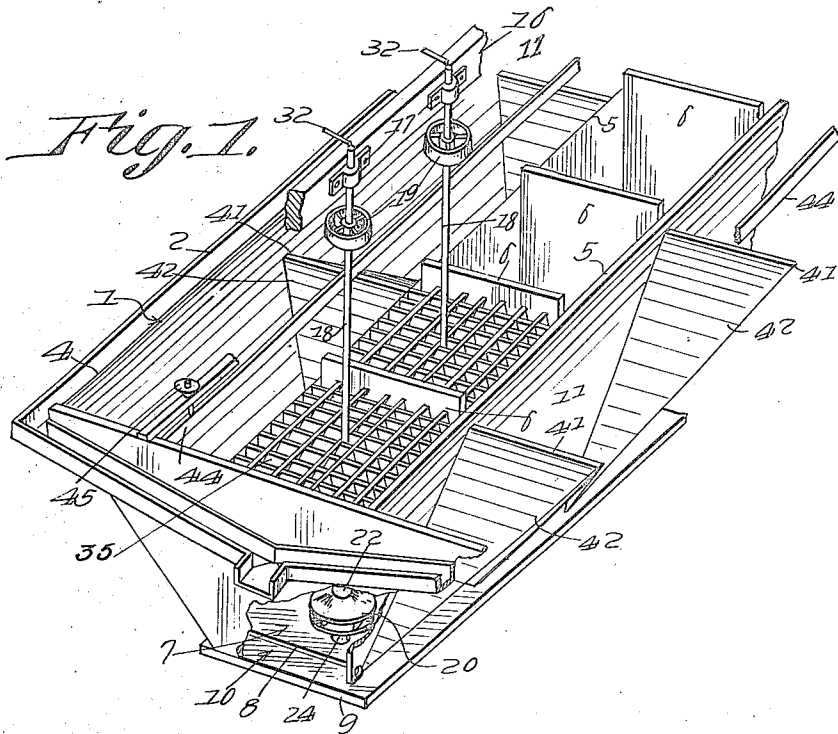


F. GROCH.
 APPARATUS FOR ORE CONCENTRATION.
 APPLICATION FILED MAR. 2, 1918.

1,283,159.

Patented Oct. 29, 1918.
 4 SHEETS—SHEET 1.



Inventor

Frank Groch

By his Attorneys

Baldern & Wright

F. GROCH.
 APPARATUS FOR ORE CONCENTRATION.
 APPLICATION FILED MAR. 2, 1918.

1,283,159.

Patented Oct. 29, 1918.

4 SHEETS—SHEET 2.

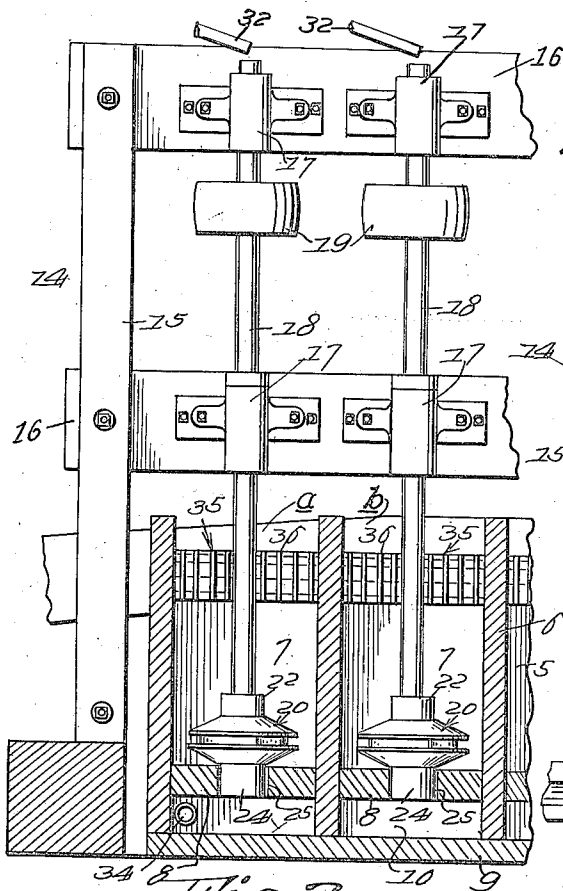


Fig. 3.

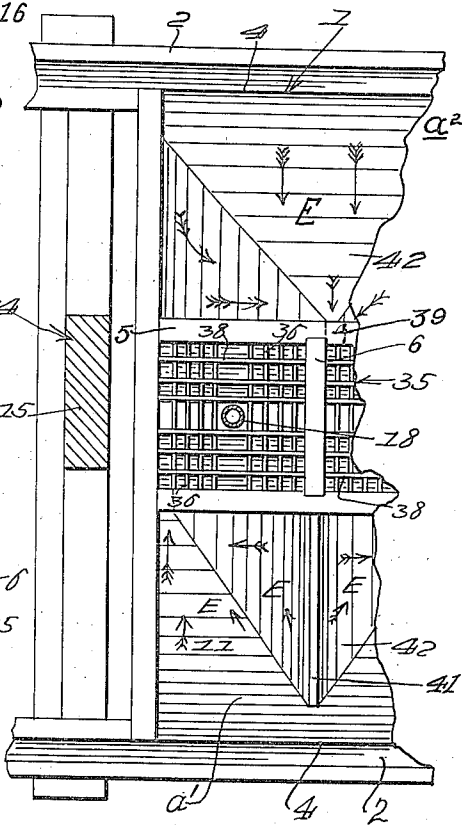


Fig. 4.

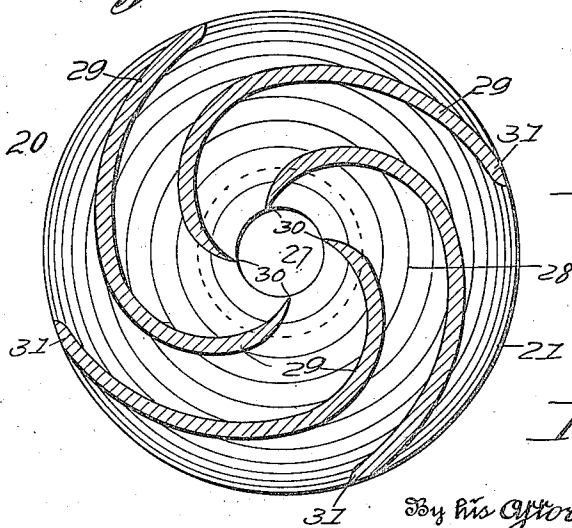


Fig. 7.

Inventor
 Frank Groch,

By his Attorneys
 Baldwin & Wigle.

1,283,159.

4 SHEETS—SHEET 3.

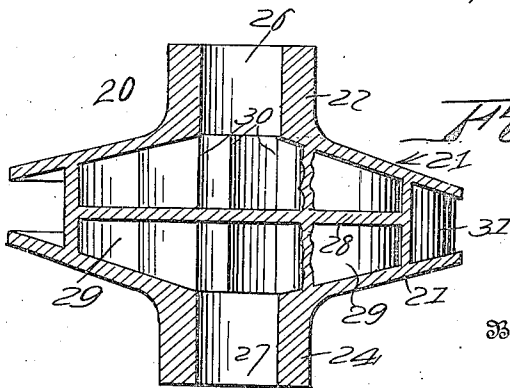
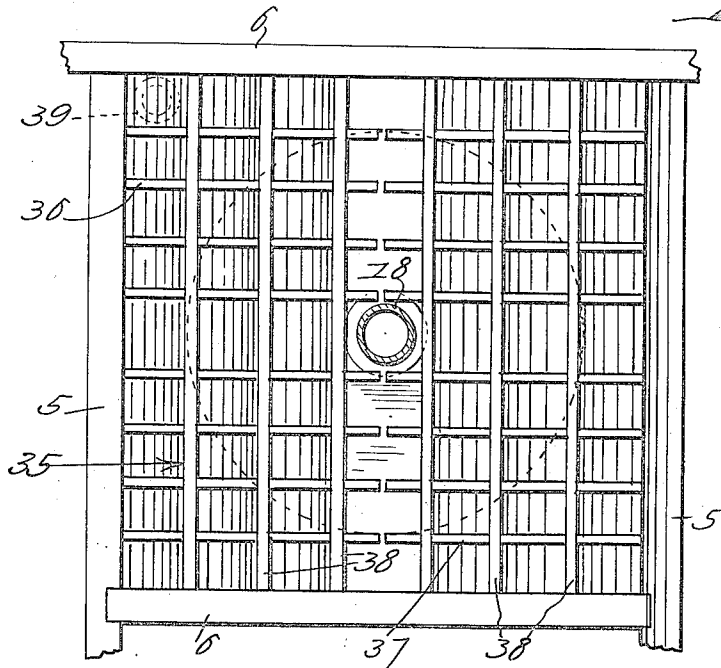
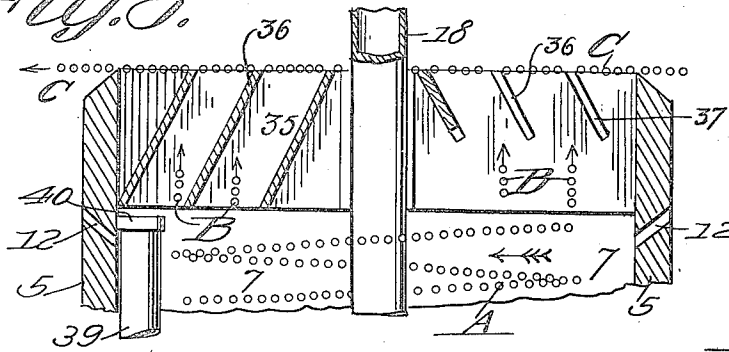


Fig. 5.

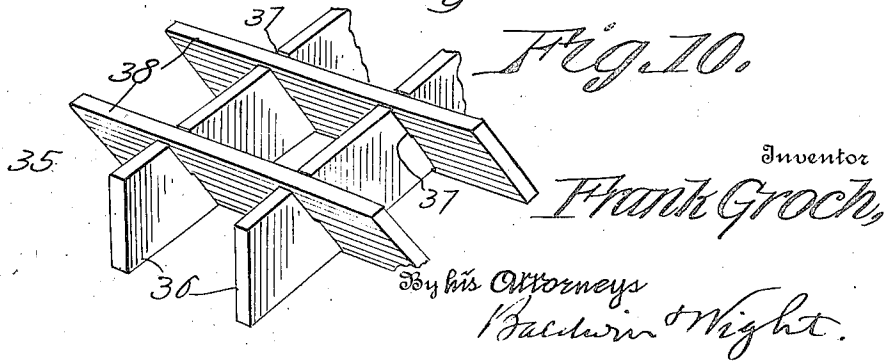
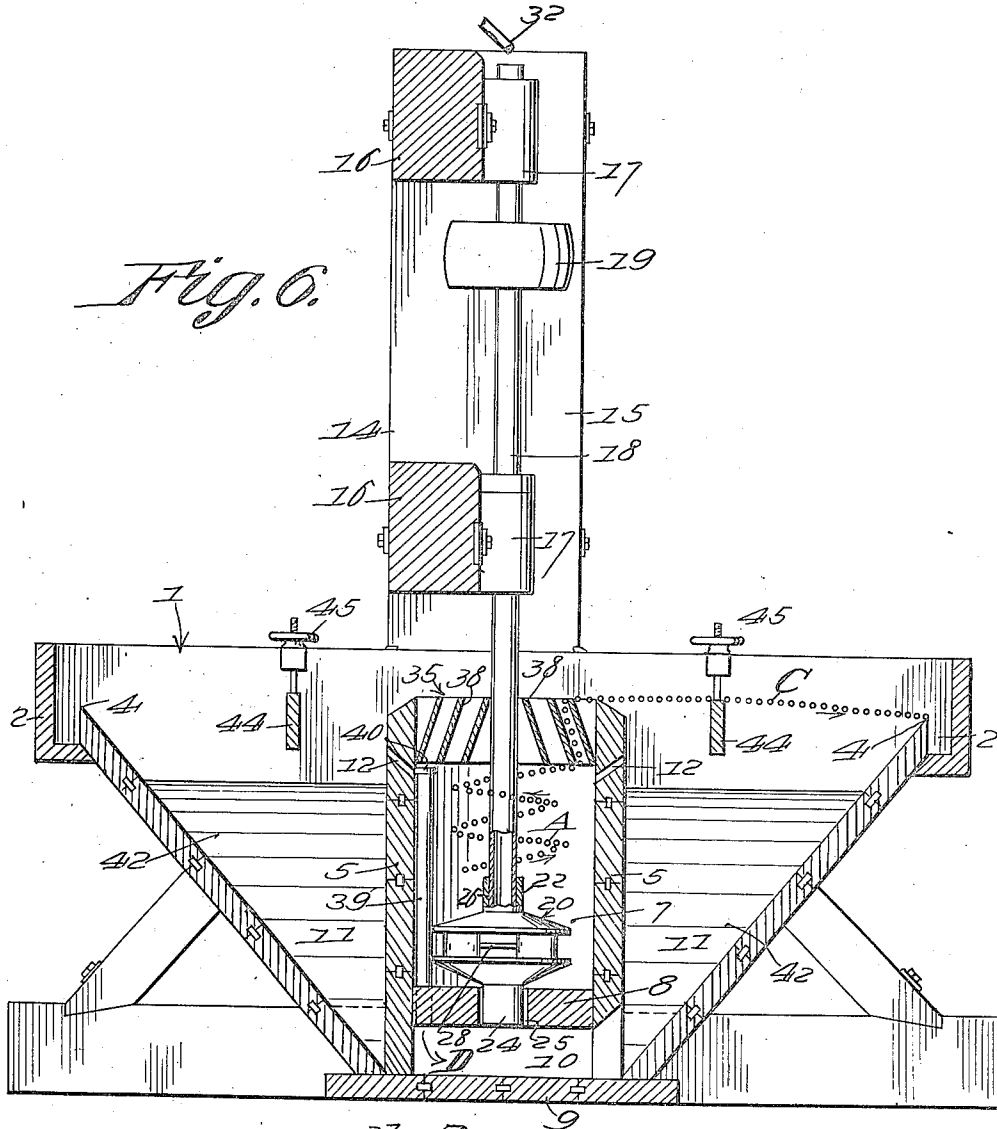
Frank Groch,

By his Attorneys
Gedwin Wright.

F. GROCH.
 APPARATUS FOR ORE CONCENTRATION.
 APPLICATION FILED MAR. 2, 1918.

1,283,159.

Patented Oct. 29, 1918.
 4 SHEETS—SHEET 4.



UNITED STATES PATENT OFFICE.

FRANK GROCH, OF COBALT, ONTARIO, CANADA.

APPARATUS FOR ORE CONCENTRATION.

1,283,159.

Specification of Letters Patent.

Patented Oct. 29, 1918.

Application filed March 2, 1918. Serial No. 219,996.

To all whom it may concern:

Be it known that I, FRANK GROCH, a citizen of the United States, residing in Cobalt, in the Province of Ontario and Dominion of Canada, have invented certain new and useful Improvements in Apparatus for Ore Concentration, of which the following is a specification.

This invention relates broadly to ore separation or concentration, and more particularly to the separation of ore by means of flotation.

The principal object of the present invention is to produce an apparatus having an agitating chamber or chambers each comprising a large zone of agitation, and a comparatively small quiescent zone.

A further object of the invention is to provide an apparatus of this type in which the air bubbles employed shall have a spiral path throughout the entire portion of the agitation zone and a substantially vertical passage through the quiescent zone.

Still another object of my invention is to provide a series of swirl plates preferably in the extreme upper portion of the agitating chambers whereby vortexing of the pulp upon operation of the apparatus is prevented, and a quiescent zone is provided.

Still another object of the invention is to provide in an apparatus of this type means for collecting and bringing into intimate association with the entire mass of pulp all of the air bubbles necessary to insure complete separation, without producing any cooling of the pulp mass.

The foregoing and other objects of my invention will be apparent as the same becomes better understood by reference to the accompanying specification and drawings forming a part thereof throughout the several views of which like characters of reference have been used to indicate like parts.

In the drawings—

Figure 1 is a perspective view of a portion of my apparatus.

Fig. 2 is a plan view, largely diagrammatic, showing my apparatus provided with means to produce a zig-zag flow of the pulp.

Fig. 3 is a longitudinal sectional view, showing a battery of two cells of a flotation apparatus.

Fig. 4 is a horizontal sectional view of a portion of the apparatus.

Fig. 5 is a vertical sectional view through the impeller.

Fig. 6 is a vertical cross sectional view through one of the cells of my apparatus.

Fig. 7 is a horizontal sectional view of the impeller shown in Fig. 5.

Fig. 8 is an enlarged detail view of the upper portion of one of the agitating chambers showing the swirl plates in position therein.

Fig. 9 is a top plan view of that portion of the apparatus illustrated in Fig. 8.

Fig. 10 is a perspective view of a portion of the swirl plates showing the same in interlocked relation.

In apparatuses which have heretofore been provided for use in connection with ore separation by the flotation process, it has been quite customary to employ an agitating chamber having an impeller located therein, but upon operation of the impeller a vortex was produced through the main body of the pulp. In actual operation, however, it has been found that the ore particles have a tendency to collect in the vortex until a sufficient mass has accumulated whereupon the entire body sinks. It has been recognized, that the elimination of the vortex and the maintaining of the ore particles in suspended condition once they have been floated is a desirable feature, and it is the purpose of the present invention to accomplish these ends.

It has also been customary in ore flotation apparatus to construct the bottom of the agitating chamber of a foraminous or porous member and force compressed air there-through into the body of the pulp. It is well known that separation is best procured at a fixed temperature, and that the passage or release of the previously compressed air tends to absorb heat and thereby cool the mass of pulp. A cooling of as high as 2° throughout the pulp body frequently takes place with previously compressed air. It is the purpose of the present invention to provide a self-contained apparatus capable of collecting and distributing its own air, the distributing action taking place in such manner that an intimate association of the air and the entire body of the pulp is produced.

Referring more particularly to the drawings, I have illustrated a main tank or res-

ervoir 1, provided with launders 2 which are separated from the interior of the tank by overflow lips or baffles 4. The main body of the tank is divided by vertical partitions 5 into a central agitating space, which is in turn subdivided by cross partitions 6 into individual agitating chambers 7. Each of the agitating chambers is preferably provided with a supplemental bottom portion 8 above the main bottom 9 of the tank and in spaced parallel relation thereto to form a channel 10 connecting the side compartments 11. The side compartments 11 constitute receptacles into which overflow takes place from the agitation chambers. It will be observed that the overflow from one side of an agitation chamber flows back to the same chamber while the overflow from the opposite side of said agitation chamber proceeds forward and enters the bottom of the next agitation chamber in the series. This rule is preserved throughout the series. In operation, I have found it desirable to extend the ends of the vertical partitions 5 slightly above the level of the overflow lips 4 and provide the same with upwardly inclined slots or openings 12.

Extending above the series of agitating chambers is a supporting frame 14 comprising vertical or upright members 15 connected by parallel beams 16. The parallel beams carry journals 17 for the hollow shafts 18. Adjacent the upper portion of each of the shafts there may be provided a pulley or the like 19 for driving the same, while the lower ends of the shafts carry impellers 20.

Referring more particularly to Figs. 5 and 7, it will be seen that each of the impellers preferably comprises upper and lower conical walls 21 arranged in reversed relation so as to provide a main body portion gradually tapering toward the periphery. The upper wall 21 is formed with a hub 22 cooperating with the lower end of the shaft 18, while the lower conical wall 21 is formed into a boss 24 extending through the opening 25 in one of the supplemental bottoms. The hub 22 constitutes an axial inlet 26 while the boss 24 forms a lower axial inlet 27, communicating with the channel 10. As shown in my copending application, Serial No. 209,117, filed December 27, 1917, each of the impellers is preferably provided with a central partition 28, spaced from both the upper and lower conical walls and terminating within the periphery of said walls. Curved blades 29 are provided on opposite sides of the central partition and are preferably constructed with their inner ends 30 terminating even with the axial inlets of the impeller, and their outer ends projecting beyond the edge of the central partition and terminating even with the periphery of the conical members.

In operation, oil, or oil and pulp may be

fed through the pipe 32 directly into the upper ends of each of the hollow shafts, or only into one or more of a series as may be desired. The oil particles collecting on the sides of the hollow shaft are picked up by the passage of the air produced through the shafts by the action of the impellers. The blades 29 produce a centrifugal action tending to force the air and oil, or air, oil and pulp fed through the hollow shafts outwardly into the agitating chambers. At the same time the curved blades below the central partition draw the pulp upwardly through the axial inlet 27 and force the same outwardly across the periphery of the central partition 28. This produces an aspirating action on the air so that a combined centrifugal impeller and ejector or aspirating action is insured.

If desired, pulp may be fed through the feed inlet 34 either entirely, or in cooperation with the feed previously described. In order to counteract the swirl of the entire body of the pulp in the agitating chambers, and overcome the tendency of the same to vortex, I provide swirl plates 35 preferably in the extreme upper portion of each of the agitating chambers. The swirl plates preferably comprise vertical members 36 having inclined slots 37 extending partway there-through to receive slots of a similar nature formed in the plates 38 and hold the same in inclined position. It has been found highly advantageous to have the swirl plates extending as closely as possible to the hollow shafts 18. By reason of this particular construction a large agitating zone is provided below the swirl plates in which the air bubbles travel in a spiral path as indicated by the arrows A. At the same time, a quiescent zone is produced through the swirl plates so that the air bubbles, together with their load of metallic values, ascend quietly as indicated by the arrows B, and float across the upper edges of the swirl plates and the vertical partitions 5 into the tanks 1 and overflow launders 2, as shown by the arrows C. The spiral passage of the air bubbles throughout the agitating zone of each of the chambers, which zone constitutes the major portion thereof, produces an intimate association of the air and oil with the pulp whereby almost complete separation of the ore is produced. In some instances, it has been found desirable to equip each of the agitating chambers with an overflow pipe 39 so that the pulp may be drawn from the upper portion of the agitating zone into the chamber 10 and back through the impeller as indicated by the arrows D. A cap, plate or valve 40 may be used to close the overflow or return pipes 39 at desired times.

It will be apparent that throughout the operation of my improved apparatus, an overflow from the agitating chambers takes

place into the compartments 11 of the tank 1 disposed on opposite sides of the agitating chambers. A zig-zag flow of the material thus passing into the compartments 11 may be produced by providing vertical partition plates 41 in the compartments in staggered relation on opposite sides of the agitating chambers. Inclined triangular members 42 cooperating therewith, as shown clearly in Figs. 2 and 4, produce a gradual onward flow in zig-zag manner, as shown by the arrows E. For example, considering the first agitating chamber as chamber a , the overflow takes place therefrom into the compartments a' and a'' . The overflow from compartment a' returns to the channel 10 under agitating chamber a , while the overflow from compartment a'' passes into the channel 10 under agitating chamber b . By reason of such a construction, all of the pulp is necessarily brought into contact with an air bubble.

For regulating the flow of the foam from the agitating chambers, supplemental baffles 44 may be provided each equipped with an adjusting hand-wheel 45 so that the depth of the foam passing thereover may be definitely controlled.

As previously pointed out the most desirable results are obtained by locating the swirl plates in the extreme upper portion of the agitating chamber, but the apparatus operates successfully where the plates are lower but maintain close relationship with the hollow shaft. It is important to have the central plates disposed as closely adjacent the hollow shaft as possible.

It will be understood that the accompanying drawings are representative of the preferred embodiment of my invention, and are not to be considered in a limiting sense.

In my application for Patent No. 107,434, filed July 3, 1916, and in the division thereof No. 247,155, filed July 29, 1918, I show an apparatus for concentrating ores comprising a tank and a rotary member which is provided with a set of passages extending from its central portion toward its periphery, and a hollow member through which said passages are in communication with the atmosphere above the liquid which the tank is adapted to contain and another set of similar passages having both ends in communication with the liquid in the tank. Said application also shows a rotary head having a set of passages for gas or air extending outwardly from the center toward the periphery of the head, and a set of liquid passages also extending toward the periphery, all of said passages being open at both ends. The rotary head consists of an impeller somewhat similar to that herein shown and described, having axial inlet ports in its opposite walls and a discharge opening, a partition within the impeller in

spaced relation to the opposite walls thereof, and impeller blades on opposite sides of the partition. I do not herein claim said subject matter, it being claimed in my application for patent Serial No. 247,155, filed July 29, 1918. Said application No. 107,434 also shows an apparatus for concentrating ores, comprising a series of agitation compartments, each provided with means for distributing air and pulp therein, a series of settling compartments communicating with the agitation compartments, a pulp receiving chamber below each agitation compartment, and means for conveying settled material from the lower portion of one settling compartment to the chamber below the next agitation compartment. I do not herein claim said subject matter as claims thereto are made in my application No. 107,434, filed July 3, 1916.

In my copending application for patent Serial No. 209,117, filed Dec. 27, 1917, I have shown an impeller of substantially the same construction as that herewith shown and described. No claim is made herein to the construction of said impeller or to an impeller of the character shown connected to or associated with other features of the invention apart from its association with what are termed in the present application swirl plates within the agitation chamber above the impeller.

I claim as my invention:

1. In an apparatus for concentrating ores, an agitating chamber adapted to receive the ore pulp, an air distributing member therein for producing a spiral movement of the air throughout the major portion of the length of the agitating chamber, and means in the extreme upper portion of the agitating chamber for producing a vertical movement of the air through said portion.

2. In an apparatus for concentrating ores, an agitating chamber adapted to receive the ore pulp, a rotary air distributing member therein for producing a spiral movement of the air throughout the major portion of the length of the agitating chamber, and means in the extreme upper portion of the agitating chamber for producing a vertical movement of the air through said portion.

3. In an apparatus for concentrating ores, an agitating chamber adapted to receive the ore pulp, a centrifugal air collecting and distributing member therein for producing a spiral movement of the air throughout the major portion of the length of the agitating chamber, and means in the extreme upper portion of the agitating chamber for producing a vertical movement of the air through said portion.

4. In an apparatus for concentrating ores, an agitating chamber adapted to receive the ore pulp, an air distributing member therein for producing a spiral movement of the air

throughout the major portion of the length of the agitating chamber, and swirl plates in the extreme upper portion of the agitating chamber, said plates insuring a substantially

5 vertical passage of the air therebetween.

5. In an apparatus for concentrating ores, an agitating chamber adapted to receive the ore pulp, an air distributing member therein for producing a spiral movement of the air

10 throughout the major portion of the length of the agitating chamber, and nested swirl plates in the extreme upper portion of the agitating chamber, said swirl plates destroying the spiral movement of the air in the upper

15 portion of the chamber and insuring a substantially vertical movement thereof between the plates.

6. In an apparatus for concentrating ores, an agitating chamber adapted to receive the

20 ore pulp, an air distributing member therein for producing a spiral movement of the air throughout the major portion of the length of the agitating chamber, and swirl plates in the extreme upper portion of the

25 agitating chamber and extending across the entire upper surface thereof to produce a quiescent zone therein.

7. In an apparatus for concentrating ores, an agitating chamber adapted to receive the

30 ore pulp, a hollow shaft extending through said chamber, an air distributing member on the lower end of said shaft for drawing air through said shaft and producing a spiral movement of the same throughout the

35 major portion of the length of the agitating chamber, and swirl plates in the extreme upper portion of the agitating chamber and extending into close cooperative relation with the hollow shaft for producing a quies-

40 cent zone throughout said upper portion.

8. In an apparatus for concentrating ores, a chamber having an agitation zone in its lower portion and a quiescent zone in its upper part, a rotary impeller in said agitation

45 zone which gives a rotary motion to the liquid therein, a hollow shaft to which said impeller is secured and through which air is supplied to the central portion of the impeller, means for continuously supplying liquid

50 to the central portion of the impeller, devices closely surrounding the impeller shaft in the quiescent zone above the impeller which arrest the rotary motion of the liquid and thus prevent vortexing thereof, and

55 means for receiving the overflow from said agitation chamber above said devices.

9. In an apparatus for concentrating ores, a chamber having an agitation zone in its lower portion and a quiescent zone in its upper part, a rotary impeller in said agitation

60 zone which gives a rotary motion to the liquid therein, a hollow shaft to which said impeller is secured and through which air is supplied to the central portion of the im-

65 peller, means for continuously supplying

liquid to the central portion of the impeller, swirl plates closely surrounding the impeller shaft in the quiescent zone above the impeller which arrest the rotary motion of the liquid and prevent vortexing thereof, and means

70 for receiving the overflow from said chamber above said devices.

10. In an apparatus for concentrating ores, an agitation chamber having means for producing rotation of the contents thereof,

75 and swirl plates in the extreme upper portion of said chamber and terminating flush with the overflow edge thereof for producing a quiescent zone directly below said edge.

11. In an apparatus for concentrating

80 ores, an agitating chamber provided with means for producing rotation of the contents thereof, and swirl plates in the extreme upper portion of said chamber and extending into the plane of the overflow edge

85 therefrom for producing a quiescent zone directly below said edge, a portion of said swirl plates being inclined to retard the passage of the foam thereover.

12. In an apparatus for concentrating

90 ores, an agitation chamber adapted to receive ore pulp, an impeller within said chamber, a supplemental bottom in said chamber below the impeller providing a channel beneath it, means for supplying

95 pulp to said channel, means for receiving the overflow from said agitation chamber, and a return connection extending from said channel below the impeller to the upper portion of the agitation chamber and opening

100 thereinto below the liquid level therein.

13. In an apparatus for concentrating ores, an agitation chamber adapted to receive ore pulp, an impeller within said

105 chamber, a supplemental bottom in said chamber below the impeller providing a channel beneath it, means for supplying pulp to said channel, means for receiving the overflow from said agitation chamber, swirl plates in the agitation chamber above

110 the impeller, and a return connection extending from said channel below the impeller to the upper portion of the agitation chamber and opening thereinto below the liquid level therein and below the swirl

115 plates.

14. In an apparatus for concentrating ores, a series of agitation chambers each having a liquid inlet in its lower portion and from which the liquid overflows on each

120 side, means for causing an upward flow of liquid through each agitation chamber, receptacles for said overflow on opposite sides of said agitation chambers, and means in said receptacles for directing liquid over-

125 flowing from one side of each chamber back to the same chamber and that overflowing from the opposite side forward to the next chamber in the series.

15. In an apparatus for concentrating

130

ores, a series of agitation chambers each having a liquid inlet in its lower portion and from which the liquid overflows on each side, means for causing an upward flow of liquid through the several chambers, receptacles for the overflow on opposite sides of the agitation chambers, and means in said receptacles for directing a portion of the liquid overflowing from each compartment back to the same compartment and the other portion of said overflowing liquid forward to the next compartment.

16. In an apparatus for concentrating ores, an agitating chamber having overflow lips formed thereon, and inclined swirl plates extending even with the plane of said lips for retarding the flow of material through said chamber.

17. In an apparatus for concentrating ores, an agitating chamber having overflow lips formed thereon, overflow compartments to receive the overflow therefrom, means in the agitating chamber for retarding said overflow, and adjustable means in the overflow compartment cooperating therewith.

18. A swirl plate construction for ore concentration apparatus, comprising a plurality of vertical plates, and a plurality of inclined plates cooperating therewith.

19. In an apparatus for concentrating ores, an agitation chamber, a hollow shaft extending downwardly into said chamber, an impeller within the chamber on the lower end of said shaft and which draws air through the shaft and distributes it centrifugally in the chamber, means for continuously supplying the liquid to be treated to the interior of the impeller, means for receiving the overflow from the agitation chambers, and swirl plates disposed in the agitation chambers above the impellers and

below the overflow, said swirl plates being arranged to closely surround the impeller shaft and to prevent vortexing of the liquid around and close to said shaft.

20. In an apparatus for concentrating ores, a series of agitation chambers each having a liquid inlet in its lower portion and from which the liquid overflows on each side, means for causing an upward flow of liquid through the several agitation chambers, receptacles for the overflow on opposite sides of the agitation chambers, an inclined plate on one side of each chamber for directing the liquid back to said chamber, and an inclined plate on the opposite side of said chamber for directing liquid overflowing from said chamber to the next chamber in the series.

21. In an apparatus for concentrating ores, a series of agitation chambers each having a liquid inlet in its lower portion and from which the liquid overflows on each side, means for causing an upward flow of liquid through the several chambers, receptacles for the overflow on opposite sides of the agitation chambers, vertically arranged partitions dividing each overflow receptacle into a series of compartments each of which receives overflow from two agitation chambers, and inclined plates in each of said overflow compartments for directing some of the liquid overflowing into said compartments back to the chamber from which it overflowed and the other portion thereof forward to the next chamber in the series.

In testimony whereof, I have hereunto subscribed my name.

FRANK GROCH.

Witness:

GEO. MITCHELL.