

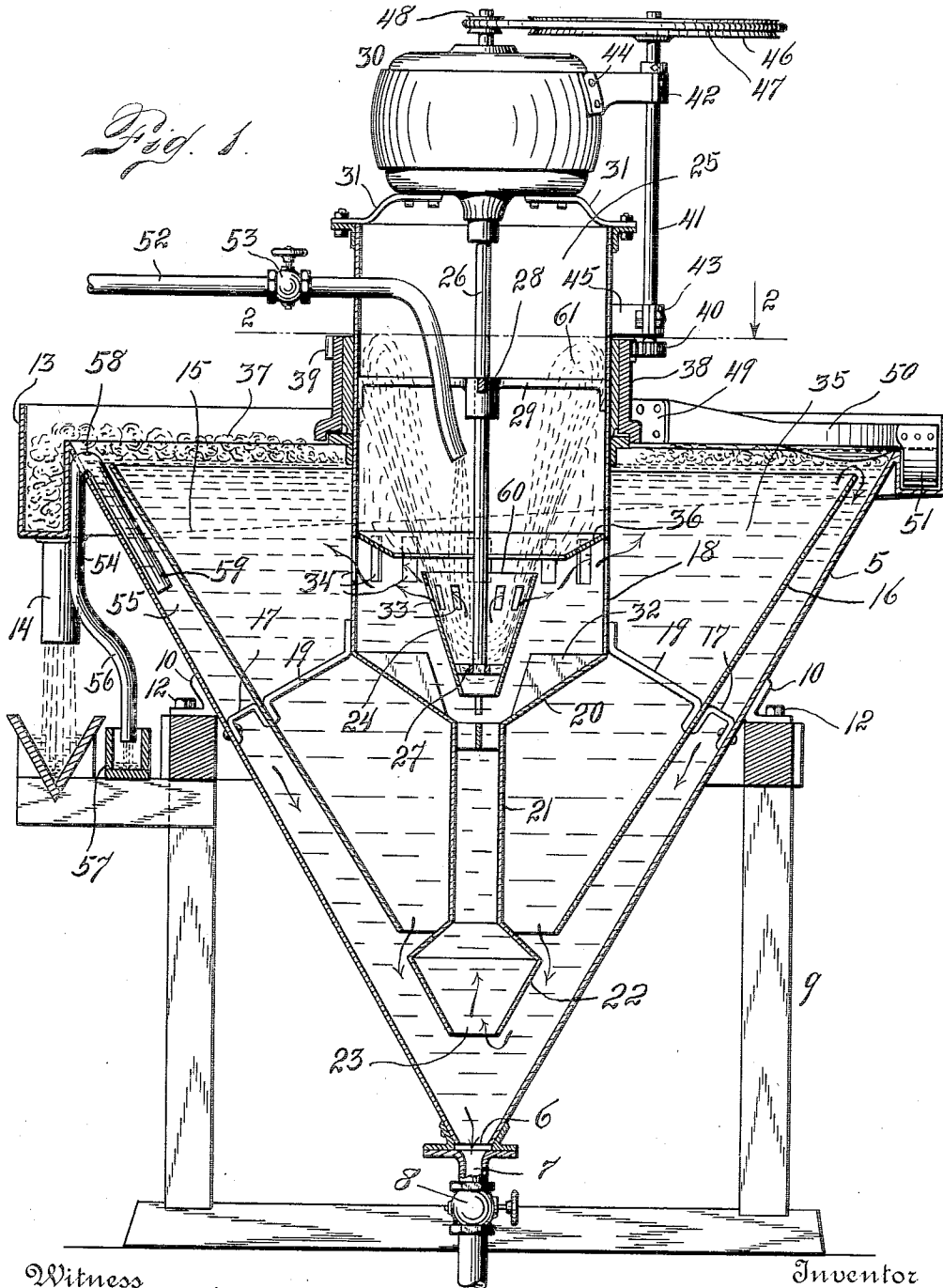
J. P. RUTH, JR.
 FLOTATION APPARATUS.

APPLICATION FILED MAY 16, 1916. RENEWED JAN. 20, 1919.

1,309,219.

Patented July 8, 1919.

2 SHEETS—SHEET 1.



Witness
Otto E. Hoddick.
John B. Wade.

Inventor
Joseph P. Ruth, Jr.
 By *A. J. S. Smith* Attorney

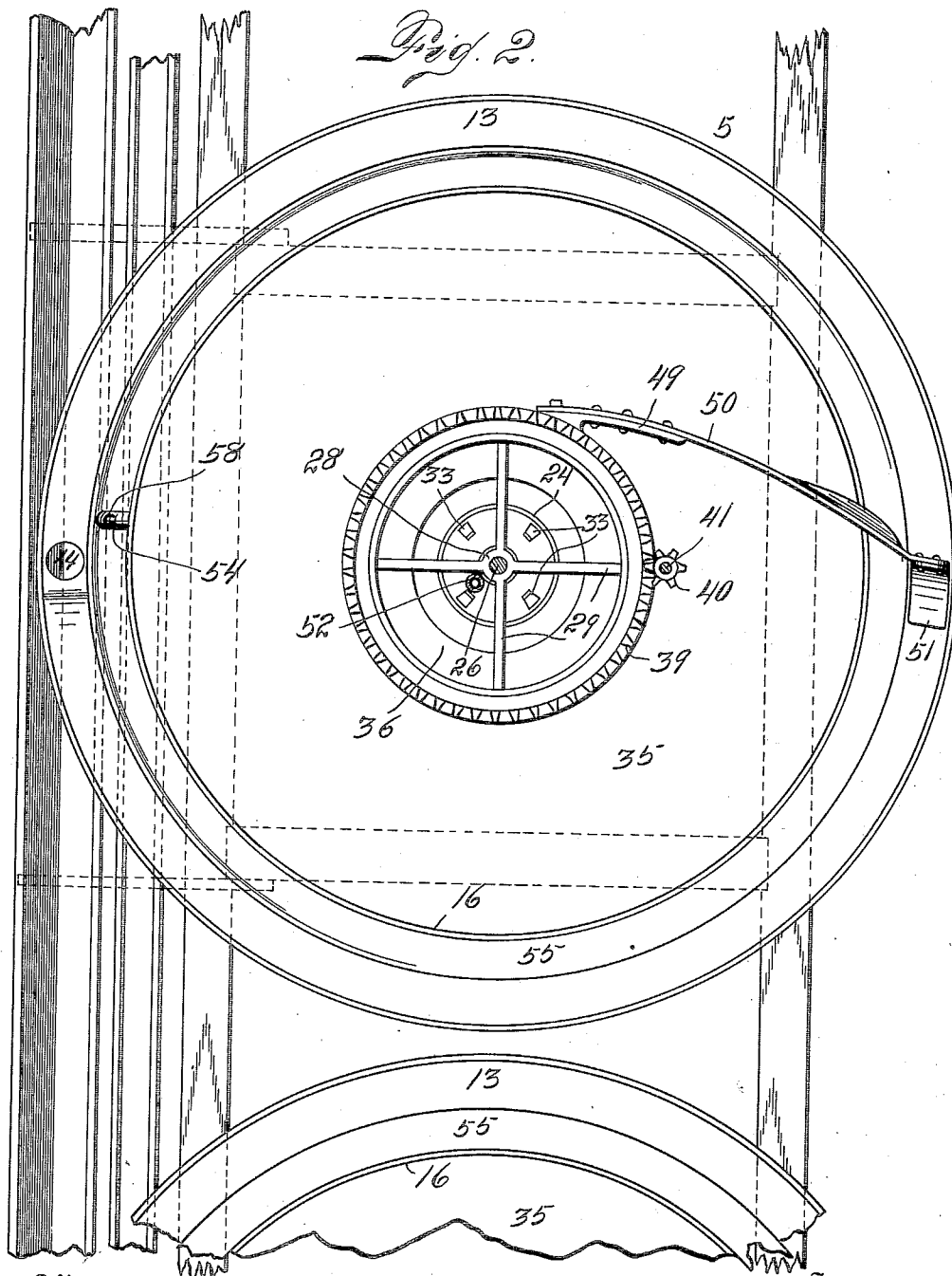
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UNITED STATES PATENT OFFICE.

JOSEPH P. RUTH, JR., OF INDEPENDENCE, COLORADO.

FLOTATION APPARATUS.

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Specification of Letters Patent.

Patented July 8, 1919.

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To all whom it may concern:

Be it known that I, JOSEPH P. RUTH, JR., a citizen of the United States, residing at Independence, county of Teller, and State of Colorado, have invented certain new and useful Improvements in Flotation Apparatus; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in flotation apparatus, my object being to provide an efficient construction for saving mineral values by what is known as the flotation process, whereby the mineral particles in the form of a pulp of suitable consistency when properly aerated and supplied with a suitable quantity of oil, shall be caused to float in the form of a froth or foam, while the gangue which is devoid of affinity for the oil and air bubbles, is caused to settle, resulting in the separation of the values or mineral particles. My further object is to provide a construction of this class which shall be exceedingly simple and therefore economical, and which shall at the same time efficiently perform the aforesaid function.

Heretofore there have been employed a number of distinct units connected in such a manner that the material to be treated is successively subjected to their action in order to impoverish the pulp of its mineral values. One of my objects is to provide a single unit which shall completely perform the function of separating the mineral values from the gangue, and whereby there is no necessity for the retreatment of the tailings after they leave the machine.

Generally speaking, my improved construction includes what may be termed a centrally located mixing compartment, a surrounding separation compartment, and an outermost compartment in which the gangue which has escaped the separation compartment, may settle to the bottom of the apparatus without any material interference from the agitation of the pulp. Within the mixing compartment is mounted a rotatable member having the shape of a hollow conical frustum, the same being open

at both ends and arranged to rotate on a vertical axis, the larger extremity of the frustum being uppermost. This frustum is provided with openings near its upper extremity through which the pulp is discharged under the action of centrifugal force, after which it passes through similar openings formed in the wall of the mixing compartment, passing thence into the separating compartment where the metallic values rise to the top in the form of froth or foam. The pulp overflows from the outer wall of the separating compartment into the gangue settling compartment whose outer wall extends somewhat higher than the adjacent wall of the separating compartment.

The rotary device moves very rapidly, whereby sufficient centrifugal force is generated to produce a cavity in the pulp which extends downwardly into the rotary device, the action of the centrifugal force causing the pulp to be thrown upwardly above the rotary device within the mixing compartment, considerably above the level of the pulp in the surrounding compartments, whereby the rising pulp in the form of a spray is caused to mingle with the atmosphere and return by gravity into the hollow rotary member, whereby a thorough aeration of the pulp is produced. The necessary oil for the treatment of the pulp is added to it before it enters my improved machine and the aeration of the pulp coöperates with the oil to perform the separating function, as heretofore explained. My improvement is equipped with an automatically actuated skimmer arm adapted to pass above the surface of the pulp in the separating and gangue-settling compartments, whereby the values in the form of froth or foam are skimmed off as they reach the surface and carried into an outer launder from which they are carried to tanks or receptacles for the saving of the concentrates.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing, in which is illustrated an embodiment thereof. In this drawing,—

Figure 1 is a central vertical section taken through my improved flotation apparatus.

Fig. 2 is a section taken on the line 2—2, Fig. 1, looking downwardly. In this view

a fragment of a second unit is illustrated as indicating that it is assumed that a plant may consist of a series or any suitable number of these units depending upon the required capacity.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate an outer cone-shaped tank or receptacle having its smaller extremity lowermost and open as shown at 6 to communicate with an outlet nozzle 7 equipped with a controlling valve 8 for regulating the discharge of the gangue. This tank 5 is supported upon a suitable framework 9, a suitable number of brackets 10 being employed for the purpose, said brackets being secured exteriorly to the tank 5 and also to the upper part of the framework 9 by means of suitable fastening devices 12. The upper edge of the tank 5 merges into a surrounding launder 13 having an outlet 14 leading downwardly from the lowest portion of its bottom, the latter being inclined as indicated by the dotted line 15 and in the usual or ordinary manner. Within the chamber of the tank 5 and suitably spaced therefrom is a frusto-conical member 16 which is supported upon the tank 5 by bracket members 17. The frustum-shaped member 16 is also connected with and spaced from a centrally located hollow casing 18, by bracket members 19. Any suitable number of the brackets or spacers 17 and 19 may be employed. The member 16 has its larger extremity uppermost to conform to the general arrangement of the tank 5, and is open at both extremities, its upper edge terminating a short distance below the upper edge of the wall of the tank 5. The lower extremity of the member 16 terminates a considerable distance above the bottom opening 6 of the tank 5.

Centrally located within the tank structure heretofore explained, is the casing 18 whose body portion is cylindrical in shape and extends both downwardly into and above the top of the surrounding tanks. The lower extremity of the casing 18 has a downwardly and inwardly tapering bottom 20 which merges into a vertically disposed conduit member 21 which at its lower extremity expands into an outlet nozzle 22 which has the shape of two hollow frustums placed base to base, the smaller extremity of one being integral with the lower end of the conduit member 21, while the lower extremity of the other is open as shown at 23 to receive the pulp as it is carried upwardly from the bottom of the tank 5 into the cylindrical portion of the casing 18, through the instrumentality of a rotary member 24 which consists of a hollow cone-shaped frustum having its lower extremity lowermost, its upper extremity terminating in the lower part of the so-called mixing chamber 25.

This frustum-shaped member 24 is suspended by a vertically disposed shaft 26 whose lower extremity is secured to the frustum-shaped member by a spider device 27 located a short distance above the lower open extremity of the member 24, the spider device being shaped to allow the pulp to travel freely through the member 24 when the apparatus is in use. This shaft 26 has a bearing 28 supported within the casing 18 by spider arms 29 whose inner extremities are formed integral with the bearing 28 and whose outer extremities are secured to the casing 18. This shaft 26 is rotated by any suitable motor 30 which, as illustrated in the drawing, is supported upon the top of the casing 18 by suitable arms 31.

The inclined bottom 20 of the casing 18 is provided on its upper surface with a number of upwardly projecting baffle plates 32 which are arranged at suitable intervals around the lower portion of the member 24 and have a tendency to retard the formation of a rotary current within the pulp in the lower part of the casing 18 due to the rotary action of the member 24. It is not desirable that a rotary current should be produced outside of the rotary member 24, since one of the objects of the last named member is to produce agitation due to its rotary action within the stationary casing 18. It is evident that if a rotary current were formed in the pulp around the member and traveling in the same direction as the latter, that agitation would be retarded rather than facilitated. Hence, the function of the baffles 32 is to retard the formation of such a current and thereby facilitate agitation due to the rotation of the member 24. The upper portion of this member 24 is provided with openings 33 for the escape of the pulp from within the hollow frustum 24, under the action of centrifugal force.

Furthermore, the casing 18 is also equipped with openings 34 suitably spaced and arranged around the upper edge of the member 24 and extending both above and below the same. These openings let the pulp out of the casing 18, into the separating chamber 35 surrounding said casing. Connected with the inner surface of the casing 18 which is above the opening 34, is the upper edge of a downwardly inclined flange 36 whose inner edge terminates in a circle extending around and somewhat larger than the upper extremity of the member 24, the inner edge of the said flange being also arranged a short distance above the top of the member 24. The flange 36 forms a sort of baffle to prevent the material which has escaped from the member 24 through the openings 33 into the chamber 25, from passing upwardly within the chamber of the casing, and whereby this pulp is caused to escape under the centrifugal force developed by 130

the member 24, into the separating chamber 35 in which the metallic sulfid values coated with a film of oil come in contact with the air bubbles and the selective action takes place as the bubbles rise to the surface and form the froth 37.

As heretofore stated, the casing 18 stands considerably above the top of the tank structure. Rotatably mounted upon this upwardly protruding portion is an annular collar 38 which is equipped at its upper edge with a gear 39 with which meshes a pinion 40 made fast to the lower extremity of a shaft 41 which is journaled in upper and lower bearings 42 and 43, the former being mounted on the motor as shown at 44 while the bearing 43 is connected with the casing 18 as shown at 45 or in any other suitable manner. The upper extremity of the shaft 41 is equipped with a pulley wheel 46 which is connected by means of a belt 47 with a similar but much smaller pulley wheel 48 made fast to the upper extremity of the shaft 26 which passes through the motor.

To the lower portion of the annular collar 38 is secured as shown at 49, a skimmer blade or arm 50 which is so located as to skim or remove the froth 37 from the top of the pulp contained in the tank structure, and cause the same to enter the launder 13, the outer extremity of the skimmer blade being equipped with a depending member 51 adapted to project downwardly a short distance into the launder for facilitating the removal of the froth, whereby the latter may be brought into position to enter the outlet pipe or nozzle 14.

The material to be treated mixed with the proper oil as heretofore explained, is fed into the upper portion of the chamber of the casing 18 through the medium of a conduit 52 equipped with a controlling valve 53. It is assumed that one extremity of this conduit is connected with a source of pulp supply while its opposite extremity is open for feeding the pulp to my improved apparatus. When the latter is in operation it is assumed that the valve 8 at the bottom of the tank 5 is so regulated as to draw off the gangue and water as fast approximately as the pulp enters the apparatus through the feed conduit 52. In any event the escape through the nozzle 7 must not be greater than the feed supply, and unless it can be accurately located it is better to have it a little less in capacity, since it is necessary in order to properly carry out the flotation principle of separation that the tank structure be practically filled with pulp and so maintained during operation. Hence, in order to compensate for any excess of pulp supply, I equip the apparatus with an overflow conduit 54 having one arm 59 extending downwardly into a settling compartment 55 while its other arm 56 is ex-

teriorly arranged to deliver the overflow to a tank or launder 57. The upper part of this pipe structure is provided with an opening 58 in order to prevent the siphoning of the pulp from the apparatus and whereby the pipe structure becomes simply an overflow. The reason the arm 59 is made to extend downwardly into the compartment 55, is that it is desirable to take the overflow from a quiet zone of the pulp or from a depth where there is as little agitation as possible and below the froth or foam, and, consequently, where the pulp is free from mineral values.

From the foregoing description the use and operation of my improved flotation apparatus will be readily understood. Assuming that the pulp has been delivered to the apparatus in any suitable manner as by way of the conduit 52 until the tank 5 is filled or approximately so, the motor 30 is then started and the rotary member 24 actuated at a high rate of speed, whereby a cavity 60 is formed in the center of the body of pulp within the casing 18, the bottom of said cavity extending downwardly well into the hollow member 24. The centrifugal force developed by the rapid rotation of the member 54 not only produces the cavity 60 in the pulp, but also causes the pulp to rise upwardly above the top of the tank 5 where it passes into the atmosphere in the form of spray 61, this spray finally striking the walls of the stationary casing 18 and being deflected backwardly and inwardly, returns through the atmosphere into the body of pulp and into the rotary member 24. Furthermore, the rotary action of this member produces the necessary centrifugal force to cause a constant flow of pulp through the openings 33 of the member 24 and through the openings 34 of the casing 18 below the baffle 36. This pulp which passes through these two sets of openings, enters the separating compartment 35 and the metal particles constituting the values, are laden with the necessary film of oil and are accompanied by the necessary air bubbles, to cause these metal particles to rise to the top of the pulp and form the froth or foam 37. It will thus be understood that this froth contains the metallic values, since they have the necessary affinity for the oil and attract the air bubbles in such a manner that the effect of the oil and the air upon the metal particles is entirely distinct and opposite from its effect upon the gangue. Hence, the metallic values rise to the top and are removed in the form of froth by the skimmer blade 50, while the gangue settles downwardly in the pulp of the tank structure and escapes at the bottom of the tank 5 through the valve-controlled outlet nozzle 7, the passage thereof being so regulated as to allow such

an escape as to approximately balance the pulp feed to the apparatus as heretofore explained.

The pulp is aerated not only while it is passing through the atmosphere as it rises upwardly under the action of the centrifugal force of the agitator 24 and returns to said agitator, but by virtue of the cavity 60 formed in the pulp below its level in the surrounding tank or receptacle, the pulp as it passes upwardly into engagement with the portion of the rotary agitator 24 where the openings 33 are located, is spread out into a comparatively thin sheet and as it passes through the openings 33, air is drawn through these openings with the pulp, thus resulting in aerating the pulp to a high degree and supplying the necessary air bubbles which coact with the oil to collect the values and cause them to rise to the top of the pulp, as heretofore explained. It will thus be noted that the agitator 24 is a very important and vital feature of this construction.

Having thus described my invention, what I claim is,—

1. In flotation apparatus the combination of a stationary pulp-containing tank, a stationary casing centrally located in the tank and having ports below the level of the pulp in the tank, a hollow open-ended member rotatable in the casing and entirely submerged in the pulp, said member also being provided with ports coöperating with the ports of the casing, and means for imparting rotary movement to the said member.

2. In flotation apparatus the combination of a stationary pulp-containing tank, a stationary ported casing centrally located in the tank, a hollow open-ended member rotatable in the casing and entirely submerged in the pulp in the tank, and means for imparting rotary movement to the said member.

3. In flotation apparatus, the combination of a stationary tank adapted to contain pulp, a stationary ported casing centrally located in the tank, a hollow open-ended member rotatable in the casing and located entirely below the level of the pulp therein, said member also having ports intermediate its extremities and coöperating with the ports of the casing, and means for imparting rotary movement to the said member.

4. In flotation apparatus the combination of a stationary cone-shaped tank, a centrally located stationary casing open at the bottom and equipped with ports intermediate its extremities, a hollow member suspended to rotate in the tank and also equipped with ports to coöperate with the ports of the casing, means for imparting rotary movement to the said hollow member, and a cone-shaped member open at both ends and sup-

ported between the tank and the said casing.

5. In flotation apparatus the combination of a cone-shaped tank having a controlled outlet at its bottom for the gangue, the smaller extremity of the tank being lowermost, a centrally located stationary casing whose lower extremity is open to receive the pulp and whose walls intermediate its extremities are provided with openings below the level of the pulp in the tank, a hollow rotary member having the shape of a conical frustum whose smaller extremity is lowermost, and means for imparting rotary movement to the hollow member.

6. In flotation apparatus the combination of a cone-shaped tank having its smaller extremity lowermost and open to permit a controlled discharge, a stationary casing centrally located in the tank and having its lower extremity open and reduced in size, an open-ended hollow frustum shaped member having its smaller extremity lowermost, the last named member being located between the said tank and the said casing, the lower reduced extremity of the casing passing through the opening in the bottom of the said frustum-shaped member, and a hollow frustum-shaped member mounted to rotate in the casing, the same being open at both ends and having its smaller extremity lowermost, the casing having openings below the top of the tank for the escape of the pulp under the action of centrifugal force produced by the rotary member.

7. In apparatus of the class described, the combination of a cone-shaped tank whose smaller extremity is lowermost and open to permit a regulated discharge, a centrally located stationary casing whose lower portion is reduced in size and extends well into the bottom of the tank, an interposed hollow frustum-shaped member open at both ends and having its smaller extremity lowermost, a hollow frustum-shaped member open at both ends and suspended to rotate in the lower part of the casing, the latter being provided with openings in its wall arranged in suitable proximity to the rotary member, the latter also being provided with coöperating openings, means for imparting rapid rotation to the rotatable member, means for feeding the pulp into the structure in regulated volume, and means for automatically removing at a single location at the top of the tank any excess of water.

8. The combination of a pulp-containing tank, means for drawing off pulp at the bottom of the tank in regulated volume, means for feeding pulp to the tank in regulated volume, a centrally located stationary casing supported in the tank, an interposed hollow frustum-shaped member suitably

spaced from the tank and casing, the said frustum-shaped member being open at both ends and having its smaller extremity lowermost, the said casing having its lower portion reduced in size and extending downwardly well into the lower portion of the said tank, a hollow open-ended member mounted to rotate in the lower part of the casing, the latter being provided with an interiorly projecting flange arranged above the level of the top of the rotary member, the wall of the casing having openings around the same just below said flange, and means for imparting rapid rotation to the rotary member.

9. In flotation apparatus, the combination of a tank adapted to contain pulp, a partition member located in the tank and forming a compartment, said compartment having communication with the tank, a hollow member open at one end and rotatable in the compartment and located entirely below the level of the pulp therein, said member having ports intermediate its extremities, and means for imparting rotary movement to said member.

10. In flotation apparatus, the combination of a tank adapted to contain pulp, a ported partition member located in the tank and forming a compartment, said compartment having communication with the tank, a hollow member open at one end, located in the compartment and entirely below the level of the pulp therein, and rotatable about a vertical axis, said member having ports intermediate its extremities and cooperating with the ports of the partition member, and means to impart rotary movement to said hollow member.

11. In flotation apparatus, the combination with a tank, a casing located in the tank and open at the bottom, a hollow member open at its lower end and mounted in the casing to rotate on a vertical axis, the hollow member having ports intermediate its ends and being located entirely below the level of the pulp in the casing, and means to impart rotary movement to the hollow member.

12. In flotation apparatus, in combination, a tank, an aeration compartment in the tank and open at the bottom, a hollow member open at its lower end and having ports intermediate its ends, said hollow member being rotatable in said compartment on a vertical axis, ports in the walls of the compartment cooperating with the ports of the hollow member, and a directing flange in the compartment and above the ports thereof.

13. In flotation apparatus, in combination, a tank, an aerating compartment located centrally in the tank and open at the bottom, a hollow member rotatable upon a vertical axis in the compartment, and being open at its lower end and having ports in-

intermediate its ends, ports in the walls of the compartment cooperating with the ports of the hollow member, and an annular directing flange on the inner walls of the compartment above the ports thereof.

14. In flotation apparatus, the combination with a tank having an aeration compartment therein, the compartment being open at its bottom, of a hollow member open at one end and having ports intermediate its ends, said hollow member being rotatable in said compartment on a vertical axis, and baffles in said compartment to prevent swirl, the upper portion of the compartment having communication with said tank.

15. In flotation apparatus, in combination, a tank, a partitioning member in the tank dividing the tank into an aerating compartment and a settling compartment, the upper portion of the aerating compartment having communication with the upper portion of the settling compartment, the aerating compartment having an opening at its bottom, a tubular member forming a communicating passage between the lower end of the settling compartment and said opening in the bottom of the aerating compartment, and an aerating member rotatable on a vertical axis in said aerating compartment.

16. In flotation apparatus, a tank, a partition in the tank dividing the tank into an aerating compartment and a separating compartment, the upper portion of the aerating compartment having communication with the upper portion of the separating compartment, the bottom of the aerating compartment having an opening therein, a conduit connecting the lower end of the separating compartment with said opening, and a member rotatable on a vertical axis in said aerating compartment.

17. In flotation apparatus, a tank, a partitioning member in the tank dividing the tank into an aerating compartment and a settling compartment, the aerating compartment having communication with the upper portion of the settling compartment and having an opening in its bottom, a conduit of relatively small cross-section connecting the lower end of the settling compartment with said opening, and a member rotatable on a vertical axis in said aerating compartment.

18. In flotation apparatus, in combination, a tank, a casing contrally located in the tank and providing an aerating compartment within it, the space outside the casing constituting a settling compartment, a hollow aerating member rotatable in said aerating compartment on a vertical axis, the aerating compartment having communication with the upper portion of the settling compartment and having an opening in its bottom, and a tubular member forming a communicating passage between the lower end of the

settling compartment and the opening in the bottom of the aerating compartment.

19. In flotation apparatus, a tank, a walled member mounted within said tank having
5 its walls spaced from the walls of the tank and having upper edges thereof positioned below the upper edges of the tank, said member being open at its bottom, a casing within said member constituting an aeration
10 compartment, and a hollow member rotatable in said aeration compartment, said casing being open at its bottom and the aeration compartment having communication with the upper portion of the space between said
15 walled member and said casing.

20. Apparatus for separating minerals by

flotation, comprising in combination with a container, a chamber therein, a suction-wheel having a rotary movement in said chamber and composed of an open-top vessel having peripheral openings for the discharge of its contents, and means for feeding material into the wheel, the chamber having an outlet for the material after it is discharged through the openings of the
25 wheel.

In testimony whereof I affix my signature, in presence of two witnesses.

JOSEPH P. RUTH, JR.

Witnesses:

GRACE HUSTON,

A. EBERT O'BRIEN.