Oct. 24, 1933. W. L. SHEELER 1,932,089

FLOTATION CELL STRUCTURE

Filed Aug. 21, 1931

Fig. 1.

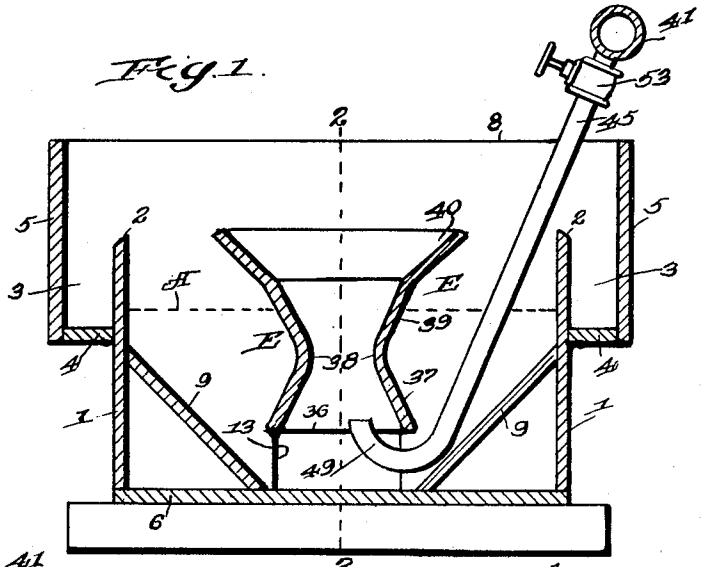


Fig. 2.

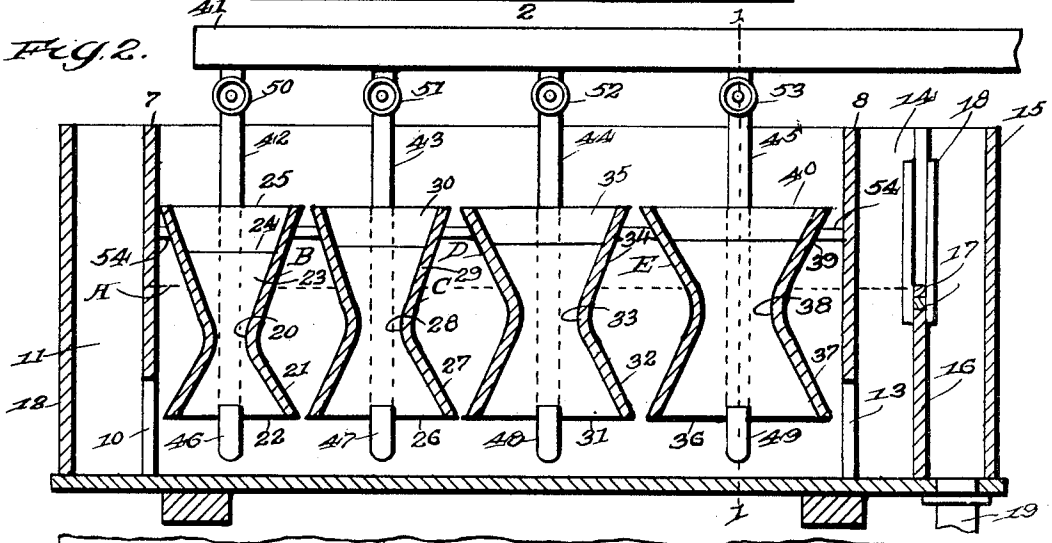
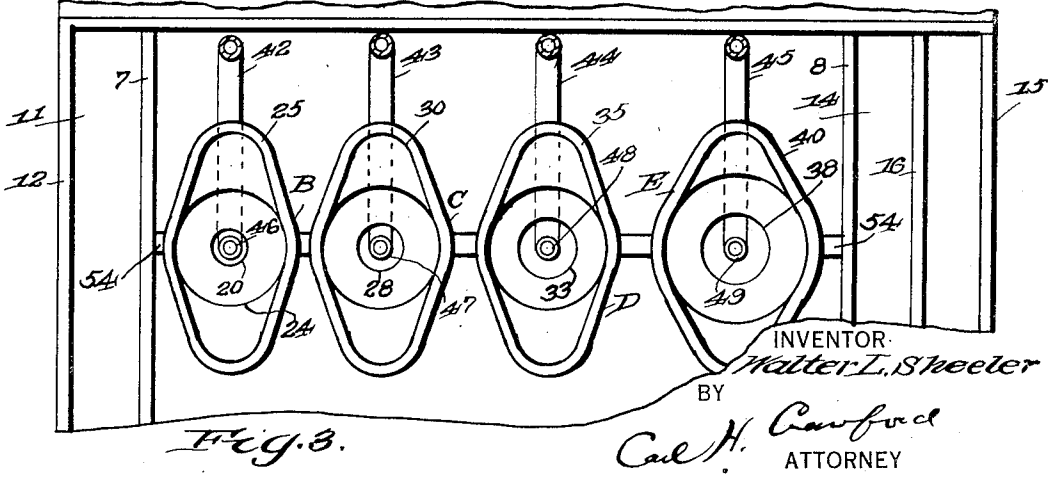


Fig. 3.



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FLOTATION CELL STRUCTURE

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11 Claims. (Cl. 261—121)

This invention relates to improvements in flotation cells and is an improvement on my pending application filed January 23, 1930, Serial No. 422,880.

One of the objects of this invention is to simplify the structure and avoid the use of certain elements in my above case under various conditions of operation.

The invention includes a tank for the solution and a plurality of Venturi pipes having lower ingress ends immersed in the solution and upper egress ends open to atmosphere and adapted to discharge accumulated froth down onto the solution level in said tank, each Venturi pipe taking the solution in at its ingress end and discharging at its egress end and each pipe thereby being completely independent in operation.

A feature of the invention consists in extending the egress ends to form expansion chambers whereby the accumulated froth may build up in each thereof, in full exposure to atmosphere, and in the most improved form of the invention, these extensions project beyond the Venturi structure proper.

The invention also includes the feature of employing Venturi pipes of different sizes and supplying each thereof with a gaseous agent in accordance with the volume and working conditions required by the various sized venturi.

A further feature consists in Venturi pipes having constrictions of different sizes, independent of, and in combination with this type of pipe, in which the constrictions are disposed at different elevations with respect to each other.

The invention has many other features and objects which will be more fully described in connection with the accompanying drawing and will be more particularly pointed out in and by the appended claims.

In the drawing:—

Fig. 1 is a vertical sectional view of a cell embodying my invention taken on line 1—1 of Fig. 2.

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Fig. 3 is a plan view partly broken away.

Like characters of reference designate similar parts throughout the different figures of the drawing.

In the drawing, I have shown a cell having side walls 1, the upper edges 2 of which form weirs. Launders 3 are constituted by bottom and side walls 4 and 5, respectively, and the upper portions of walls 1, as will be clear from Fig. 1. A bottom wall 6 connects with side walls 1 and with end walls 7 and 8 to thereby form a tank for the solution, the level of which is indicated at A. Converging walls 9 serve to localize lower portions of the solution near the lineal center of the tank.

The end wall 7 is located at the ingress end of the tank and has an ingress opening 10 for passage of the solution therethrough. An ingress chamber for the solution is indicated at 11 and is formed by the bottom wall 1, end wall 7, and an outer wall 12. The wall 8 is at the egress end of the tank and is provided with an egress opening 13 communicating with a discharge chamber 14 formed by walls 8, 15 and bottom 6. This discharge chamber is provided with a weir 16 having fillets 17 which latter are insertable between guide bars 18. An outlet pipe 19, opens through bottom wall 6.

The foregoing structure is substantially the same as is shown in my heretofore referred to pending case.

Reference will next be made to what more particularly constitutes the structure of my invention, in combination with any suitable form of solution tank.

A series of mineral collecting bubble stream forming pipes is indicated at B to E, and while all of these pipes are generally alike in structure and function, there are specific distinctions that require each to be designated by different numerals.

Pipe B, which is nearest to the ingress end of the tank has a constriction 20, a lower section 21, and the latter has an ingress end 22 that is immersed in the solution below the level A. Said pipe B has an upper section 23, above the constriction 20, and the proportions are such that this pipe, like all the others, will afford a Venturi action. However, the Venturi structure, strictly speaking, is between the bottom 22 and line 24 of the upper section 23, in the present illustration.

From line 24 to the top 25, the pipe is enlarged or flared to form a limited expansion chamber in which the froth can cumulatively build up in full exposure to atmosphere before it is discharged over the top edge of said chamber down onto the solution level A. In order to conserve space, when the pipes are disposed in a row, as shown in the present illustration, the major portion of the enlargement is transversely of the tank, as clearly shown in Figs. 1 and 3. Thus, from line 24, upwardly, the pipe ceases to be a venturi or have any Venturi action, as will be more particularly described in the operation, later on. In this connection, however, the number 25, will designate the enlargement or limited froth expansion chamber.

Pipe C, has an ingress end 26 in its lower section 27 and a constriction 28 slightly enlarged with respect to constriction 20, and at a slightly higher elevation than the latter. The upper section 29, terminates in an enlargement or limited expansion chamber 30. Pipe D, has an ingress end 31 in its lower section 32 and a constriction 33 slightly larger and at a slightly higher elevation than the constriction 28 of pipe C. The upper section of pipe D, designated at 34, terminates in an enlargement or limited froth expansion chamber 35. Likewise, pipe E, has an ingress end 36, for its lower section 37, and a constriction 38, which is larger and at a higher elevation than constriction 33 of pipe D. The upper section 39, terminates in an enlargement or limited expansion chamber 40.

Reference will next be made to the means for establishing and maintaining a hydrostatic differential causing the solution to ascend in said pipes in the form of mineral collecting bubble streams.

A manifold 41, is shown extending longitudinally of the cell and is suitably connected with a source of supply of a gaseous agent, which may be air. Gaseous supply pipes 42 to 45 connect with said manifold and extend downwardly in the cell tank where the lower ends are bent, as indicated 46 to 49, so that each of said pipes delivers to a Venturi pipe at the ingress end thereof and sufficiently above the latter to insure ascent of the delivered air into the Venturi pipes and prevent delivery of the gaseous agent laterally of said pipes. I have shown the delivery pipes 42 to 45 of the same size although this is not material. Pipe 42, has a valve 50, pipe 43, a valve 51, pipe 44, a valve 52 and pipe 45, a valve 53, therefore the volume of air that is supplied to each Venturi pipe can be controlled. This is a feature of importance, in combination with Venturi pipes of different sizes, as will be later described.

Treated ore solution is fed into the ingress chamber 11 and the level A, or any variation thereof, is maintained in the tank by the fillets 17, over which the solution discharges after being treated in the tank by the novel features, the operation of which is about to be described, the pipe 19 conveying the egressing material. Of course if a solution contains more than one type of ore, one will be treated in the tank and the remaining values of other ores will pass off with the gangue to another tank, as will be understood by those skilled in the art, but I have thought it sufficient to show only one tank and its equipment, as each of a gang of tanks would merely perform its individual function in the same way. It will be understood that the solution being treated in the tank will have received whatever frothing and other reagents necessary.

Now assuming that a solution level has been attained in the tank, as for example at dotted line A, and the valves 50 to 53 have been opened to deliver a gaseous agent to the ingress ends of each Venturi pipe B to E, preferably in large volume and low pressure, it will be seen that such delivery will create and sustain a hydrostatic differential in the tank favorable to the interiors of the Venturi pipes and hence the buoyancy of the solution therein will cause the latter to ascend. The ascent of the solution will be accompanied by a stream of mineral collecting bubbles in each of the Venturi pipes as a result of the gaseous agent delivered thereto. The bubbles collect the values, as will be understood by those skilled in the art.

Because of the Venturi action of the pipes B to E, there will be an acceleration of ascent in the lower sections thereof because of the convergence, and this acceleration will attain its maximum at the constrictions and thereafter, the ascent will be retarded in velocity by the divergence of the upper sections of said pipes. As the solution ascends in the lower sections, any large bubbles will be broken up by the convergence and the constriction, into small bubbles, with a thorough aeration of the solution resulting, and an intimate mixture and diffusion of the reagents with the ascending solution. When the solution ascends above the constrictions, the bubbles reform into a fine froth which is accentuated by full exposure to atmosphere and expansion permitted by the upper expansion portions, permits the froth cumulatively to build up and finally discharge over the tops of the pipes B to E onto the solution level. The froth then surges over the weirs 2, into the launders 3.

It will now be clear that each of the Venturi pipes B to E, has its own individual ingress end and its own individual expansion egress, and the coaction of said pipes is due to the fact that they all are supplied from the same tank of solution and that the latter may pass a plurality of times through each or all of said pipes while the solution is being treated.

In the more restricted venturi, as for instance, in pipe B, which is nearest the ingress end of the tank, you would obtain a relatively higher or greater velocity than in any of those pipes C to E, toward the egress end of the tank. Thus, pipes B and C would treat and bring into contact with the reagents, a greater volume of solution than pipes D and E, per minute, although the duration of contact would of course be less than with pipes D and E. Therefore, throughout the cell, advancing from the ingress toward the egress end, velocity is decreased and duration is increased.

Now while it is true that in the initial venturi, the duration of contact is reduced by virtue of increased velocity, it is also true that greater recoveries are made in the inital ventur and the recovery decreases as you approach the egress end of the tank, and it is a great advantage to have a greater or increasing volume of froth near the egress end of the tank where the values become leaner, because this increases recovery efficiency where it is most needed. It will be clear that in the smaller venturi where the velocity is greatest, the froth volume is correspondingly more quickly built up than in the slower velocity pipes nearest the egress end of the tank.

It will therefore be clear that with this improved construction, a greater capacity can be obtained from a relatively smaller cell than was heretofore possible.

In addition to the fact that the capacity of the cell is greatly increased without a corresponding increase in size, it will also be clear that with the smaller initial pipes B and C, a lesser volume of air or gaseous agent is required to prime and sustain them in operation as compared to the larger pipes D and E, hence, I obtain a two fold advantage. It will now be clear that the feature of independent valve control of the several pipes 42 to 45, for supplying the gaseous agent to pipes B to E, assumes an interdependent relation of inventive significance, as without such independent control, a part of the savings in economy would be lost.

As regards the difference in size of the pipes B to E, it is informative to state that the invention resides in the varying size of the constrictions

and size of the pipes, and in either thereof alone.

It will be seen that the feature of disposing the constrictions 20, 28, 33 and 38, at gradually increasing heights from the ingress toward the egress ends of the tank not only affords the advantage of locating the lower ends of the pipes B to E on substantially the same level so as not to result in a higher solution level, but it also provides for longer lower sections of said pipes, which is a distinct advantage in carrying out the lower velocity feature, and affording a larger area for diffusion of the reagents and also duration of contact thereof with the values. With the gradually longer lower sections, the volume of gaseous agent supplied can be very materially increased, for example in section 37 of pipe E, with respect to section 21, of pipe B.

It will be further understood that in the larger pipes, not so much gangue will be carried up and over the tops into the froth onto the solution level by reason of the fact that the lower sections are not only larger but longer and the velocity is so reduced that the heavier specific gravity of the gangue is freer to become effective and cause the gangue to descend in the pipes if it has entered them at all. This would be true irrespective of whether the constrictions were disposed at successively higher elevations or not.

It will also be clear that while I have shown the pipes B to E having gradually larger restrictions or constrictions from the ingress to the egress end of the tank, and the elevations thereof increasing in the same direction, it will be clear that this is important and valuable in some installations but not essential to all, as under some conditions, the reverse might be necessary or advisable, and hence, in view of the disclosure herein made, I deem it within the purview of my invention if the pipes have a varying or variable constriction and the same or different elevation thereof, irrespective of the order in which the variation is present.

In view of all the foregoing, it will now be clear that there is a most intimate interdependence between the individual valve controlled pipes 42 to 45, and the Venturi pipes B to E, of different size, since in addition to the inherent ability of the proportion of the venturi to vary velocity and duration, I provide control of the air, by means of which latter, I can obtain intensive adjustment of velocity in the Venturi pipes within a relatively wide range provided by each thereof.

I have generally indicated at 54, in Figs. 2 and 3, that the Venturi pipes B to E are rigidly secured in the position shown although they may be anchored in any desired manner.

It is desired to emphasize the fact that in this improved form of the invention, as well as in the pending case hereinbefore referred to, it is a desideratum of the invention to provide a cell that will efficiently operate with a large capacity, with the solution at a shallow depth, such for example as two and one half to three feet or less. It is further important to employ a gaseous agent, not an air lift, but at such low pressure and large volume that the mineral collecting bubble streams will be initiated and sustained by buoyancy.

It is believed that the invention and its operation will be fully understood from the foregoing description, and while I have herein shown and described one specific form of the invention, I do not wish to be limited thereto except for such limitations as the claims may impart.

I claim:—

1. In a flotation cell, a tank for the solution, a series of independently acting Venturi pipes having lower ingress ends immersed in the solution and upper egress ends open to atmosphere above the solution and adapted to discharge froth down onto the solution level and the egress end of each pipe being extended to form a froth expansion portion, whereby portions of the solution may pass a plurality of times through any one or all of said pipes and expand in each thereof prior to discharge, and means delivering a gaseous agent to the ingress ends of said pipes to create a hydrostatic differential and cause mineral collecting bubble streams to ascend in said pipes.

2. In a flotation cell, a tank for the solution, a series of independently acting Venturi pipes having lower ingress ends immersed in the solution and upper egress ends open to atmosphere above the solution and adapted to discharge froth down onto the solution level, the constrictions of said venturi being disposed at different elevations with respect to each other, and means delivering a gaseous agent to the ingress ends of said pipes to cause mineral collecting bubble streams to ascend therein.

3. In a flotation cell, a tank for the solution, a row of independently acting Venturi pipes having lower ingress ends immersed in the solution and upper egress ends open to atmosphere above the solution and adapted to discharge froth onto the solution level, the constrictions of said row of venturi being disposed at gradually increasing elevations with respect to each other from that pipe at one end of the row to that pipe at the remaining end of the row, and means delivering a gaseous agent to the ingress ends of said pipes to cause mineral collecting bubble streams to ascend therein.

4. In a flotation cell, a tank for the solution, a series of independently acting Venturi pipes having lower ingress ends immersed in the solution and upper egress ends above the solution and adapted to discharge froth onto the solution level, the constrictions of said venturi being disposed at different elevations with respect to the respective ends of said venturi, and means for causing the solution to ascend in said pipes.

5. In a flotation cell, a tank for the solution, a series of Venturi pipes having lower ingress ends immersed in the solution and upper egress ends above and adapted to discharge froth onto the solution level, the constrictions of said Venturi pipes being disposed at different elevations with respect to each other and with respect to the lower ends of the respective pipes, and means for causing mineral collecting bubble streams to ascend in said pipes.

6. In a flotation cell, a tank for the solution, a series of Venturi pipes having lower ingress ends immersed in the solution and upper egress ends above and adapted to discharge froth onto the solution level, the constrictions of the several pipes being of different diameter with respect to each other, and means for causing mineral collecting bubble streams to ascend in said pipes.

7. In a flotation cell, a tank for the solution, a row of Venturi pipes having lower ingress ends immersed in the solution and upper egress ends above and adapted to discharge froth onto the solution level, the constrictions of said pipes being enlarged from one extreme pipe of the row to the remaining extreme pipe of the row, and means for causing mineral collecting bubble streams to ascend in said pipes.

8. In a flotation cell, a tank for the solution, a series of Venturi pipes having lower ingress

ends immersed in the solution and upper egress ends above and adapted to discharge froth onto the solution level, the constrictions of the several pipes being of different diameter and at different elevations with respect to each other, and means for causing mineral collecting bubble streams to ascend in said pipes.

9. In a flotation cell, a tank for the solution having ingress and egress ends, a row of Venturi pipes in said tank having lower ingress ends immersed in the solution and upper egress ends above and adapted to discharge froth onto the solution level and said pipes extending in a row from the ingress to the egress ends of said tank, the constrictions of said pipes being enlarged and at successively higher elevations from the ingress toward the egress ends of said tank, and means for causing mineral collecting bubble streams to ascend in said pipes.

10. In a flotation cell, a tank for the solution, a series of Venturi pipes having lower ingress ends immersed in the solution and upper egress ends open to atmosphere and adapted to discharge froth down onto the solution level, said Venturi pipes being of different sizes whereby the velocity of flow and duration of contact will vary in different Venturi pipes, a gaseous feed pipe delivering to the ingress end of each Venturi pipe to sustain an ascending mineral collecting bubble stream in each thereof, and each gaseous feed pipe having an independent valve control to vary the volume of gaseous agent delivered to the Venturi pipes in accordance with the requirements of each thereof.

11. In a flotation cell, a tank for the solution, a series of Venturi pipes having lower ingress ends immersed in the solution and upper egress ends open to atmosphere and adapted to discharge froth down onto the solution level, said Venturi pipes being of different sizes whereby the velocity and duration of contact will vary in different Venturi pipes, and means for causing mineral collecting bubble streams to ascend in said Venturi pipes.

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