April 21, 1959 A. C. DAMAN 2,883,169

AERATING APPARATUS FOR FLOTATION PULPS

Filed April 29, 1955 2 Sheets-Sheet 1

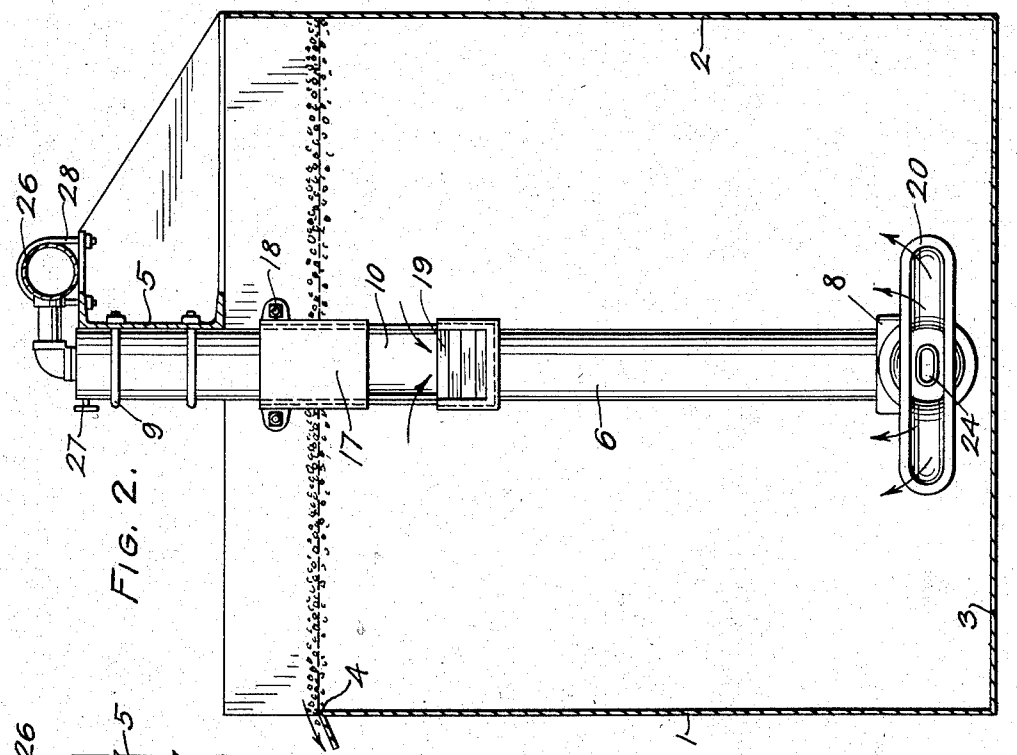

FIG. 2.

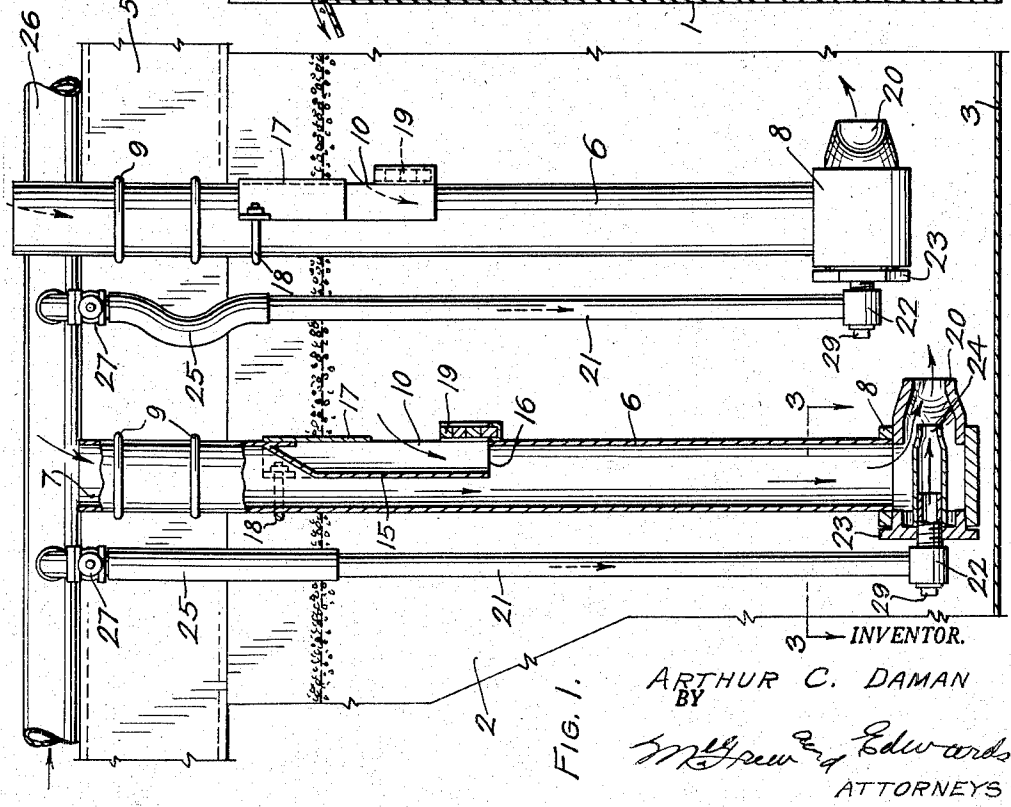

FIG. 1.

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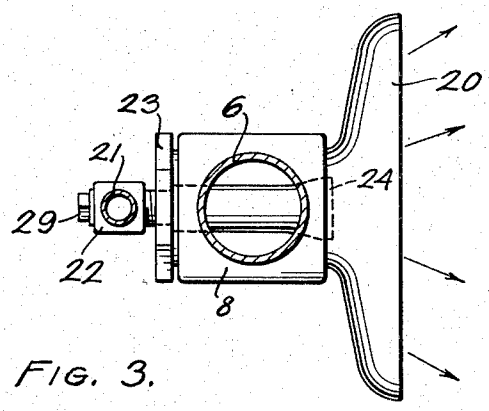

FIG. 3.

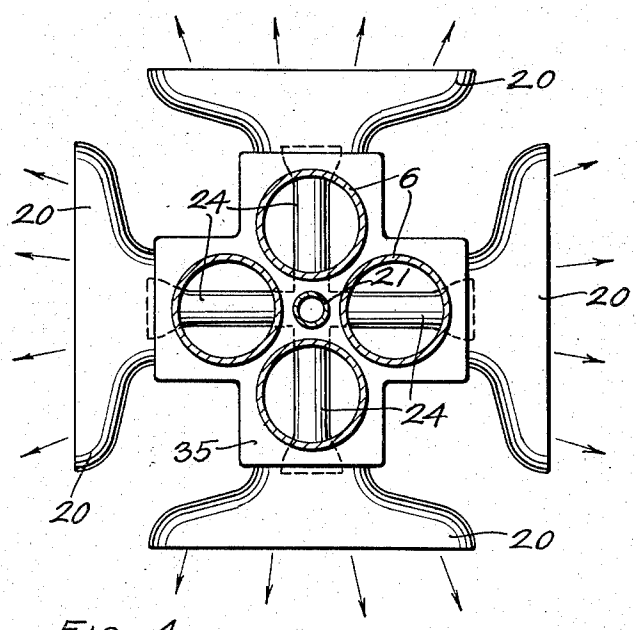

FIG. 4.

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AERATING APPARATUS FOR FLOTATION PULPS

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Application April 29, 1955, Serial No. 504,950

3 Claims. (Cl. 261—77)

This invention relates to aerating apparatus and more particularly to improvements in apparatus for aerating and circulating liquids in a treatment zone, especially for aerating froth flotation ore pulps.

In general, the invention of the present application includes an aerating unit for use in an upright tank which holds a pool of an ore pulp or a liquid in a substantial depth. The aerating unit, also, provides circulation of the liquid in the pool from the bottom to the top thereof, and, further, provides two zones of aeration. The circulating and aerating unit includes a confined zone which is aspirated from the bottom by means of a jet pump utilizing a gas as the injector medium. Liquid is introduced into the confined zone from a point below the surface of the pool, and it is permitted to cascade to the bottom of the confined zone in the presence of low pressure aerating gas as a first stage aeration. The liquid from the cascading column is then subjected to a second stage where it is aerated and admixed with the gas from the jet pump. As the liquid cascades down the confined zone, it is maintained in intimate contact with either atmospheric air or low pressure gas, and it is contacted with high pressure air or gas in the second stage. The unit provides a vertical circulation of the fluid in the cell, keeping the fluid well agitated and mixed without interfering with the frothing action. For froth flotation, the vertical circulation prevents a build up of a heavy layer immediately below the surface of the pool. Such a heavy layer is formed in a froth flotation machine where there is little or no vertical circulation of the pulp, and it is formed by particles which will float to the pool surface but do not have enough buoyancy to pass up into the froth bed.

The aeration unit may be utilized in a single cell or in a series of single cells in a froth flotation battery. The unit may, also, be utilized in series spaced along an elongated tank, known as a "hog trough flotation machine." The aerating unit may, furthermore, be utilized as a booster for flotation machines utilizing rotary aerating and circulating impellers. Since the aerating unit is small and does not require impellers, motors, and the like, it may be placed in the unobstructed parts of a cell in conjunction with other types of aerating equipment, or with other similar units.

A principal object of the present invention is to provide an improved aeration device which utilizes a confined zone which is aspirated by a gas jet pump for circulating liquid in the pool and for intimately mixing aerating gas with the liquid.

Another object of the invention is to provide an aeration machine which provides two zones of aeration wherein one zone utilizes an initial mixing of liquid and low pressure gas in a cascading column and the other zone

utilizes a high velocity stream of gas for mixing and aerating the cascading liquid.

A further object of the invention is to provide an efficient circulating system in an aerating machine which prevents the formation of a high density layer beneath the froth bed of incompletely treated solids in a froth flotation treatment.

Still another object of the invention is to provide a versatile aeration machine which may be used alone, in series with similar units, or with conventional and other type aeration machines.

A further object of the invention is to provide an efficient aeration machine which circulates liquid in a pool and aerates the liquid on very low power requirements.

These and other objects and advantages of the invention will be readily understood by referring to the following specification and appended drawings, in which:

Fig. 1 is a side elevation, in partial section, of an aerating machine according to the present invention;

Fig. 2 is a front elevation of an aerating unit according to the present invention;

Fig. 3 is a top plan view showing the details of the discharge head of aerating unit according to the invention; and

Fig. 4 is a modified head of an aerating unit.

Fig. 1 illustrates the positioning of two aerating and circulating units in a hog-trough type flotation cell, but it is to be understood that the invention is not limited to use of the aerating units in a hog trough flotation tank or conneced in series along a flotation machine. The units may be used in single cells, alone or in combination with other types of mechanical agitators and aerators and the like. As illustrated, the flotation tank comprises a substantially upright front wall **1** and a back wall **2** interconnected by means of the bottom wall **3**. The ends of the tank are closed by end walls, not shown, forming a tank for holding a pool of pulp or other liquid to be aerated in a substantial depth. A mounting superstructure **5** is mounted on the top of the tank in a position to hold various parts of the equipment for suspension into the pool and for holding air lines and the like. The aerating unit includes a stand pipe **6** which extends from a point above an overflow lip **4** to a point near the bottom **3** of the pool. The stand pipe **6** has an open top **7** which is in free communication with the atmosphere, and the lower end of the pipe terminates in a distributor head **8**, described in further detail below. The stand pipe **6** is secured to the superstructure **5** by means of clamps **9** which hold the stand pipe at a predetermined height in relation to the tank bottom. The device in Fig. 1 is illustrated with the left unit extended almost to the bottom of the tank, while the right unit is pulled up away from the bottom of the tank; the units, however, may be placed at any desired height in the tank. The stand pipe **6** is provided with an opening **10** in a position to be below the surface of the pool so that pulp from the pool enters the stand pipe **6**. A baffle **15** internally of the stand pipe **6** is secured to the pipe above the opening **10** and provides a lower opening **16** which extends downwardly internally of the stand pipe. The baffle **15** prevents direct upward communication with the interior of the pipe. An adjustable baffle plate or shield **17** is mounted on the stand pipe **6**, and is adjustably retained by means of a U-clamp **18** secured around the pipe **6**. The froth baffle **17** adjustably closes the upper portion of the opening **10** so as to permit main-

taining the opening 10 below the froth bed, which prevents the froth from entering the stand pipe 6. Weir blocks 19 provide an adjustable weir for opening 10, which provides an additional control for the opening 10 in relation to the shield 17. The shield 17 in the weir 19 provides means for controlling the size of the opening 10 in the stand pipe 6 so that it may be positioned at various heights or positions below the surface of the pool to provide a desired flow of pulp into the pipe 6 without permitting froth from the froth bed to enter the same. The distributor head 8 includes a fan-shaped outlet nozzle 20 through which pulp in the stand pipe is discharged back into the lower portion of the pool. The head is secured to the stand pipe 6 in such a manner that it may be turned to direct the nozzle into any horizontal direction in the pool, and the adjustable stand pipe 6 provides means for adjusting the height of the nozzle in relation to the bottom of the pool. An air line 21 extends from an upper part of a flotation tank to a lower portion thereof and is secured to an air header or a tee 22 which is secured to a back plate 23 of the head 8. A fan-shaped gas discharge nozzle 24 is secured to and communicates with the conduit 21 through the header 22. The gas nozzle 24 is positioned adjacent the internal end of the fan discharge so that by-passing high velocity gas through the discharge 24 an aspirating or ejector action is created, which draws pulp from the stand pipe 6. The gas conduit 21 is secured to a flexible connector or hose 25, which permits the conduit to be raised or lowered with the pipe 6 without changing the length of the conduit. The conduit 21 is interconnected to a main header conduit or supply line 26 supported on the superstructure 5. A valve 27 controls the flow of gas to the aerating unit from the header 26. The header 26 is secured to the superstructure by means of U-clamps 28. Where the connection 22 is a tee, and a single gas outlet 24 is utilized, a plug 29 is utilized to close the unused opening of the tee.

In the modified form illustrated in Fig. 4, four stand pipes 6 are utilized in a group attached to a cross-shaped distributor head 35. A flared outlet nozzle 20 is secured to each outlet of the distributor 35, and provides means for distributing pulp from the stand pipes 6 into four directions. The gas conduit 21 is connected to four intersecting nozzles 24 which extend from the conduit 21 to the throat of the distributor head 20. Gas passing through the conduit 21 and out the outlet throats of the nozzles of the distributor aspirates each of the stand pipes 6. Each stand pipe 6 has an opening 10, as described above, for the entry of pulp from below the surface of the pool.

In operation the tank is filled with a liquid up to the lip 4, and the shield 17 and weir blocks 19 are adjusted to have the opening 10 at a point below the surface of the liquid. Gas valve 27 is opened releasing gas through conduit 21 and through the outlet 24 as a high velocity stream of gas. The high velocity stream of gas passing through the throat of the nozzle 20 aspirates the stand pipe 6 at a discharge rate to prevent a stand of liquid in the stand pipe. As pulp is aspirated from the pipe, more pulp from the upper portion of the tank passes into opening 10 and cascades downwardly past baffle 15 to the nozzle 24. The stand pipe 6 is open at upper end 7 to atmospheric air which admixes with the cascading pulp. The mixed air and pulp is further aerated by contacting the gas from the stream of gas exhausting from the jet 24. The ejector action mixes the pulp in the pipe 6 with the gas. The aerated pulp passes out through the fan-shaped nozzle 20 and rises toward the surface. Pulp from the upper portion of the pool passes into the stand pipe 6 providing a vertical, circulating action of the pulp which aids the movement of treated material into the froth bed. The solid material which has enough buoyancy to pass from the bottom toward the upper part of the pool but not sufficient buoyancy to

enter the froth bed is pulled into the stand pipe 6 by the circulating pulp thereby preventing a high density layer build up which hinders normal froth flotation.

In many froth flotation treatments, air is the gaseous medium for forming the froth. In such case high pressure air may be conveyed through the main header 26 into the jet 24, and the stand pipe 6 has its upper end 7 open to the atmosphere. Other gases, however, may be utilized instead of the air. Where a gas other than air is used, low pressure gas may be introduced into the stand pipe 6 instead of atmospheric air and high pressure gas is passed through the header 26. The apparatus provides a double aeration action and mixing of liquid with the aerating gas, as well as providing a vertical circulation of the liquid in the pool.

While the invention has been illustrated by means of specific examples, there is no intent to limit the invention to the precise details so disclosed, except insofar as set forth in the following claims.

I claim:

1. An aerating unit for a froth flotation machine containing a body of pulp having a froth bed overflowing from its surface, comprising a tubular body having an upper opening for the admission of atmospheric air extending downwardly into the body of the pulp and terminating in a lower outlet at an adjustable distance from the bottom thereof, an adjustable opening inlet for pulp in the upper portion of said tubular body adjacent to and spaced below the surface of said body of pulp, shield means arranged to prevent entrance of froth into said inlet, a partition member internally of said tubular body separating the inlet from the upper portion of said tubular body and arranged to mix pulp and air at a point below said inlet, and means for passing a high velocity stream of aerating gas from said lower outlet into said body of pulp and in aspirating relation with the outlet of said conduit at a rate sufficient to aspirate said tubular body to prevent a stand of liquid therein and to intimately admix and aerate pulp passing through said tubular body with the aerating gas.

2. An aerating unit for a froth flotation machine containing a body of pulp having a froth bed overflowing from its surface, comprising a tubular body having an upper opening above said froth for the admission of atmospheric air and extending downwardly into the body of the pulp and terminating in a lower outlet at a variable distance from the bottom thereof, an adjustable weir inlet for pulp in the upper portion of said tubular body adjacent to and spaced below the surface of said body of pulp, a shield above said inlet arranged to prevent entrance of froth in said tubular body, a partial partition member internally of said tubular body separating the inlet for said pulp from the upper portion of said tubular body and arranged for mixing cascading pulp and air at a point below said weir inlet, and a compressed air conduit extending into the outlet of said conduit and arranged for passing a high velocity stream of aerating gas from said lower outlet into said body of pulp and in aspirating relation with the outlet of said conduit at a rate sufficient to draw pulp from said tubular body and prevent a stand of pulp therein and to intimately admix and aerate the same with the aerating gas.

3. An aerating unit for a froth flotation machine which includes a tank of substantial depth for containing a body of pulp having a froth bed overflowing from its surface, comprising a tubular conduit having an upper opening extending beyond the surface of said pool for the admission of low pressure gas and extending a substantial distance vertically into the tank and terminating in a lower outlet at an adjustable distance adjacent to the bottom of the tank, said conduit being of substantially smaller cross sectional dimensions than the tank in which it is mounted, an inlet for pulp in the upper portion of said tubular conduit spaced so as to be adjacent to and below the surface of a body of pulp, a partition member mounted internally in the upper

portion of said tubular conduit and arranged to separate the entering stream of pulp and the low pressure gas in said conduit, said partition being arranged to cascade a stream of pulp into mixing relation with the low pressure gas in said conduit at a point below said partition, a high velocity gas aspirator mounted in a horizontal direction at the lower outlet of said conduit, and means for passing a high velocity stream of gas through said aspirator to aspirate pulp and gas from said conduit and at a rate substantially equal to the rate of the incoming pulp to prevent a stand of liquid in the conduit whereby pulp cascades down the length of the conduit from its pulp inlet to its discharge.

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