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AERATING ASSEMBLY FOR FROTH FLOTATION CELLS

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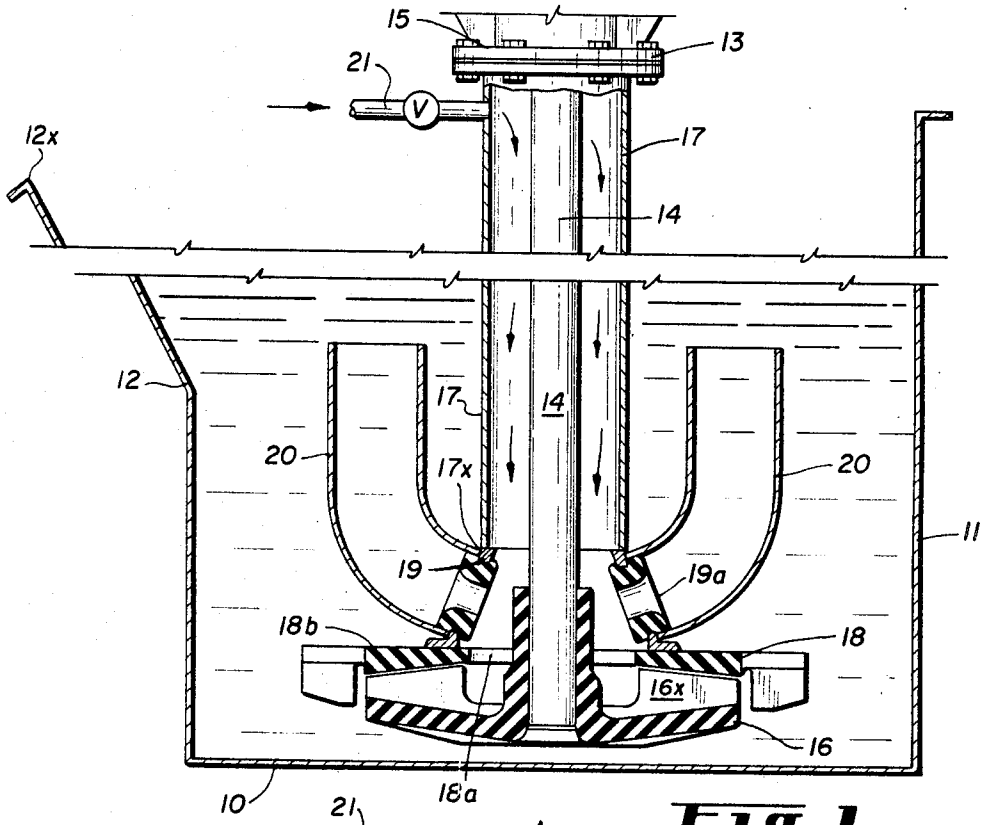


Fig_1

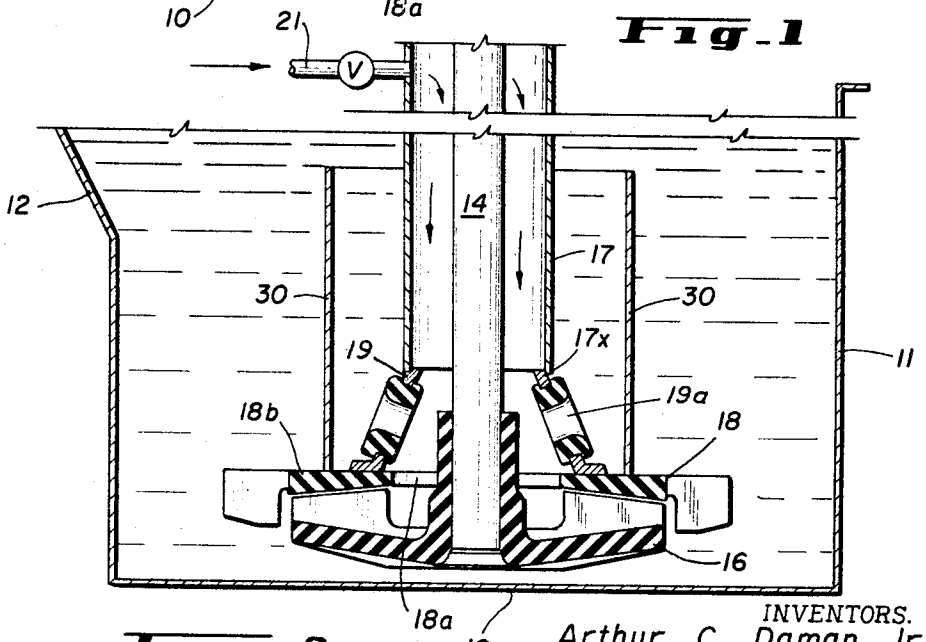


Fig_2

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AERATING ASSEMBLY FOR FROTH FLOTATION CELLS

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7 Claims. (Cl. 209—169)

ABSTRACT OF THE DISCLOSURE

Froth flotation cell having mechanical aerator and agitator assembly arranged to induce upward circulating flow of impeller discharge and recirculation of pulp from upper portion of contained pulp body as sole pulp feed to enclosed impeller, including flooding impeller intake above elevation of gas input thereto. Assembly may provide single or multiple passages for directing recirculating pulp to impeller and flooding impeller intake, with individual and total passage intake capacity exceeding discharge capacity to impeller intake opening through restricted opening or openings over impeller intake opening.

This application is a continuation of applicants' application Ser. No. 353,982, filed Mar. 23, 1964, now abandoned, for Aerating Assembly for Froth Flotation Cells.

This invention relates to an aerating assembly for froth flotation cells. Features disclosed but not claimed herein have been claimed in the copending application of Arthur C. Daman, Jr. and Leland H. Logue, Ser. No. 342,068, filed Feb. 3, 1964 and owned by the assignee of this application.

Present-day froth flotation practices frequently require introduction of large volumes of aerating gas into the aerator unit of a flotation cell. Where the aerator unit includes a covered impeller which provides the mixing and gas dispersion in the pulp, the gas discharge frequently tends to develop back pressures which, if not offset, may result in release of aerating gas from the aerating and mixing zone before it is mixed with and dispersed in the pulp.

It is an object of our invention to provide a simple, durable and efficient aerator assembly for froth flotation cells which is arranged to distribute large volumes of aerating gas uniformly through a flotation pulp circulating through said assembly.

Another object of our invention is to provide an aerator assembly for froth flotation cells which is adapted to be incorporated in existing installations as well as being a component of new cells being put into service for the first time.

Another object of this invention is to provide an aerator assembly for froth flotation cells which effectively recirculates a sufficient quantity of dilute pulp containing solids in finer sizes to fluidize settled solids on the bottom of the cell.

A further object of this invention is to provide a simple, durable and efficient aerator assembly for flotation cells which has provision for prevention of back pressures in the gas flow within the impeller enclosure.

Other objects reside in novel details of construction and novel combinations and arrangement of parts which will be set forth in detail in the course of the following description.

Briefly stated, this invention includes a hub between the conduit supplying pressurized gas and the cover member. Restricted openings in this hub provide an inlet above the opening in the cover member. Pulp conducting

members extend from the openings to a selected fluid level and are shaped to collect pulp therein. The intake capacity of the pulp conducting members is greater in size than the restricted openings and the circulating pulp collects to provide a hydrostatic seal. thereby precluding the incoming pressurized gas from escaping out the restricted openings. The recirculated pulp passing through the restricted openings combines with the pressurized gas prior to discharge through the opening in the cover member. This dilute recirculated pulp contains primarily solids in finer sizes which when discharged from the impeller displaces and fluidizes settled solids on the bottom of the cell beyond the impeller, thereby avoiding stratification effects.

The essential features of the invention may be incorporated in a variety of structural embodiments and typical embodiments have been illustrated in the accompanying drawings. The practice of our invention will be described with reference to said drawings. In the drawings, in the several views of which like parts bear similar reference numerals:

FIG. 1 is a vertical section of one embodiment of an aerating assembly according to our invention illustrated as installed in a flotation cell; and

FIG. 2 is a fragmentary vertical section of another embodiment of the aerating assembly illustrated in relation to the bottom portion of the flotation cell in which it is installed.

In FIG. 1 there is shown the flotation cell having a flat bottom **10**, an upright rear wall **11** and a forward upright wall having an upper inclined portion **12** terminating in a froth overflow lip **12***x*. Superstructure (not shown) is mounted at the top of the cell in the usual manner for support of drive components, control members and the like. The plate or beam **13** is shown to represent the superstructure or corresponding supporting members. A shaft **14** is journaled for rotation in a sealed bearing assembly **15** mounted on plate **13** and extends downwardly to a point adjacent but spaced from cell bottom **10**.

A dished impeller **16** is mounted at the lower end of the shaft **14** and has upstanding blades **16***x* in a radial arrangement. A hollow column **17** is supported in a depending position from beam **13** and in enclosing relation to shaft **14** and terminates at a point substantially above cover member **18**. Cover member **18** is positioned in spaced overhanging relation to impeller **16** and has a central opening **18***a* and an imperforate top portion **18***b* extending outwardly therefrom.

A hub or interconnecting member **19** is supported on and attached to the top portion **18***b* and is attached to the lower end **17***x* of conduit **17**. Attachment of hub member **19** can be made by a permanent means such as welding or can be removably positioned having intermediate supports rigidly attached to the cover member **18** and conduit **17**. The hub member **19** has a plurality of restricted openings **19***a* in renewable bushings, preferably of rubber or other wear-resistant material, which openings provide a pulp inlet for directing the flow of pulp onto impeller **16**.

Conduits **20** extend outwardly and upwardly from openings **19***a* for receiving and directing the pulp into openings **19***a*. Conduits **20** extend to a submerged position at a preselected depth and receive a dilute pulp having primarily solids in finer sizes which is conducted through the impeller, mixed with aerating gas therein and discharges from the impeller as aerated pulp.

A valve controlled conduit **21** delivers large volumes of aerating gas into conduit **17** which passes through its lower end **17***x* mixing with the pulp supplied through openings **19***a* prior to conjoint passage through cover intake opening **18***a* onto the dished surface of impeller **16**.

The impeller is rotated at high speeds and the confining relation of the proximity of the blades to the cover member produces an intense beating and mixing action as the aerated pulp is directed to the periphery of impeller **16** by centrifugal force, and in such action back pressures tend to develop when excess gas in introduced which may cause the gas flow to escape up through hub openings **19***a* and out conduits **20**. However, because of the difference in diameters of conduits **20** and hub openings **19***a*, pulp passing into conduits **20** will be entrained in a larger volume than it can discharge through the restricted hub openings **19***a* and stands to a considerable distance above these openings.

In operation, the pulp is directed into conjoint discharge with the gas supplied through conduit **17** thereby aerating the pulp prior to its discharge through opening **18***a*. This pulp is then subjected to the beating and mixing action imparted by blades **16***x* and is discharged with the gas in fine bubble formation distributed throughout the pulp as it is impelled across the periphery of the impeller by centrifugal action. Any tendency to develop a back pressure condition in such discharge is overcome by the depth of the liquid column in conduits **20** which descend through hub openings **19***a* and cover plate **18***a*, and the only escape for the gas input is with the discharge flow passing from the periphery of the impeller.

The elimination of back pressure release permits the operator to set the valve of inlet **21** to supply any required volume of gas and the operation thereafter requires no additional operator control until a new aerating requirement is determined. The mixing of pulp and gas effects a substantially uniform distribution of aeration gas in fine bubble formation throughout the circulating pulp body in the cell. With proper aeration, the coarse sizes of the pulp that have been properly conditioned float readily and an efficient flotation concentration is obtained even with ore ground in a relatively coarse size range.

The embodiment of our invention shown in FIG. 2 functions similarly to the assembly shown in FIG. 1, but with a modification in the conduit supplying pulp to openings on hub **19**. While details of the cell structure are not shown in FIG. 2, they are essentially the same as in FIG. 1 and comprise a bottom **10**, an upright rear wall **11** and a forward wall **12**. A shaft **14** carries the impeller **16** disposed in close proximity to cell bottom **10**. An air conduit **21** delivers aerating gas past openings **19***a* and onto impeller **16** in the manner previously described.

The cover **18** in this form is the same as in FIG. 1 with a central opening **18***a* and the remaining top surface **18***b* being imperforate. Hub member **19** is supported on the lower end of conduit **17** and attached to the cover top surface **18***b*. Again in this form, the lower end **17***x* of conduit **17** terminates above the restricted openings **19***a* which direct pulp streams in converging relation to the gas flow passing to the central opening **18***a* of member **18**. A tubular enclosure **30** seats on the cover top surface and extends upwardly exteriorly of conduit **17** and defines with the outer surface of conduit **17** a flow path for recirculating pulp.

This arrangement also provides a hydrostatic seal which effectively prevents back pressure leakage and regulates the volume of pulp recirculated from the cell onto the impeller. Again the pulp is directed into conjoint discharge with the gas in conduit **17** thereby mixing with the pulp prior to its discharge through openings **18***a*.

Both embodiments therefore provide for introduction of large volumes of aerating gas, which gas is effectively dispersed through the circulating pulp and provides an intense aeration which after discharge from the impeller raises the conditioned particles to the surface where they are collected and discharged as concentrate. The conduits or conduit extending from the openings above the impeller have an intake capacity exceeding the discharge capacity and thereby effect a hydrostatic seal which assures that all of the gas will be discharged across the periphery of the impeller.

In addition, the tendency of solids in the pulp to stratify within the pulp body is effectively offset by the recirculating action which returns a sufficient quantity of dilute pulp containing solids in finer sizes in the flow delivered onto the impeller to displace and fluidize settled solids on the bottom of the cell beyond the impeller. This displacement effect maintains solids in all sizes in suspension, thereby permitting the flotation action to function continuously under optimum conditions.

While the apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus and that changes may be made without departing from the scope of the invention which is defined in the appended claims.

We claim:

1. In a froth flotation cell having a froth overflow in its upper portion and an aerating assembly for circulating an aerating pulp in the lower portion of the cell, said assembly including a vertical rotary shaft, an impeller mounted at the lower end of the shaft for conjoint rotation therewith, a stationary cover member secured in closely spaced overhanging relation to the impeller and having a central intake opening, a stationary hollow conduit encompassing and spaced from said shaft extending from an upper support to a discharge opening disposed in spaced relation above and in proximity to the central intake opening of the cover member, said conduit being sealed against admission of pulp throughout its length and having an inlet for aerating gas, means for delivering an aerating gas through the conduit inlet for discharge onto the impeller, hub means interconnecting the lower end of said conduit and said cover member and having a plurality of circumferentially spaced restricted openings for directing circulating pulp into converging discharge with gas from the conduit, and pulp-directing and recirculating means disposed exteriorly of the hollow conduit with a lower surface in sealed connection with the cover member, said means including a passage-defining member having at least one exterior imperforate surface extending upwardly from the sealed connection in a position approximately over the periphery of the impeller, and having a submerged pulp intake in an upper portion of the cell at an elevation above the bottom outlet of the conduit providing a descending pulp flow as the sole pulp intake for the impeller, said exterior surface defining with the walls of the cell a vertical passageway through which the impeller discharge is caused to move in an upcast flow into the upper portion of the cell and adjacent the submerged pulp intake of the passage-defining member, and the lower end of said passage-defining member being in communication with said spaced restricted openings and of a size capable of maintaining a continuous flooding volume of descendng recirculated pulp above the central opening of the impeller cover member.

2. In a froth flotation cell as set forth in claim **1** a passage-defining member having an intake capacity at its intake exceeding the total discharge capacity of said restricted openings.

3. In a froth flotation cell as set forth in claim **1**, a passage-defining member including a tubular member encompassing said conduit and secured at its lower end to the cover member outwardly of said central opening of said cover member.

4. In a froth flotation cell as set forth in claim **1**, a passage-defining member including separate conduit portions extending outwardly and upwardly in the pulp body from each restricted opening, each conduit member having an intake capacity exceeding the discharge capacity of its associated restricted opening.

5. In a froth flotation cell as set forth in claim 1, wherein at least two of said restricted openings are disposed in opposite relation.

6. In a froth flotation cell as set forth in claim 1, wherein said hub means is inclined to the vertical so as to direct the circulating pulp in a downwardly and inwardly inclined direction to mix with the aerating gas.

7. In a froth flotation cell having a froth overflow in its upper portion and an aerating assembly for circulating and aerating pulp in the lower portion of the cell, said assembly including a vertical rotary shaft, an impeller mounted at the lower end of the shaft for conjoint rotation therewith, a stationary cover member secured in closely spaced overhanging relation to the impeller and having a central intake opening, a stationary hollow conduit encompassing and spaced from said shaft extending from an upper support to a discharge opening disposed in spaced relation above and in proximity to the central intake opening of the cover member, said conduit being sealed against admission of pulp throughout its length and having an inlet for aerating gas, means for delivering an aerating gas through the conduit inlet for discharge onto the impeller, hub means interconnecting the lower end of said conduit and said cover member and having a plurality of circumferentially spaced restricted openings for directing circulating pulp into converging discharge with gas from the conduit, and pulp directing and recirculating means disposed exteriorly of the hollow conduit with a lower surface in sealed connection with the cover member, said means including a plurality

of passage-defining members, each having an exterior imperforate surface extending upwardly from the sealed connection in a position approximately over the periphery of the impeller, and having a submerged pulp intake in an upper portion of the cell at an elevation above the bottom outlet of the conduit for entrainment of a dilute pulp containing solids in fine sizes and providing a descending pulp flow as the pulp intake for the impeller, each said exterior surface defining with the walls of the cell a vertical passageway through which the impeller discharge is caused to move in an upcast flow into the upper portion of the cell and adjacent the submerged pulp intake of the passage-defining member, and the lower end of said passage-defining member being in communication with one of said spaced restricted openings and of a size capable of maintaining a continuous flooding volume of descending recirculated pulp above the central opening of the impeller cover member.

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