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FLOTATION MACHINE

Filed May 24, 1965

2 Sheets-Sheet 1

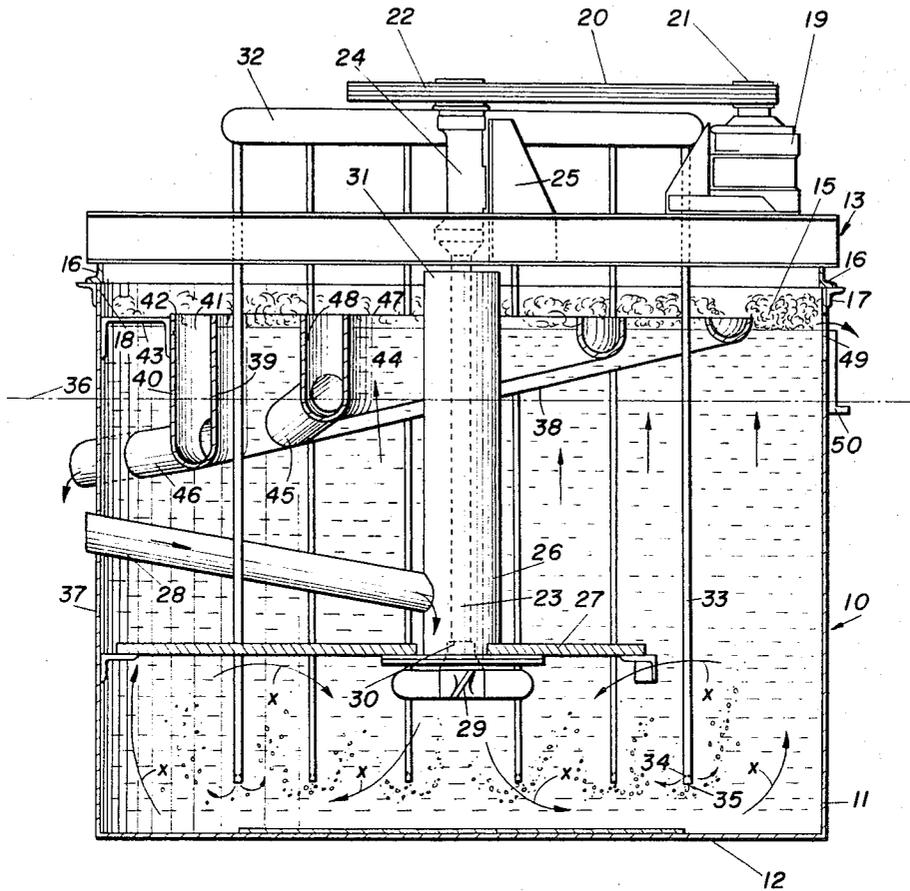


FIG. 1

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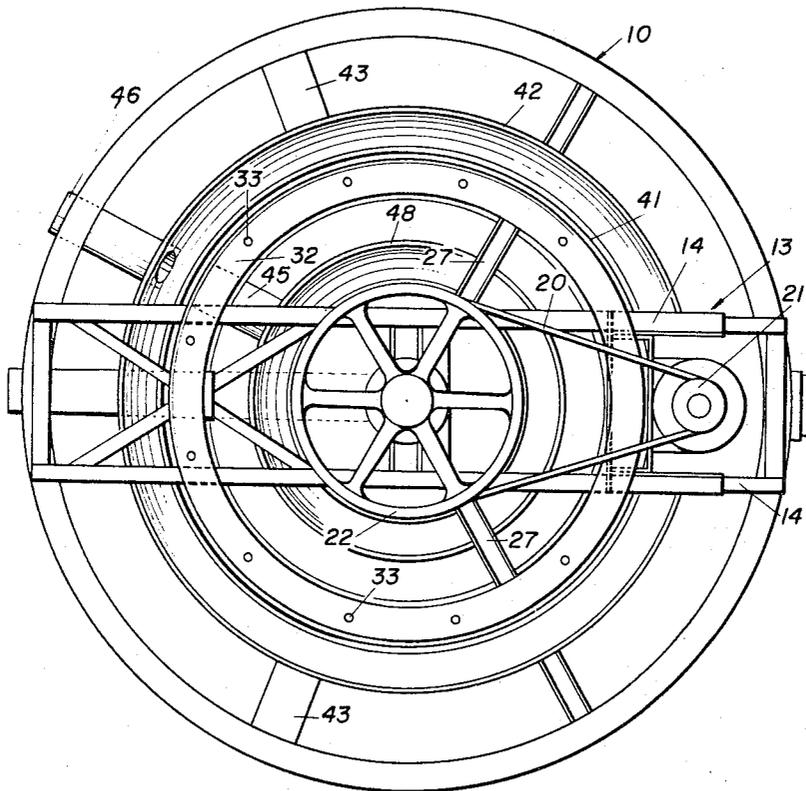


FIG. 2

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FLOTATION MACHINE

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ABSTRACT OF THE DISCLOSURE

A combined pulp conditioning and froth flotation device having plural froth overflow weir edges of a length substantially greater than the perimeter of the device and a plurality of aerating injector tubes injecting air into the lower region of the pulp mass.

This invention relates to flotation apparatus and to the method of separating minerals by a flotation technique.

A flotation machine is an apparatus to carry out a flotation process. The operation called flotation comprises the separation of unlike particles at an interface between two contacting fluid phases one of which at least must be liquid. The separation is effected by the mechanism of one class of particles clinging to the interface and another or other classes of particles failing to cling to such interface. The functions of prior flotation machines are therefore to produce this separating interface, to bring the particles to be separated and the interface together and to lead selected and rejected particles out of the machine by different paths. Excepting the thick pulp conditioning step utilized in bale flotation and the captive bubble flotation test procedure used in the laboratory no procedure has been devised in the past to effect contact between an air bubble and a collector coated solid particle in the interior of the suspending phase or pulp body. The separation of rejected from selected particles takes place slowly by differential gravitational setting in frothing machines of the prior art. In those devices known as sub-aeration machines there is generally an open topped box containing an agitator and means for confining the agitation of the pulp to a zone directly around the agitator to reduce swirl around the top of the pulp. A froth overflow lip is provided at the outer edges of the box and feed and discharge ports are provided for pulp. The pulp must be preconditioned and the separation of concentrate from tailing is made in the column of bubbles maintained above the pulp in the box. High speed impeller machines provide a bubble column by drawing air into the pulp mass centrally and distributing it towards the outer walls of the box to rise in column effect substantially at the walls. Selection is effected by bubble column action. Radio baffles are provided in the prior art to prevent stalling and to avoid vortex formation whereby the body of pulp above the baffles is substantially quiescent but is full of eddies.

It is customary in flotation plant installations to provide a series of conditioning machines adapted to condition the ore pulp from which the same is pumped or conveyed to a flotation separation device. The plant floor space taken up is very substantial especially since the flotation separating devices all depend upon the principle of a weir for separating the froth carried material from the pulp. Separating flow must therefore proceed over a weir edge of a particular lineal extent and it is this length which limits the capacity of the installation.

According to this invention pulp conditioning is combined with flotation separation in such manner as to provide a weir edge or lip of many times that formerly available with tanklike structures whereby a unit of the invention taking up a predetermined floor space may replace

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separate conditioning units and flotation separating units of up to ten times the combined floor area for the same output and up to many times the horsepower requirement of the unit of the invention.

5 It is accordingly a prime object of the invention to provide a combined conditioning and flotation unit having plural weir edges located inwardly of the side walls of the pulp vessel by means of an inward launder having separating edges of a length substantially greater than the perimeter of the vessel.

10 Other objects of the invention will be appreciated by a study of the following specification taken in conjunction with the accompanying drawings.

In the drawings:

15 **FIGURE 1** is a vertical sectional view of a unit according to the invention.

FIGURE 2 is a plan view of **FIGURE 1**.

In the drawings the combined pulp conditioning and flotation separating unit of the invention comprises a cylindrical open ended vessel **10** having cylindrical side walls **11** and a bottom wall **12**. A superstructure frame **13** in the form of parallel spaced apart stringers **14** extends across the open end **15** of the vessel to join by supports **16** to the rim **17** in the form of the angle strip extending about the upper periphery or lip **18** of the vessel or tank. Frame **13** supports drive motor **19** adapted by belt drive **20** and pulleys **21** and **22** to drive the conditioning impeller shaft **23** supported in journal bracket **24** of the central frame structure **25**. Shaft **23** extends downwardly into the vessel within the hollow feed column **26** supported relative to side walls **11** by spider frame arms **27**. An inlet conduit **28** connects through the side walls **11** to communicate feed that is raw ore pulp from a point exterior of the vessel into the feed column **26** above the impeller blades **29** supported by the lower end **30** of shaft **23** and adapted to draw the feed downwardly from the feed column into the vessel **10**. The upper end **31** of the feed column **26** is open to the atmosphere but the impeller blades are driven at such speed and in such manner having a suitable spiral angle thereon as to contribute a feeding function rather than a primarily beating function. In this respect the feeder blades have a conditioning function for the pulp and are referred to hereinafter as a conditioning impeller. Accordingly the feed column **26** will not serve in the proper functioning of the unit herein for the introduction of large quantities of ore and the structure herein should not be confused with a flotation unit having a central beater adapted to draw large quantities of air through the central column. It is known that such beaters have radial blades of little or no spiral or helical inclination and serve to beat a conditioned pulp in flotation apparatus of the prior art to drive air into the pulp in large quantity. The impeller herein having inclined blades will not serve this purpose but it serves essentially the same purpose as the impeller blade of a pulp conditioner of the prior art of somewhat similar appearance.

The arrows indicate the path of motion of the indrawn pulp as influenced by the conditioning impeller that is outwardly towards the outer vessel walls **11** to develop a columnar action upwardly within said walls but where-in some degree of recirculation and turbulence will occur in the lower regions of the vessel.

The invention specifically contemplates the introduction of substantial quantities of air by relatively small orifices and at a plurality of points within the pulp for the lower regions thereof and spaced inwardly from the side walls of the vessel. Thus air header **32** supported on frame stringers **14** embodies a plurality of relatively small downwardly extending or depending outlet tubes **33** as for example twelve in number as shown in **FIGURE 2**. According to the invention air header pressure is at

3.1 pounds per square inch. A plurality of exit orifices are formed in each of said pipes or tubes near the lower ends 35 thereof of the diameter of the order of one-eighth of an inch. The plural orifices in the lower ends of the aerating pipes 33 serve as aerating injectors expelling air radially therefrom in the lower regions of the pulp mass which on rising within the pulp mass reduce the turbulence thereof until at a point which may be between say one foot and two feet below the upper surface of the pulp say at the line 36 the pulp is quiescent thereabove. Thus below the line 36 to substantially the line 37 that is effectively in the mid regions of the pulp there is a columnar action similar to that achieved by conventional flotation separation devices. Whereas in the lowermost regions of the vessel the conditioning impeller in conjunction with the air injection by the aerating pipes effects a pulp conditioning similar to that found in pulp conditioning apparatus of the prior art but confined to this lowermost zone in the unit of the invention. In the uppermost zone of the vessel the pulp is quiescent as is required for flotation separation but of importance to this invention is the inward location of a launder ring 38 in the form of a continuous annular U-shaped section having inner and outer side walls 39 and 40 terminating upwardly in inner and outer weir separating edges 41 and 42 fastened by the outward radial arms 43 to the side walls 11 of the vessel.

Preferably also a second annular separating launder is provided of similar structure within the first mentioned launder and generally indicated by numeral 44 and having a connecting flow conduit to the first launder 38 which in turn has an outlet conduit 46 extending through the side walls 11 of the tank for exterior delivery of concentrate. Observe that the upper edges 47 and 48 of the inner launder are in alignment with the separating edges of the outer launder 38. While each of the launders is of U-shape in section they are of inclined progressive depth towards the outlet conduits 45 and 46 thereof. By this means the weir edges of substantial length can be provided within the unit of the invention to replace a plurality of units of the prior art. It is the aim of this invention to bring as much of the concentrate froth in contact with a weir edge as is practical on the surface of a pulp body within a vessel as for example in the manner indicated and may include according to the invention the utilisation of the outer peripheral edge 18 of the vessel itself although not essentially required as disclosed herein.

The level of the pulp is controlled in a manner known in the art by providing a pulp exit opening 49 in the side walls 11 having an adjustable weir plate 50 over which the pulp may exit to thereby assist in controlling the depth of pulp in the vessel and accordingly the separating point relative to the separating weir edge of the concentrate froth.

Units of the invention already in operation demonstrate for a given concentrate output a high yield in relation to floor space and horsepower as contrasted with devices of the prior art with no depreciation of concentrate quality the conditions of flotation agent pulp grind and the like remaining consistent with the prior art providing due attention is given to introducing the pulp feed with a higher percentage of solids than is normal practice of the prior art that is to say with a given pulp in prior art practice having 25% solids the unit of the invention operated more effectively with a solids increase of the order of about 40% that is to say to about 30% solids.

It is intended that the present disclosure should not be considered in any limiting sense other than that indicated by the scope of the following claims having regard to the utility of the prior art and the invention.

What I claim is:

1. In apparatus for conditioning an ore pulp containing a flotation agent and separating a mineral therefrom, a machine comprising: a cylindrical flotation tank having a substantially flat bottom and a cylindrical wall terminating in an edge defining an open top; superstructure supported on said edge and extending over said open top; an impeller shaft supported by and depending from said superstructure centrally of said tank; an impeller drivably mounted on the lower end of said shaft in spaced relation to said bottom and including blades inclined with respect to said bottom; driving mechanism on said superstructure operably connected to said shaft to rotate said impeller to move pulp downwardly from regions above said impeller to regions below said impeller and outwardly towards said cylindrical wall; a feed column about and spaced from said shaft between said impeller and said open top; an inlet conduit passing through an opening in said cylindrical wall and communicating with said feed column; an air header of circular formation and of a diameter less than said cylindrical wall, said header being mounted on said superstructure; a plurality of bubble tubes angularly spaced apart and depending from said header in connected relation thereto and spaced from said cylindrical wall; said bubble tubes extending below the level of said impeller and having radial orifices therein below said level; a pulp weir carried by said cylindrical wall in a predetermined relation to said edge; a circular froth launder of U-shaped cross section presenting opposed spaced side walls connected by a bottom wall and having upper weir edges at a predetermined level below said tank edge with the outermost weir edge spaced from said cylindrical wall and said bottom wall of said launder being inclined with respect to such tank bottom, said launder being mounted on said cylindrical wall; and an outlet conduit communicating with said launder adjacent to the bottom wall at the lowest region thereof and extending through said cylindrical wall.

2. The pulp conditioning and separating tank of claim 1 including a second circular launder of U-shaped cross section presenting opposed spaced side walls connected by a bottom wall and having upper weir edges at said predetermined level below said tank edge, said bottom wall of said second launder being inclined with respect to said tank bottom, said second launder being disposed radially inward of said launder and connecting with said outlet conduit.

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