March 9, 1937. E. H. HOAG 2,072,880

FLOTATION APPARATUS

Filed Aug. 17, 1934 2 Sheets-Sheet 1

Fig. 1.

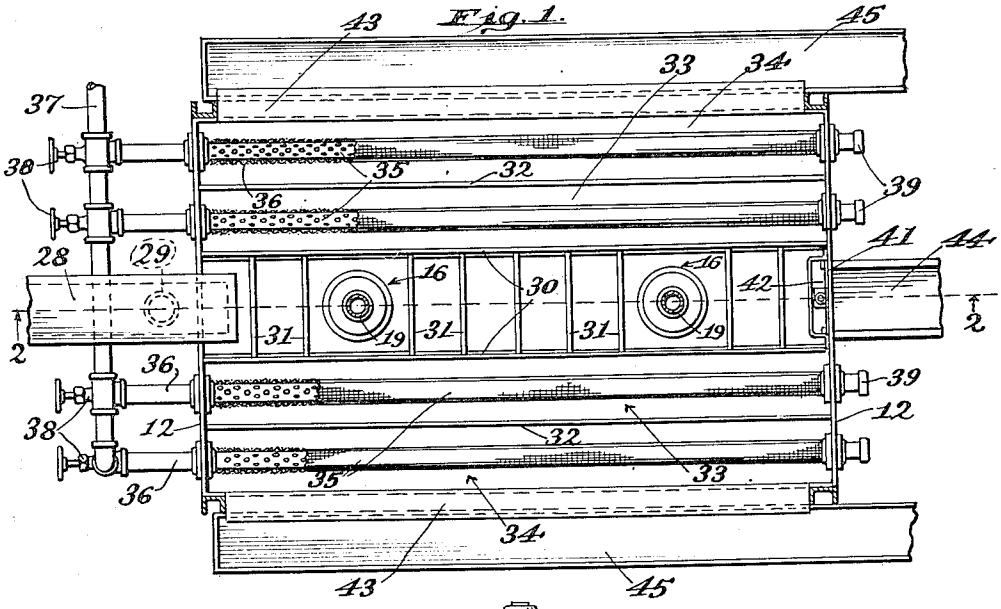
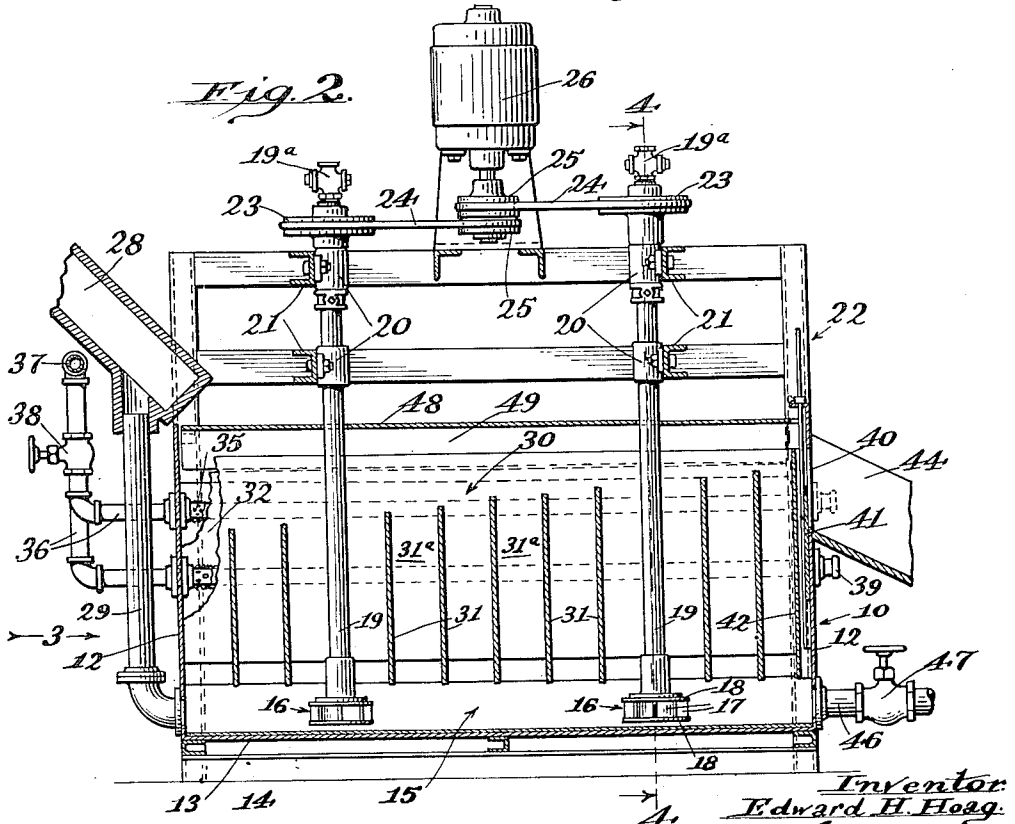


Fig. 2.



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FLOTATION APPARATUS

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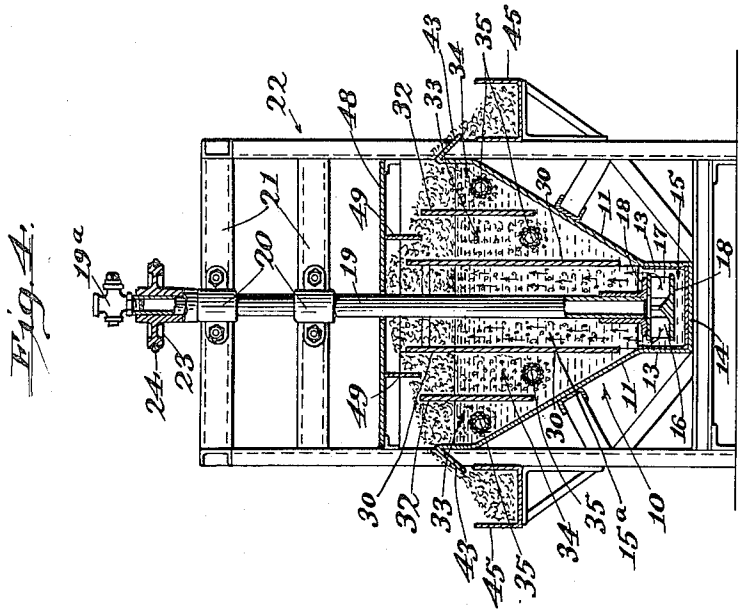


Fig. 4.

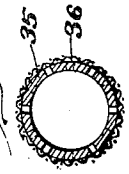


Fig. 6.

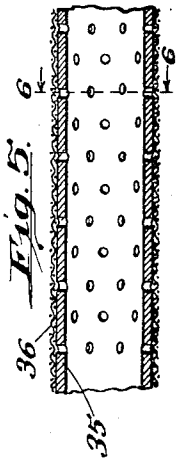


Fig. 5.

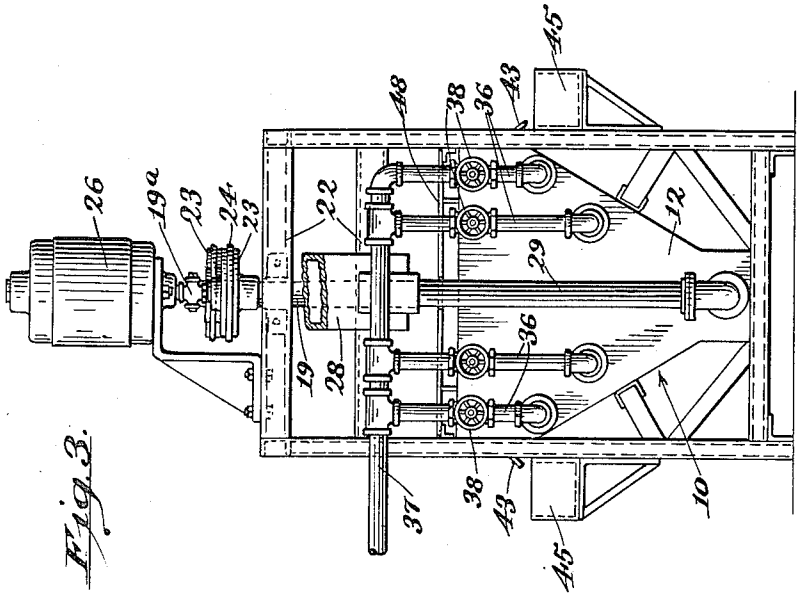


Fig. 3.

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UNITED STATES PATENT OFFICE

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FLOTATION APPARATUS

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Application August 17, 1934, Serial No. 740,243

3 Claims. (Cl. 209—169)

This invention relates to ore concentrating apparatus and more particularly to a flotation machine.

It is generally accepted by those skilled in the art that flotation is a surface phenomena exclusively, dependent entirely on the condition of film formed on the surface by chemical reagents. The two most fundamental principles involved in the process are frothing and collecting. Frothing is effected by thoroughly agitating and distributing small globules of air through the pulp, to which has been added some reagent or chemical or oil, the molecules of which are not only water-avid and oxygen bearing, but attached to these qualities, it should have carbon and hydrogen atoms. Collecting is effected by adsorption at the surface of the metal particle, surface tension of the medium, size of particles, flocculatotion polarization, angle of contact, etc. The phenomena and the degree of concentration at the surface is entirely dependent on the reagents or chemicals used, the form of agitation and the distribution and volume of minute air globules in the pulp, all of which are explained by their ability to accelerate or retard base-metals at the air-water interface, which is generally known as "selectivity".

Heretofore several types of flotation machines have been designed. While these machines accomplish the desired result they prove to be of more or less expensive construction to install and operate; it being necessary for the operator to continuously manipulate valves or the like within the machines to maintain the proper condition of the froth in order to obtain a high concentrate or extraction of values.

It is therefore the principal object of the present invention to provide an improved flotation method for separating the desirable from undesirable particles in ore by application of scientific principles involved in the flotation process, or selective flotation.

Another object is to provide a flotation apparatus in which the correct volume of air is admitted by "control valves", through perforated pipes, covered with a porous medium, located longitudinally of the apparatus, whereby the operator may observe and obtain the "class" (tenacity, quantity, size, fragility, color, cohesiveness, amount enrichment) of froth he seeks.

Another object is to provide a flotation apparatus and system for the extraction of the valuable from the invaluable products by controlling and separating the functions of agitating and quiescent chambers.

A further object is to provide a flotation apparatus of simple construction and automatic in operation in which all valves and attendance thereto are eliminated except a sliding weir gate, adjustable at the discharge, for the control of the pulp level.

A further object is to provide a flotation apparatus in which air under complete control is employed for removing flotation froth from the surface of the pulp and delivering it to the overflow lips, as soon as it is formed or accumulates.

A still further object is to provide a flotation apparatus with an improved system for controlling the direction of the flow of pulp and froth laterally, or towards the overflow lips of the machine.

Other objects will be apparent from the following description reference being had to the accompanying drawings in which:

Fig. 1 is a top plan view of the flotation machine parts being broken away and shown in section.

Fig. 2 is a longitudinal section taken on line 2—2 of Fig. 1.

Fig. 3 is a front elevation taken in the direction indicated by the arrow 3 of Fig. 2.

Fig. 4 is a cross section taken on line 4—4 of Fig. 2.

Fig. 5 is a detail section taken through one of the aeration pipes.

Fig. 6 is a section taken on line 6—6 of Fig. 5.

Referring more specifically to the drawings 10 designates the cell or tank of the apparatus.

Tank 10 is preferably formed of sheet steel and has upwardly and outwardly inclined side walls 11 and vertically disposed end walls 12.

Depending from the side walls are vertically disposed walls 13 and a bottom 14 which together form a narrow trough or compartment 15 through which the sands or heavy particles pass, said trough also serves to bring the pulp into close contact with impellers designated at 16 (in the present instance two in number) arranged therein.

Impellers 16 consist of a plurality of vanes 17 disposed between discs 18 and are secured to the lower ends of hollow shafts 19.

Shafts 19 are journalled in antifriction bearings 20 secured to the cross members 21 of a frame 22 and secured to the upper ends of said shafts are sheaves 23 over which pass endless belts 24 which in turn engage the grooves of sheaves 25 secured to the shaft of an electric motor 26.

While the above type of drive provides desirable means for imparting rotation to the impellers it

will be understood that other forms of transmission may be substituted therefor such as belts and pulleys driven from a line shaft.

Pulp from a conditioning tank (not shown) is continuously fed into a launder **28** and passes therefrom downwardly through a pipe or conduit **29** into the trough **15** wherein it meets with the agitating action of the impellers, the impellers and shafts being rotated at sufficient speed (about 1000 R. P. M.) to cause air to pass through the hollow shafts and be uniformly distributed through the pulp. Mounted in the upper ends of shafts **19** are valves **19***a* by which the volume of air passing therethrough may be regulated.

Arranged in the cell on each side of the impellers are vertically disposed longitudinal partitions **30** which define an agitation chamber **15***a* that communicates with the trough **15**, and positioned between said partitions is a series of other partitions **31** disposed at right angles thereto, which divide the chamber into a plurality of cells **31***a* that are provided for a purpose hereafter described.

Positioned between partitions **30** and the side walls **11** of the tank are longitudinal partitions **32** that form quiescent chambers **33** and **34** respectively.

Disposed in the quiescent chambers and extending throughout their length are perforated air distributing pipes **35** that are covered with porous material indicated at **36'** preferably one or more layers of fabric as clearly shown in Figs. 5 and 6, the covering serving to prevent short circuiting and to effect an even distribution of air in minute bubbles throughout the pulp within said quiescent chambers.

Pipes **35** are connected to air inlet pipes **36** externally of the tank which in turn are connected to a header **37** which leads to an air compressor or blower (not shown) the flow of air through each pipe **36** being controlled by a valve **38**. The opposite ends of pipes **36** are closed by caps or the like **39** to prevent escape of air therethrough.

Formed in the rear wall of the tank **10** is a pulp discharge opening **40** controlled by a slidably mounted gate or weir **41**, and surrounding said gate is an open ended casing **42** through which the pulp flows upwardly.

It will be particularly noted that by raising or lowering gate **41** the pulp level within the tank may be effectually regulated, also that the froth or condition of the same may be varied, (according to the character of the ore being treated) by adjusting the level of said gate in relation to the overflow lips **43** extending along the outer edges of the side wall **11**. In other words after the proper pulp level has been determined no further adjustment on the part of the operator is necessary except when the condition of the pulp or mill stream changes.

Pulp or tailings are discharged through the opening **40** into a launder **44** while the froth or concentrates over-flow into launders **45** on each side of the tank.

Secured to the rear wall and communicating with the agitating trough or chamber **15** is a pipe **46** controlled by a valve through which the sands or heavy particles may be discharged when required.

Arranged above the agitating and quiescent chambers of the tank is a flat horizontally disposed plate **48** having baffle plates **49** that extend downwardly therefrom into the quiescent chambers. The plate **48** serves to prevent splashing or an excessive accumulation of froth above the agitation chamber **15***a* while the baffles divert it from the inner to the outer quiescent chambers as clearly shown in Fig. 4.

The lateral partitions **31** in the agitation chamber gradually increase in height toward the discharge end of the machine as shown in Fig. 2 and serve to detain the more valuable portions of the pulp for "time contact" during its passage therethrough. In other words, that portion of the pulp detained between the lateral partitions is gradually returned from the discharge toward the feed end of the machine, thereby allowing sufficient time for the flotation reagents to effect the surface of the desirable content until the pulp raises to the surfaces of the longitudinal divisions and overflows into the quiescent chambers.

Operation.—Pulp from the conditioning tank (wherein the essential oils or reagents in proper proportions are added) flows into the launder **28**, thence through pipe **29** into the tank **10** wherein it seeks a level according to the position of the weir gate **41** in relation to the opening **40**.

Pulp in the narrow agitation chamber **15** is subjected to agitation created by an air blast induced by the impellers **26** which results in an even distribution of air through the pulp, the action of which carried the valuable mineral content, and a certain portion of the floatable gauges upwardly until it reaches the top of partitions **31** over which it flows longitudinally toward the head of the tank, due to the diminishing level of said partitions.

The undesirable products such as sand or the heavy particles present in the pulp remain in the lower zone or compartment **15** wherein they move in a substantially straight line toward the discharge end and enter casing **42** through which they are carried upwardly by the flow of the pulp over the weir gate and are finally discharged into the launder **44**. The suspended pulp is retained in the cells **31***a* for time contact, and passes over the top of the longitudinal divisions **32** to the first quiescent chamber **33** wherein it comes in contact (for the first time) with minute bubbles of air which have been admitted through the perforated pipes **35**.

Froth enriched by differential action in this chamber is transferred into the second quiescent chamber **33** wherein it again meets air in minute bubbles from the pipes **35**.

The undesirable material returns to the agitating chamber **15** through a narrow space between the lower end of the partitions **30** and side walls **11** of the tank.

It will be particularly noted that by adjusting valves **38** the enrichment of the froth may be varied, and that after said valves and the weir gate **41** have been properly adjusted no further attention on the part of the operator is required except to occasionally observe the condition of the froth.

While the apparatus above described may be termed a single cell machine, it will be understood that by providing additional impellers and dividing the tank with lateral partitions it may be converted into a plurality of cells, in which instance the froth in the second should be returned to the first cell by a centrifugal pump or the like.

It will also be understood that several single cells of the construction above described may operate in conjunction in the usual manner.

I claim as my invention:

1. A flotation apparatus comprising a tank having upwardly and outwardly inclined side

walls and a narrow chamber extending along the bottom thereof for removing the sand or heavy particles, impellers disposed in the narrow chamber of said tank for agitating pulp passing therethrough by distributing air into the same, a pair of longitudinally disposed partitions in said tank and forming an agitation chamber, lateral partitions disposed between said longitudinal partitions and forming a series of cells to move the pulp forwardly and retain the same for time contact, perforated pipes disposed in said tank for admitting air in small bubbles into the pulp for selective flotation, and means for controlling the volume of air through said pipes whereby the enrichment of the froth may be regulated.

2. A flotation apparatus comprising a cell, a pair of longitudinally disposed partitions in said cell and forming an agitating chamber, lateral partitions arranged between said longitudinal partitions and dividing said agitating chamber into a plurality of secondary cells, impellers disposed in said agitation chamber for distributing air into pulp therein, partitions disposed in parallel relations to said first partitions and forming quiescent chambers horizontally disposed, perforated pipes mounted in the latter chambers and extending lengthwise thereof for admitting air in small bubbles into the pulp for selective flotation, means for controlling the volume of air through said pipes whereby the enrichment of the froth may be regulated, and a slidably mounted weir gate arranged in said cell for regulating the pulp level therein in relation to the froth overflow.

3. A flotation apparatus comprising a tank having upwardly and outwardly inclined side walls and a narrow chamber extending along the bottom thereof for removing the sand or heavy particles, impellers disposed in the narrow chamber of said tank for agitating pulp passing therethrough, vertically disposed hollow shafts secured to said impellers and extending above the pulp level for passage of air therethrough into the pulp during rotation of the impellers for agitating and distributing air into the same, a pair of longitudinally disposed partitions in said tank forming an agitation chamber, lateral partitions disposed between said longitudinal partitions forming a series of cells to move the pulp forwardly and retain the same for time contact, a plurality of horizontally disposed perforated pipes mounted in said tank for admitting air into the pulp for selective flotation, and valves interposed in each of said pipes for controlling the volume of air therethrough whereby the enrichment of the froth may be regulated.

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