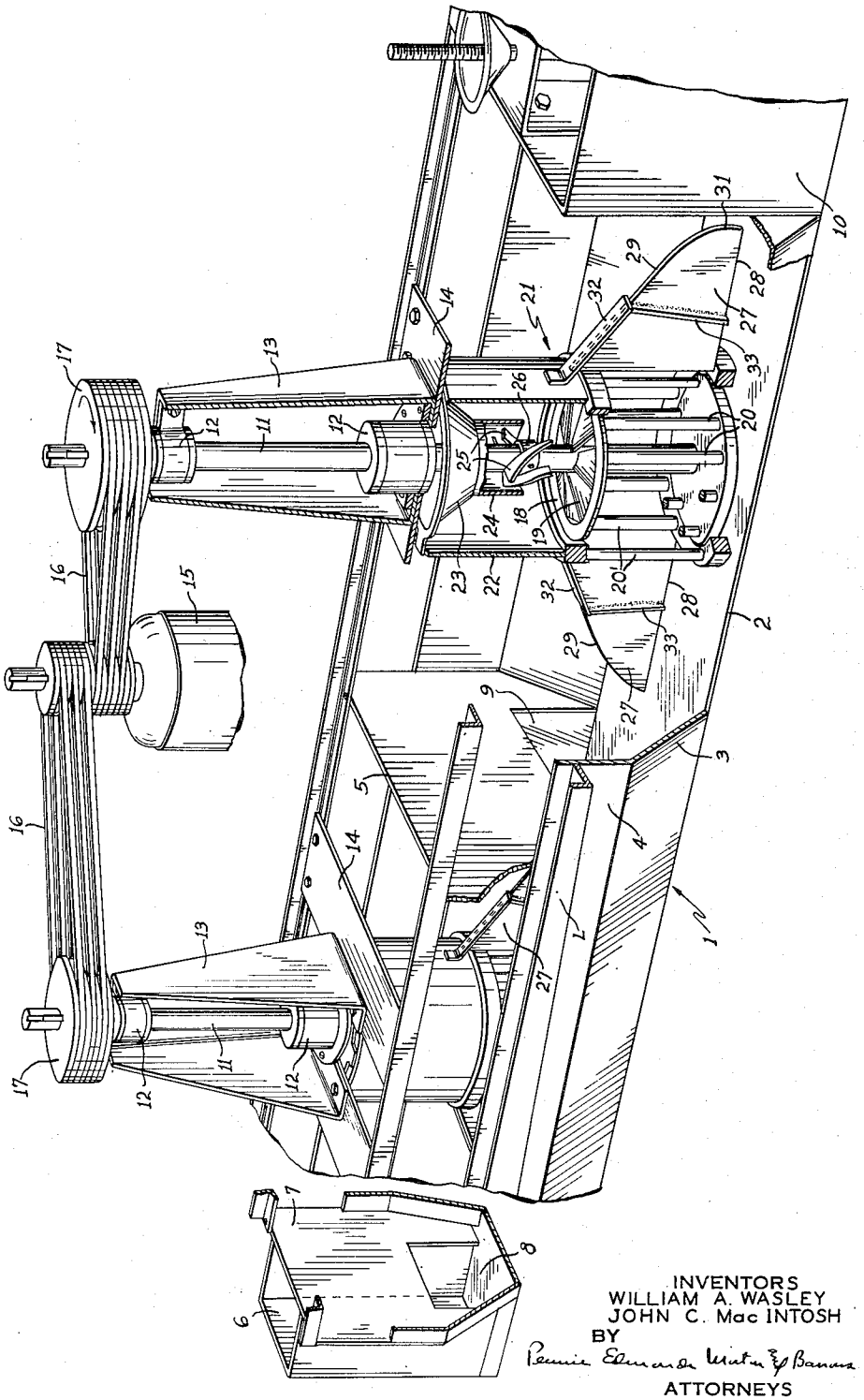
Oct. 30, 1951 W. A. WASLEY ET AL 2,573,520

FLOTATION APPARATUS

Filed Oct. 4, 1947



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Patented Oct. 30, 1951

2,573,520

UNITED STATES PATENT OFFICE

2,573,520

FLOTATION APPARATUS

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Application October 4, 1947, Serial No. 778,006

2 Claims. (Cl. 209—169)

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This invention relates to flotation apparatus, and is particularly concerned with the provision of improvements in flotation machines having submerged air pumps, especially machines of the Fagergren type. The principal feature of the present invention is the provision, in such apparatus, of baffles of improved design which are arranged so as not to impede the flow of an ore pulp through the machine, but which minimize rotary motion of the pulp induced by the air pump. We have found that the provision of such baffles leads to a decided improvement in the recovery of mineral values in the flotation concentrate produced in Fagergren type flotation machines.

A typical flotation machine of the type to which the invention relates comprises a long trough-like chamber divided by transverse partitions into a plurality of cells. The partitions are formed with openings which permit an ore pulp to flow lengthwise from cell to cell through the chamber. An impeller mounted on a vertical shaft for rotation in a substantially horizontal plane beneath the normal level of the pulp is provided in each cell for introducing air into the pulp. The impeller and shaft are usually enclosed by a housing that extends upwardly from about the impeller to above the zone in which the flotation froth collects, to prevent recirculation of the froth by the impeller.

In apparatus of this character, the invention provides the improvement comprising a pair of thin vertical baffles positioned below the normal pulp level in each cell. The baffles extend lengthwise of the trough chamber, parallel to the line of pulp flow therethrough; they are arranged on opposite sides of the impeller housing, and advantageously are secured thereto. Except for these baffles, none are provided in apparatus according to the invention, so that each cell is substantially free of any obstruction, apart from the impeller housing, to the flow of pulp therethrough, but the baffles serve to minimize rotary flow of the pulp caused by rotation of the impeller.

A preferred embodiment of the invention is shown in the single figure of the accompanying drawing, which shows in perspective, parts being broken away, a Fagergren type flotation machine equipped in accordance with the invention.

The flotation machine comprises a long trough-like chamber 1 having a flat bottom 2, and side walls each having a lower portion 3 which slopes outwardly and upwardly from the bottom and an upper portion 4 which is substantially vertical.

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The chamber is divided by a series of transverse partitions 5 into a plurality of individual cells (only two cells are shown in the drawing, but ordinarily the chamber 1 will be long enough to contain five or six cells).

A feed box 6 is provided at one end of the trough-like chamber 1. The end wall 7 of the chamber which separates the feed box 6 from the chamber itself is formed with an opening 8 near its bottom, so that an aqueous ore pulp introduced into the feed box may enter and flow lengthwise through the chamber. Openings 9 in the transverse partitions 5 enable the ore pulp to flow lengthwise from the feed box serially through the several cells to a tailing discharge box 10 at the opposite end of the chamber.

A vertical impeller shaft 11 is mounted substantially centrally in each cell, in bearings 12 supported on vertical and horizontal frame members 13 and 14. The impeller shafts are rotated in their bearings at fairly high speed by a motor 15 connected by V-belts 16 to pulleys 17 keyed to the upper ends of the shafts.

An impeller 18 is mounted at the lower end of each shaft beneath the normal level of the ore pulp in the cell. The impeller comprises fan-like blades 19 set at an angle such as to force air downwardly into the ore pulp when the impeller shaft is rotated in its normal operating direction (clockwise, as indicated by the arrow, in the apparatus shown in the drawings). The impeller also comprises a squirrel cage of vertical bars 20 which rotate with the blades 19. The impeller and impeller shaft are surrounded by a cylindrical housing 21, the upper portion 22 of which, above the impeller, is of solid wall construction, and the lower portion of which, immediately about the impeller, comprises a cage of stationary vertical bars 20'.

Inside the solid wall upper portion 22 of the housing is a splash cone 23, which terminates in a substantially cylindrical lower portion 24 located about at the normal pulp level. A series of vanes 25 on a collar 26 extend laterally from the impeller shaft inside the lower cylindrical portion 24 of the splash cone, and also at about the normal level of the pulp in the cell. These laterally extending vanes are pitched at an angle to the vertical, thereby forming an air screw which assists in forcing air downwardly when the impeller shaft is rotated in its normal operating direction. The vanes 26 also prevent any accumulation of ore pulp mud in the splash cone. The air screw formed by these vanes is not a part of heretofore known Fagergren type

flotation machines. They form the subject matter claimed in our copending patent application Serial No. 778,436, filed October 7, 1947, and are more fully described therein.

In the operation of apparatus as thus far described, an ore pulp to which suitable flotation reagents have been added is introduced into the feed box 6 and flows lengthwise through the chamber 1 from cell to cell. The impeller shafts are rotated at a fairly high speed by the motor 15, so that the impeller blades 19, assisted by the air screw vanes 25, suck air downwardly about the impeller shaft through the splash cone 23, and deliver it radially outwardly through the squirrel cage bars 20 and the housing bars 20' into the body of the pulp. The air bubbles form a froth in the pulp which rises to the surface carrying the mineral values of the ore with it and overflows into collecting launders L arranged alongside the upper edges of the vertical side members 4. The gangue component of the ore does not float, but flows with the main body of the pulp to the tailing discharge box 10, through which it is withdrawn.

It is desirable and important that once air has been admitted to the pulp, it be agitated as little as possible, for otherwise many of the froth bubbles will be broken and the mineral values carried thereby will sink. The lengthwise flow of pulp through the apparatus is sufficiently slow so as not to produce excessive agitation. The rapid rotation of the impeller, however, tends to impart a vigorous rotary or swirling motion to the pulp. To a considerable extent this is overcome by the cage bars 20' of the impeller housing, but it is not by any means entirely overcome thereby. It is, however, very largely overcome in accordance with the invention by the provision of a pair of substantially vertical thin sheet baffles 27. These baffles extend radially out from the impeller housing 21, on opposite sides thereof, in a vertical plane parallel to the flow of pulp lengthwise through the apparatus from cell to cell. The bottom edges 28 of the baffles are parallel and spaced quite closely to the floor 2 of the flotation chamber 1. The upper edges 29 of the baffles slope downwardly from the side 30 adjacent the impeller housing to the side 31 remote therefrom. Thus the width (vertical height) of the baffles is greatest near the impeller, and progressively less at progressively greater distances outwardly therefrom. The baffles are stiffened against lateral deflection by straps 32 and 33, or other suitable stiffening elements, welded to the baffle sheets.

With the baffles 27 arranged in a vertical plane and parallel to the line of pulp flow through each cell, as shown and described, they impose no appreciable resistance to the flow of pulp through the cell, and they cause no deflection in the direction of pulp flow lengthwise through the apparatus which might contribute to breaking of the flotation froth bubbles. However, they do provide substantial resistance to rotary motion of the pulp induced by rotation of the impeller, thereby minimizing turbulence in the pulp. Rotary motion which the impeller tends to induce in the pulp is greatest near the impeller and progressively less as the radial distance therefrom increases. Since the baffles are widest near the impeller and slope to substantially less width in the radial direction outwards from the impeller housing, they are uniformly effective throughout their length in minimizing rotary motion of the pulp. This uniform baffling efficiency is achieved while at the same time the depth of the top edge of the baffles below the normal level of the pulp is made maximum at all points. In consequence, the baffles have a minimum effect in preventing the froth, as it rises to the surface of the pulp, from flowing laterally to the side edges of the cell and overflowing into the collecting launders L.

The substantially improved results obtained with Fagergren type flotation machines equipped in accordance with the invention is shown in the following table. One of five rows of Fagergren type flotation machines in a concentrator plant treating sulphidic copper ore was equipped with baffles 27 and air screw vanes 25 of the character herein described, while the remaining rows were not so equipped. The second column of the table shows the percentage of copper in the tailings withdrawn from the machines in rows 1 to 4 (the rows in which standard Fagergren machines were not equipped with baffles or air screws), and the third column shows the corresponding analysis of tailings from row 5 (the row of machines that were equipped with baffles and air screws). The data are given for the twenty-two successive days that formed the test period. The difference between the amount of copper present in the tailings from machines in rows 1 to 4 and in the tailings from the machines in row 5 are given in the fourth column of the table.

Table I

Days	Rows 1, 2, 3, 4 and 6, Per Cent Copper	Row #5, Per Cent Copper	Difference, Per Cent Copper
1st day	.123	.093	.030
2nd day	.139	.099	.040
3rd day	.117	.078	.039
4th day	.128	.091	.037
5th day	.125	.093	.032
6th day		Mill Down	
7th day	.134	.090	.044
8th day	.117	.080	.037
9th day	.118	.090	.028
10th day	.121	.090	.031
11th day	.142	.111	.031
12th day	.170	.144	.026
13th day	.174	.147	.027
14th day	.171	.152	.019
15th day	.164	.144	.020
16th day	.176	.153	.023
17th day	.158	.141	.017
18th day	.171	.149	.022
19th day	.183	.169	.014
20th day	.192	.182	.010
21st day	.135	.123	.012
22nd day	.160	.148	.012
Averages	.148	.122	.026

It is evident from the foregoing table that the invention enables a substantial improvement to be achieved in the recovery of copper in the concentrate, as indicated by the markedly and consistently less amount of copper present in the tailings from machines equipped in accordance with the invention, as compared with the tailings from machines not so equipped but operating concurrently as the same ore pulp.

We claim:

1. In flotation apparatus comprising a long trough-like chamber divided by transverse partitions into a plurality of cells, said partitions being formed with openings adjacent the floor of the cells for permitting an ore pulp to flow lengthwise directly from cell to cell through the chamber, an impeller of substantial height rotating in each cell for introducing air into the pulp therein, said impellers being located substantially in the horizontal plane of the partition openings, and a housing surrounding each impeller, the improvement comprising a pair of

thin vertical baffles positioned below the normal pulp level in each cell and substantially in the horizontal plane of the impeller therein, said baffles extending lengthwise of the trough a substantial distance and parallel to the line of pulp flow therethrough from cell to cell and being arranged on opposite sides of the impeller housing, the height of each baffle at the housing being substantially equal to the vertical dimension of the impeller, each cell being substantially free of any obstruction apart from the impeller housing to the flow of pulp lengthwise therethrough, but said baffles serving to substantially preclude rotary flow of the pulp in the cells.

2. In flotation apparatus comprising a long trough-like chamber divided by transverse partitions into a plurality of cells, said partitions being formed with openings adjacent the floor of the cells for permitting an ore pulp to flow lengthwise directly from cell to cell through the chamber, an impeller of substantial height rotating in each cell for introducing air into the pulp therein, said impellers being located substantially in the horizontal plane of the partition openings, and a housing surrounding each impeller, the improvement comprising a pair of thin vertical baffles mounted on opposite sides of each impeller housing below the normal level of the pulp and substantially in the horizontal plane of the impeller, said baffles also being positioned in a vertical plane parallel to the line of flow of the pulp from cell to cell and extending a substantial distance lengthwise of the cell, the bottom edges of said baffles being close to and

substantially parallel with the floor of the chamber and the top edges thereof being sloped downwardly from the side thereof adjacent the impeller housing to the side remote from said housing, the height of the baffles thus being greatest near the impeller, and there being substantially equal to the height of the impeller, and progressively less at progressively greater distances outwardly from the impeller, each cell being substantially free of any obstruction apart from the impeller housing to the flow of pulp lengthwise therethrough, but said baffles serving to substantially preclude rotary flow of the pulp in the cells.

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