United States Patent [19]

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[11] **3,864,438**

[45] **Feb. 4, 1975**

[54] **FLOTATION MACHINE**

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[22] Filed: **Mar. 15, 1973**

[21] Appl. No.: **341,675**

[30] **Foreign Application Priority Data**

Mar. 18, 1972 Japan 47-27602

[52] **U.S. Cl.** **261/87**, 209/169, 259/96

[51] **Int. Cl.** **B03d 1/16**

[58] **Field of Search** 259/7, 8, 23, 24, 107, 259/108, 96; 209/163, 168, 169; 261/83, 84, 261/85, 87; 68/183

[56] **References Cited**

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[57] **ABSTRACT**

A flotation machine comprising a flotation cell having therein an air inlet pipe for introducing air into the liquid being treated, a rotating body for agitating the liquid, and a dispersing unit having a plurality of guide vanes characterized by the improvement in which projection portions are provided in the flow passages for the liquid formed between the guide vanes.

8 Claims, 4 Drawing Figures

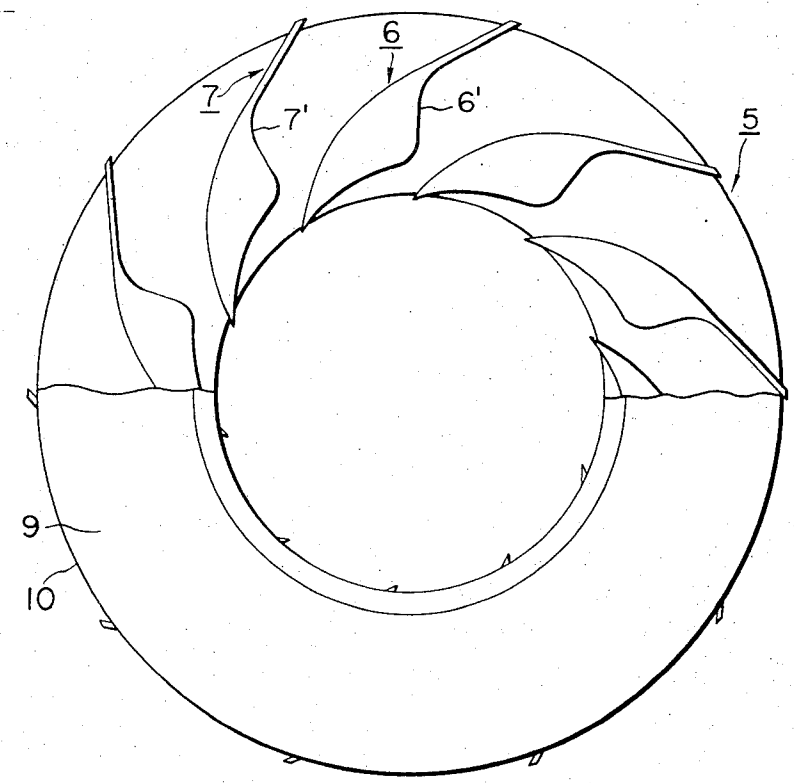


FIG. 1

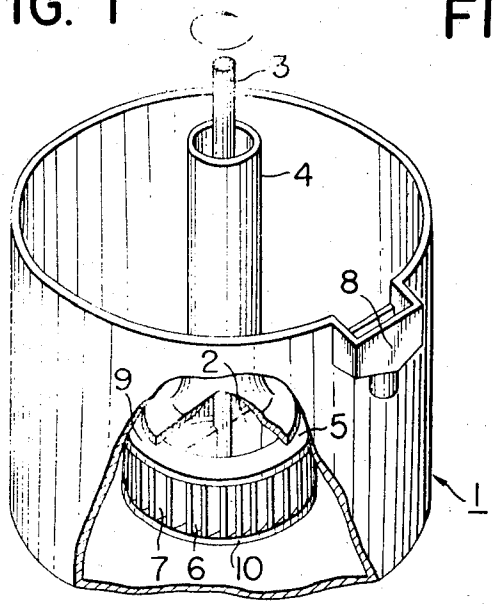


FIG. 3

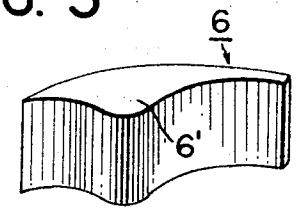


FIG. 4

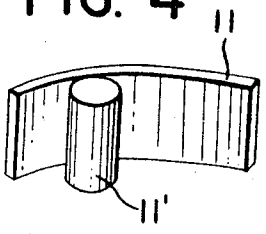
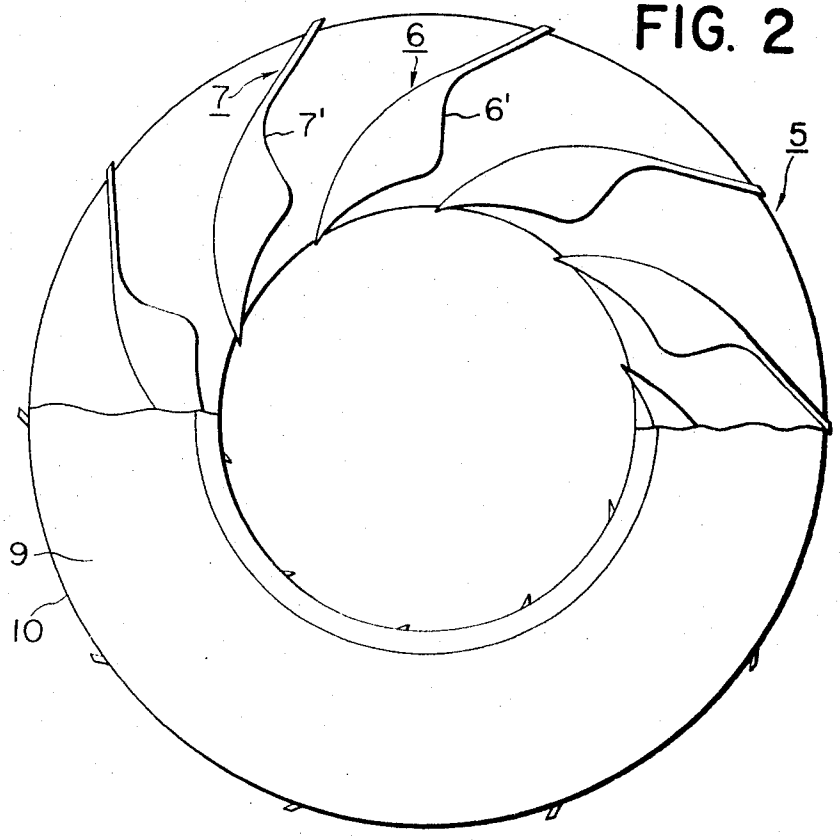


FIG. 2



FLOTATION MACHINE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a flotation machine in which the air bubbles generated in the flotation cell are subdivided and the surface area of the bubbles is enlarged.

The flotation machine is required to provide the function of generating air bubbles in the liquid, or slurry of solids and liquid being treated therein. The material desired to be separated from the flotation liquid adheres to the bubbles so that it rises to the surface of the tank or cell with the bubbles. Therefore it is desired that the flotation machine be capable of generating a large amount of bubbles because the flotation efficiency can be increased in proportion to the amount of generated air bubbles to a certain degree.

Heretofore, the amount of bubbles generated in the cell has been controlled to a certain degree by regulating the kind and amount of the flotation agent that is employed. But in general, the amount of bubbles generated depends on the amount of air that is introduced into the cell. The amount of air introduced into the cell has heretofore been increased by increasing the speed of rotation of the agitator or impeller or by blowing in a large amount of air progressively into the cell of the flotation machine. However, when the amount of air introduced into the cell is increased by increasing the speed of rotation of the rotating body of the flotation machine, there are the drawbacks that the consumption of power is increased and the amount of wear of the rotating body and its supporting mechanical structure is increased. When air is blown progressively into the cell, there is the drawback that extra equipment and power are required for the preparation and supply of the pressurized air.

SUMMARY OF THE INVENTION

The present invention is intended to provide an improved flotation machine capable of improving the flotation efficiency by increasing the surface area of the generated air bubbles, but without necessarily increasing the total volume of air sucked into the cell.

The inventor has discovered, as a result of numerous studies, that the surface area of the bubbles generated by suction of air can be increased in a flotation machine employing an air suction pipe, such as a stand pipe or a hollow shaft, positioned in parallel with the vertical axis of the flotation cell, a rotating body for effecting agitation of the flotation liquid and a dispersing unit consisting of a plurality of guide vanes provided at the bottom portion of the flotation cell. When the relatively small number of relatively large diameter bubbles in the flotation liquid directed from the center of the cell through the dispersing unit and thence toward the side wall of the flotation cell are subdivided into a larger number of smaller diameter bubbles, the efficiency of flotation is enhanced. Particularly when projecting portions are provided between the guide vanes of the dispersing unit, the efficiency of flotation is conspicuously enhanced.

The present invention is based on this discovery.

The present invention will be further described in detail with reference to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partially cut-away perspective view showing the inside of a cell.

FIG. **2** is an enlarged, partially cut-away, plan view of the dispersing unit of the FIG. **1.**

FIG. **3** is a perspective view of a guide vane.

FIG. **4** is a perspective view of a modified guide vane.

DETAILED DESCRIPTION OF THE INVENTION

The structure of the flotation machine, except for the structure of the guide vanes of the dispersing unit as shown in the drawings is generally similar to that of a conventional flotation machine and it will be described only briefly.

The apparatus comprises a flotation cell **1** having a rotating body or impeller **2** for drawing air into the cell and circulating the liquid through the cell. The impeller **2** is rotated by a shaft **3.** An air inlet pipe **4** encircles and is spaced from the shaft **3.** A stationary dispersing unit **5** is mounted on the lower end of the pipe **4.** The dispersing unit **5** has a series of guide vanes, such as the vanes **6** and **7.** A froth discharging trough **8** is provided in the side wall of the cell at the upper end thereof. The guide vanes are mounted on support rings **9** and **10.**

When the impeller **2** is rotated in the direction of the arrow (FIG. **1**) after feeding the flotation liquid to the flotation cell **1,** air is sucked in through the inlet pipe **4.** This air flows to the inside of the dispersing unit **5,** is mixed with the flotation liquid thereat and then is directed between the guide vanes of the dispersing unit **5** toward the side wall of the flotation cell by the rotation of the impeller **2.**

As shown in FIG. **2,** projecting portions (**6'**, **7'**) are provided in the passage formed between the guide vanes. It has been discovered that these projecting portions cause the air bubbles to be subdivided so that a larger number of smaller diameter bubbles are formed, as compared with the case of the conventional dispersing unit which has guide vanes made of curved plates and which do not have any projection portions. That is, by employing the apparatus shown in FIG. **2,** the generated air bubbles are subdivided and dispersed in the flotation liquid. The mixture of air bubbles and liquid is discharged from the dispersing unit flowing in a substantially circumferential direction relative to the side wall of the flotation cell. It is believed that this subdivision effect is obtained because the air bubble-liquid mixture is squeezed as it passes through the narrow passages provided by the projecting portions **6'**, **7'** on the vanes **6** and **7.** Accordingly, comparing the flotation machine on the present invention with the conventional flotation machine, when both flotation machines are operated in such a way that the amounts of the air sucked in are substantially equal, in the flotation machine of the present invention, a larger number of the smaller diameter air bubbles are formed as discussed in the foregoing, the total surface area of the bubbles is increased, and the amount of the material which adheres to bubbles is increased. For this reason, the amount of discharge of froth per unit time to the froth discharging trough **8** as shown in FIG. **1** is also improved.

As the projecting portions of the dispersing unit to be installed in the flotation machine of the present invention, it is desirable to make the projecting portions integral with the guide vanes. Particularly it is preferable to

provide the projecting portions on the leading surface of the guide vanes, in the direction of rotation of the impeller, that is, on the otherwise concave sides of the vanes. Also, as the shape of the projecting portions, there is no particular limitation, but guide vanes having a streamline type projecting portions as shown in FIG. 3 corresponding to the guide vanes in FIG. 2 or the guide vanes 11 having columnar shape projecting portion 11' as shown in FIG. 4 can be employed in the present invention. In the present invention, if the spacing between the tip of the projecting portion and the back surface of the guide vane adjacent thereto, namely, the narrowest dimension of the zone between adjacent vanes is excessively narrow, the flow of the flotation liquid can be interrupted. Also when it is excessively large, the bubble breaking and dispersing effects are reduced. It has been found advantageous, therefore, to employ projecting portions which occupy at the narrowest point of said zone, from about 20 to 90 percent of the gap that would exist between adjacent guide vanes if the vanes were of constant wall thickness.

The dispersing unit according to the present invention can be installed not only in circular type flotation cells as illustrated, but also in any type of the flotation cell and in any case, similar effects can be obtained.

The invention will be further described with reference to the following illustrative example.

Example

Using a flotation machine (a) according to the present invention in FIGS. 1 and 2, and a flotation machine (b) for comparison purposes in which a dispersing unit employing curved plates of constant wall thickness as the guide vanes, namely, a dispersing unit not having the projecting portions on the guide vanes of the flotation machine of the present invention, flotations were effected under identical conditions. A waste water having a Cu^{++} concentration of 30 ppm was supplied to each flotation machine and furthermore, ethyl xanthate and a frother were added thereto to form precipitates of Cu xanthate. Flotation was effected for 10 minutes.

The floating conditions of each flotation machine (temperature, speed of rotation of impeller) were identical.

The results were as shown in the following table.

Table 1

Performance / Flotation machine	Cu concentration in tailings after flotation (ppm)	Distribution ratio of Cu (%)	
		tailings	froth
(a) flotation machine according to the present invention	0.5	1.7	98.3
(b) comparative flotation machine	2.4	8.0	92.0

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a flotation machine comprising a flotation cell having an air inlet pipe for introducing air into the liquid being treated, a rotatable impeller for mixing the air with the liquid and circulating same in the cell, and an annular dispersing unit having a central opening in which said impeller is disposed and having a series of circumferentially spaced guide vanes defining flow passages for directing flow of the air and the liquid from the impeller, the improvement which comprises: each guide vane has an integral projecting portion on its leading side, in the direction of rotation of said impeller, said portion projecting toward the trailing side of the adjacent leading guide vane and defining therewith a zone which converges and then diverges in a direction away from the central opening of the dispersing unit, for causing subdivision of air bubbles in the liquid.

2. A flotation machine according to claim 1, in which said dispersing unit comprises a series of guide vanes which are forwardly curved in the direction of rotation of said impeller, said dispersing unit being stationarily mounted on the lower end of said air inlet pipe and adjacent to the bottom wall of the cell, said dispersing unit being coaxial with the axis of the rotation of said impeller.

3. In a flotation machine comprising a flotation cell having an air inlet pipe for introducing air into the liquid being treated, a rotatable impeller for mixing the air with the liquid and circulating same in the cell, and an annular dispersing unit having a central opening in which said impeller is disposed and having a series of circumferentially spaced guide vanes defining flow passages for directing flow of the air and the liquid from the impeller, the improvement which comprises: each guide vane has a concavo-convex shape with the concave side thereof being the leading side of the vane in the direction of rotation of said impeller, each guide vane having a member disposed in contact with the concave side thereof and extending partway across the flow passage defined between said vane and the convex side of the adjacent leading vane, and defining therewith a flow passage zone which converges and then diverges in a direction away from the central opening of the dispersing unit.

4. A flotation machine according to claim 3, in which said dispersing unit comprises a series of guide vanes which are forwardly curved in the direction of rotation of said impeller, said dispersing unit being stationarily mounted on the lower end of said air inlet pipe and adjacent to the bottom wall of the cell, said dispersing unit being coaxial with the axis of rotation of said impeller.

5. In a flotation machine comprising a flotation cell having an air inlet pipe for introducing air into the liquid being treated, a rotatable impeller for mixing the air with the liquid and circulating same in the cell, and an annular dispersing unit having a central opening in which said impeller is disposed and having a series of circumferentially spaced guide vanes defining flow passages for directing flow of the air and the liquid from the impeller, the improvement which comprises: projecting portions integral or contiguous with the guide vanes and located thereon between the central opening and the periphery of said dispersing unit, each portion projecting toward the opposing surface of the adjacent guide vane and extending partway across the flow passage defined between said adjacent guide vanes and forming a narrowed zone in said flow passage for causing subdivision of air bubbles in the liquid, said flow passage being enlarged relative to said narrowed zone on opposite sides of said zone.

6. in a flotation machine comprising a flotation cell having an air inlet pipe for introducing air into the liquid being treated, a rotatable impeller for mixing the air with the liquid and circulating same in the cell, and an

annular dispersing unit having a central opening in which said impeller is disposed and having a series of circumferentially spaced guide vanes defining flow passages for directing flow of the air and the liquid from the impeller, the improvement which comprises: a projecting portion disposed in each of said flow passages between the opposing surfaces of the adjacent guide vanes that define the flow passage, the projecting portion being located in the flow passage between and spaced radially from said central opening and the periphery of said dispersing unit, the projecting portion extending from one side of the flow passage toward the other side of the flow passage partway across the flow passage and narrowing the width of said flow passage, with the width of said flow passage being enlarged on opposite sides of said projecting portion.

7. A flotation machine as claimed in claim **6,** in which said projecting portion is located closer to said central opening than to the periphery of said dispersing unit.

8. A flotation machine as claimed in claim **6,** in which said projecting portion extends from the leading side of one vane, in the direction of rotation of the impeller, partway toward the trailing side of the adjacent guide vane.

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