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FLOTATION APPARATUS

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FIG. 3

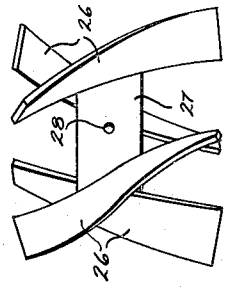

FIG. 1

FIG. 2

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FLOTATION APPARATUS

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2 Claims. (Cl. 261—93)

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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 (impellers) driven by a vertical shaft that extends downwardly from above the normal level of an ore pulp in the machine. The invention is especially adapted for use in connection with flotation machines of the Fagergren type. The principal feature of the present invention is the provision of a supplementary air screw comprising a plurality of vanes projecting laterally from the vertical air pump (or impeller) shaft adjacent the normal level of the ore pulp in the apparatus. The vanes are pitched at an angle to the vertical so as to cause them to force air downwardly when the shaft is rotated in its normal operating direction.

A typical Fagergren-type flotation machine of the character to which the invention may be applied with advantage (such, for example, as is shown and described in Taggart's Handbook of Mineral Dressing (1945 edition), section 12, pages 66 and 67) comprises a long trough-like chamber divided by transverse partitions into a plurality of cells. Each cell is provided with an air pump for aerating the pulp comprising a substantially vertical rotatable impeller shaft, with an impeller mounted on the shaft at its lower end beneath the normal level of pulp in the cell. A housing surrounds the impeller and shaft, and a splash cone generally is provided inside the housing adjacent the normal level of the pulp in the cell.

In apparatus of this character, the invention provides the improvement comprising a plurality of vanes projecting laterally from the impeller shaft adjacent the normal level of the pulp, said vanes being pitched at such an angle to the vertical as to force air downwardly toward the impeller during rotation of the impeller shaft in its normal operating direction. The vanes may be permanently mounted on a collar having the proper inside diameter to slide-fit on the impeller shaft. The collar then may be provided with a set screw for clamping it and the vanes at a desired position on the shaft. The splash cone itself advantageously is formed with a substantially vertical cylindrical portion at its lower end, which surrounds but is spaced from the impeller shaft adjacent the normal level of the pulp. The vanes, in such case, are secured to the impeller shaft inside this cylindrical lower extension of the splash cone.

The vanes referred to serve a dual purpose: They increase the amount of air which the air pump impeller delivers to the ore pulp; and they

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prevent accumulation of ore pulp mud in the splash cone around the impeller shaft, thereby insuring an open passage for air from the atmosphere to the impeller.

A preferred embodiment of the invention is shown in the accompanying drawings, in which

Fig. 1 shows in perspective (parts being broken away) a Fagergren-type flotation machine equipped in accordance with the present invention;

Fig. 2 is a plan of the air screw assembly of collar and vanes shown in Fig. 1; and

Fig. 3 is an elevation of the air screw assembly shown in Fig. 2.

The flotation machine shown in Fig. 1 comprises a long trough-like chamber 1 having a flat bottom 2, and side walls each having a lower portion 3 which slopes outwardly from the bottom and an upper portion 4 which is substantially vertical. The chamber is divided by a series of transverse partitions 5 into a plurality of individual cells (only two such cells are shown in full, in Fig. 1, but ordinarily the chamber 1 will be long enough to contain five or six similar 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 Fig. 1). 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 vertical bars 23.

The apparatus of Fig. 1 is shown provided with a pair of vertical baffles 24 in each cell. The baffles are secured to the impeller housing and project radially therefrom in a direction lengthwise of the chamber 1 parallel to the flow of ore pulp through the apparatus from cell to cell. These baffles, which serve to prevent rotary motion of the pulp in each cell, are not a part of Fagergren-type flotation machines as heretofore known. They form the subject matter claimed in our copending application Serial No. 778,006, filed October 4, 1947, and are more fully described therein.

In the operation of the apparatus 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 suck air downwardly about the impeller shaft and deliver it radially outwardly through the rotating squirrel cage bars 20 and the stationary housing bars 23 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 25 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, of course, important that an adequate amount of air be delivered to the pulp to insure formation of a large volume of froth. Otherwise deficient recovery of the mineral values in the concentrate may result. In accordance with the invention, the delivery of an adequate volume of air is insured by the provision of a plurality of vanes 26 secured to the impeller shaft 11 about at the normal surface level of the pulp in the cell. The vanes are pitched at such an angle to the vertical that when the impeller shaft rotates in its normal operating direction, they serve as fan or air screw blades to force air downwardly to the impeller.

The vanes can be welded or otherwise fastened directly to the impeller shaft 11, but preferably they are mounted on a collar 27, as by being welded thereto. The assembly of collar and vanes is shown on an enlarged scale in Figs. 2 and 3. The internal diameter of the collar is just enough larger than the diameter of the shaft to slidefit easily therein. The collar is formed with threaded radial holes 28 to receive set screws 29 by which the collar may be clamped at a chosen position on the impeller shaft.

It is customary to provide Fagergren type flotation machines with a splash cone 30. The purpose of this cone is to prevent ore pulp splashed by the rotating impeller from being recirculated thereby. It is of course recognized that to whatever extent the impeller serves merely to recirculate splashed ore pulp, its capacity to force air into the pulp is correspondingly diminished. In apparatus constructed in accordance with the invention, we prefer to provide the splash cone, at its lower end, with a downwardly extending cylindrical portion 31 which is concentric with but spaced from the impeller shaft. This lower cylindrical portion (or extension) of the splash cone is situated about at the normal level of pulp in the cell, and the air screw assembly of collar 27 and vanes 26 is mounted inside it. The inside diameter of the downward extension 31 of the splash cone should be only slightly greater than the diameter of the circular path described by the outer edges of the vanes as they rotate with the impeller shaft.

While splash cones generally have been found necessary in flotation machines of the type described to minimize recirculation of splashed ore pulp and froth, they have often been found to provide a focal point for the accumulation of ore pulp mud. An accumulation of mud in the splash cone reduces the cross-sectional area of the passage through the cone through which air must pass from the atmosphere to the impeller. An accumulation of mud therefore reduces the rate at which the impeller can deliver air to the pulp. We have found that the above-described air screw is extremely efficient in preventing any accumulation of ore pulp mud in the splash cone, especially when the splash cone is provided with the cylindrical downward extension 31 shown in the drawings, and when the inside diameter of this extension is not much larger than the overall diameter of the air screw. The action of the air screw in preventing any accumulation of ore pulp mud may be considered as a mechanical scraping action because as ore pulp mud tends to begin to accumulate in the opening of the cone, it is scraped off by the radially extending rotating vanes of the air screw.

It is apparent from the foregoing that the air screw vanes 26, rotating with the impeller shaft 11, insure delivery of an adequate volume of air to the pulp in two ways: first, by keeping the air passage through the splash cone free from any accumulation of ore pulp mud; and, second, by positively forcing air downwardly toward the impeller.

Tests have shown that the increased aeration of an ore pulp achieved by equipping Fagergren-type flotation machines with air screws of the character described results in improved recovery of mineral values in the concentrate, and reduced losses of the desired mineral values in the tailing. In a comparative test of Fagergren-type machines treating a pulp of sulphidic copper ore, in which some of the machines were equipped with air screws of the character described and with baffles 24, and in which the other machines were not so equipped, it was found that the copper content of the tailings from the machines not equipped in accordance with the invention averaged, over a considerable period of time, about 20% higher than the copper content of the tailings from the machines that were equipped in accordance with the invention.

In addition to leading to improved flotation concentrate recovery of mineral values, the air screws of the invention also reduce the difficulty of keeping the machines in good operating condition, by reducing the frequency with which it is necessary to clean mud from the splash cone and elsewhere in the immediate vicinity of the impeller shaft.

We claim:

1. In a flotation apparatus comprising a cell adapted to contain ore pulp and having therein means for aerating the pulp comprising a substantially vertical rotatable impeller shaft, an aerating impeller mounted on the shaft at the lower end thereof beneath the normal level of pulp in the cell, a housing surrounding the im-

peller shaft, said housing being continuous and imperforate from the aerating impeller upwardly to above the level of the pulp thereby defining an enclosed air admission space about the impeller shaft above said impeller, and a splash cone inside the housing adjacent the normal level of the pulp, said splash cone having its apex cut away to form a circular opening through which the impeller shaft passes, the improvement comprising a plurality of vanes pitched at an angle to the vertical and projecting laterally from the impeller shaft in the enclosed air admission space directly above the aerating impeller, said vanes being positioned directly in the circular opening of the splash cone and extending radially from the shaft almost to the inner edge of the splash cone defining said circular opening, the pitch of said vanes being such that during normal rotation of the impeller shaft the vanes force air downwardly through the opening of the splash cone toward the impeller and the radial extension of the vanes being such that accumulation of ore pulp mud in the opening of the splash cone is prevented by the mechanical scraping action of the rotating vanes.

2. In flotation apparatus comprising a cell adapted to contain a body of ore pulp and having therein means for aerating pulp comprising a substantially vertical rotatable impeller shaft, an aerating impeller mounted on the shaft at the lower end thereof beneath the normal level of pulp in the cell, and a housing surrounding the impeller and shaft, said housing being continuous and imperforate from the aerating impeller upwardly to above the level of the pulp thereby defining an enclosed air admission space about the impeller shaft above said impeller, the improvement comprising a splash cone inside the

housing above the impeller and terminating at its lower end in a substantially vertical cylindrical portion concentrically surrounding the impeller shaft adjacent the normal level of the pulp but spaced from said shaft to form an annular air passageway around said shaft, and a plurality of vanes secured to the shaft adjacent the normal pulp level inside said cylindrical portion of the splash cone, said vanes being pitched at an angle to the vertical and projecting radially from the impeller shaft almost to the inner surface of said cylindrical portion, the pitch of the vanes being such that during normal rotation of the impeller shaft the vanes force air downwardly through the cylindrical portion of the splash cone toward the aerating impeller and the radial extension of the vanes being sufficient to prevent accumulation of ore pulp mud in said cylindrical portion by mechanical scraping action when said shaft is rotated.

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