Dec. 11, 1962 S. RODOZ 3,067,988

FLOTATION WITH MECHANICAL AGITATION

Filed April 24, 1959 2 Sheets-Sheet 1

fig.1

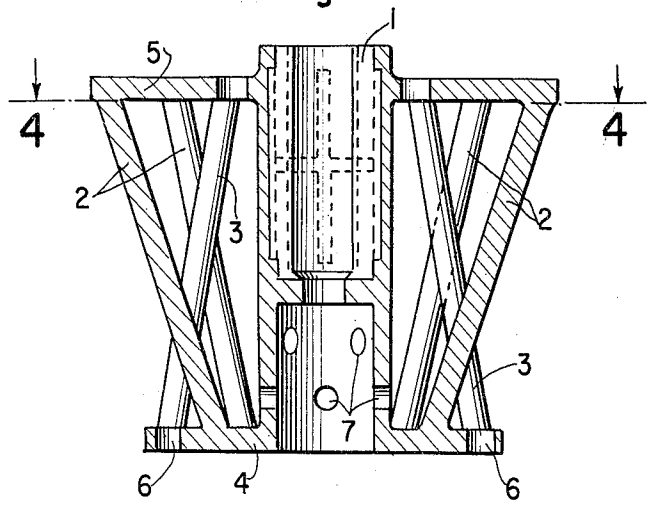
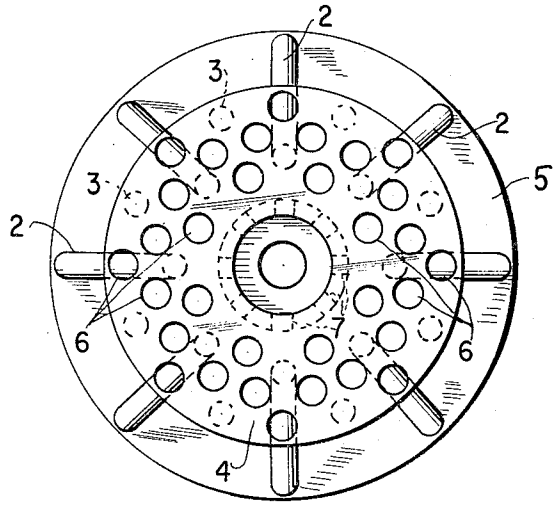


fig.2



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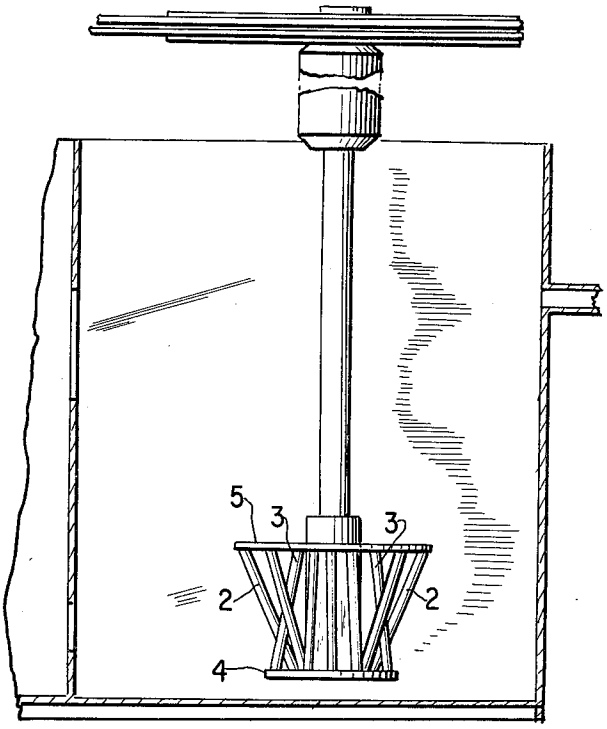

fig.3

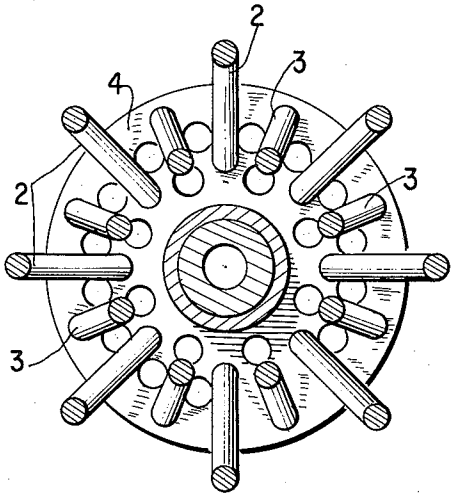

fig.4

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FLOTATION WITH MECHANICAL AGITATION

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5 Claims. (Cl. 261—29)

The present invention relates to improvements in flotation with mechanical agitation.

For a long time past, the flotation of ores, for example, has been carried out in a static form; to this end, a gas was caused to pass through a tank with a porous bottom containing the pulp to be treated, the bubbles of said gas passing through the pulp collected the particles of ore and brought them to the surface, from which the foam and froth could be recovered. This method of flotation had generally a poor efficiency as a result of the bad diffusion of the reagents and of the air or gas in the tank, and also due to the sedimentation of the pulp caused by inadequate agitation of the pulp by the passage of the gas.

This method of flotation was subsequently improved by the use of mechanical agitation ensuring aeration by cavitation; in spite of the increase in the cost of treatment due to the wear of the agitators and to the substantial consumption of energy necessary, the efficiencies obtained under these conditions are such that this form of dynamic flotation has become almost universally adopted.

During the course of studies made with the object of trying to reduce the cost of these operations, the applicant has been led to make a detailed analysis of the functions of the various factors acting on the quality of the flotation. It has thus been found that the blade type agitator of the usual type, mounted in a flotation tank, plays three parts which are bound together although they are very different, namely:

Pumping: this keeps the ore in suspension in the water, which gives a homogeneous pulp and ensures the flow of the pulp from one tank to the next following tank.

In order to ensure the suspension of the ore in the pulp and the flow of this latter into the following tank (or to draw the pulp from the preceding tank), it is only necessary to give the pulp a speed of the order of 2 to 3 metres per sec., which necessitates a relatively low power, generally comprised between 0.25 and 1.5 H.P. per cell.

The putting into contact of the reagents with the particles of ore to be recovered: this contact phase depends on the dimensions of the liquid stream at the outlet of the agitator much more than on the violence of the agitation; in other words, there is a greater need for an agitator which divides the pulp finely than for an impelling device with a high mechanical efficiency, in order to obtain a good distribution of reagents.

Aeration: this introduces by cavitation the air required for the flotation, by cavitation throughout the mass of the pulp; tests which have been carried out have shown that the consumption of energy is enormous as compared with that necessary for agitation, taking account of the relatively small hourly volume of air required for the purposes of flotation.

Under these conditions, the applicant has had the idea of overcoming the drawbacks of known flotation devices having mechanical agitation, by utilizing special agitators which act as little as possible as impellers. To this end, the present invention relates to a flotation device which functions by mechanical agitation of the baths, in which the agitator is formed by bars arranged on at least one cone and preferably on two opposite coaxial cones, the

air being preferably injected along the axis of the cone and the surfaces of the bases of the cone being pierced with holes for the circulation of the pulp.

The apex angles of the cones may be equal or different, and are preferably comprised between 15 and 25 degrees.

The applicant has found that the device which forms the object of the invention ensures a very powerful cavitation and that it has therefore a very low impulsion efficiency; this poor impulsion efficiency is due to the different peripheral speeds existing at various points along the lengths of the inclined bars. The use of two oppositely-disposed cones further reduces the impulsion efficiency. As regards the cavitation, this is increased by the holes formed in the discs which constitute the bases of the cones.

The device in accordance with the invention thus enables the desired results to be obtained, by reducing very considerably the power required for flotation by mechanical agitation. The reduction in power obtained amounts in certain cases, all other things remaining equal, to about 30%. This reduced consumption of energy is accompanied by a reduction in the consumption of the reagents and by a very considerable increase in the metal recovered. Finally, the wear of the equipment is also reduced to a very considerable extent.

One form of embodiment of a device according to the invention is described below, reference being made to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view in cross-section of the device.

FIG. 2 shows a bottom plan view of the device.

FIG. 3 is a schematic view of a pulp tank containing the device.

FIG. 4 is a cross-section through the device taken approximately at line 4—4 of FIG. 1.

On a hollow shaft **1** which is used for the introduction of the aerating air through the holes **7** shown in FIG. 1, are mounted coextensively between the bases or end plates **5** and **6** two series of bars arranged following the generator lines **2** of a first cone and the same lines **3** of a second cone coaxial with and oppositely-disposed with respect to the first cone. The bases **4** and **5** are pierced with holes **6** to permit the passage of the pulp.

The shaft **1** is rotated by any suitable means, such as a belt, motor or other driving means conventionally used in the art.

What I claim is:

1. Flotation aparatus comprising a tank for holding a body of liquid pulp containing finely divided solids to be floated from suspension, an agitator rotatable in said tank to maintain an aeration zone within said body and circulation of the pulp into and from said zone and to disperse air bubbles into the pulp in said zone, means for flowing air into the pulp within said zone, said agitator comprising a shaft mounted for rotation on a substantially vertical axis and a rotor carried by said shaft at a location below the pulp level of said tank, and means for rotating said shaft on said axis, said rotor comprising a multiplicity of elongated agitating bars mutually spaced apart and spaced radially from said shaft in a fixed circumferential pattern wherein each of said bars extends predominantly vertically but is inclined with respect to said axis in a plane containing said axis, there being two circumferential series of said bars the respective bars of which are arranged in alternation and are inclined oppositely with respect to said axis, in crossing relation, the bars of one of said series being spaced farther from said axis at their upper ends than at their lower ends, the bars of the other of said series being spaced farther from said axis at their lower ends than at their upper ends but with their lower ends at a shorter

distance from said axis than the upper ends of the bars of said one series.

2. Flotation apparatus comprising a tank for holding a body of liquid pulp containing finely divided solids to be floated from suspension, an agitator rotatable in said tank to maintain an aeration zone within said body and circulation of the pulp into and from said zone and to disperse air bubbles into the pulp in said zone, means for flowing air into the pulp within said zone, said agitator comprising a shaft mounted for rotation on a substantially vertical axis and a rotor carried by said shaft at a location below the pulp level of said tank, and means for rotating said shaft on said axis, said rotor comprising a multiplicity of elongated agitating bars mutually spaced apart and spaced radially from said shaft in a fixed circumferential pattern wherein each of said bars extends predominantly vertically but is inclined at an angle of between 15° and 25° with respect to said axis in a plane containing said axis, there being two circumferential series of said bars the respective bars of which are arranged in alternation and are inclined oppositely at different angles with respect to said axis, in crossing relation, the bars of one of said series being spaced farther from said axis at their upper ends than at their lower ends, the bars of the other of said series being spaced farther from said axis at their lower ends than at their upper ends but with their lower ends at a shorter distance from said axis than the upper ends of the bars of said one series.

3. Flotation apparatus comprising a tank for holding a body of liquid pulp containing finely divided solids to be floated from suspension, an agitator rotatable in said tank to maintain an aeration zone within said body and circulation of the pulp into and from said zone and to disperse air bubbles into the pulp in said zone, means for flowing air into the pulp within said zone, said agitator comprising a shaft mounted for rotation on a substantially vertical axis and a rotor carried by said shaft at a location below the pulp level of said tank, and means for rotating said shaft on said axis, said rotor comprising a multiplicity of elongated agitating bars mutually spaced apart and spaced radially from said shaft in a fixed circumferential pattern wherein each of said bars extends predominantly vertically but is inclined with respect to said axis, there being two circumferential series of said bars the respective bars of which are arranged in alternation and are inclined oppositely with respect to said axis, in crossing relation, the bars of one of said series being spaced farther from said axis at their upper ends than at their lower ends, the bars of the other of said series being spaced farther from said axis at their lower ends

than at their upper ends but with their lower ends at a shorter distance from said axis than the upper ends of the bars of said one series.

4. Flotation apparatus as claimed in claim 3, said rotor also comprising upper and lower radial end plates respectively joining the upper and lower ends of all of said bars together and to said shaft, each of said end plates being formed with a plurality of openings therethrough for the flow of pulp therethrough axially into the spaces between said plates and said shaft and said bars.

5. Flotation apparatus comprising a tank for holding a body of liquid pulp containing finely divided solids to be floated from suspension, an agitator rotatable in said tank to maintain an aeration zone within said body and circualtion of the pulp into and from said zone and to disperse air bubbles into the pulp in said zone, said agitator comprising a shaft mounted for rotation on a substantially vertical axis and a rotor carried by said shaft at a location below the pulp level of said tank, means for rotating said shaft on said axis, and means carried by said shaft for flowing air into the pulp at a location inside the orbit of said rotor, said rotor comprising a multiplicity of elongated agitating bars mutually spaced apart and spaced radially from said shaft in a fixed circumferential pattern wherein each of said bars extends predominantly vertically but is inclined with respect to said axis, there being two circumferential series of said bars the bars of one of which are spaced farther from said axis at their upper ends than at their lower ends, the bars of the other of said series being disposed at circumferential locations between and inclined oppositely to the bars of said one series in crossing relation thereto, the lower ends of the bars of said other series being spaced farther from said axis than the upper ends thereof but being at a substantially lesser radial distance from said axis than the upper ends of the bars of said one series, so that upon rotation of said agitator the greatest peripheral speed of said rotor, hence the strongest outward propulsion of the pulp being agitated, occurs near the upper end of said rotor.

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