

June 19, 1934.

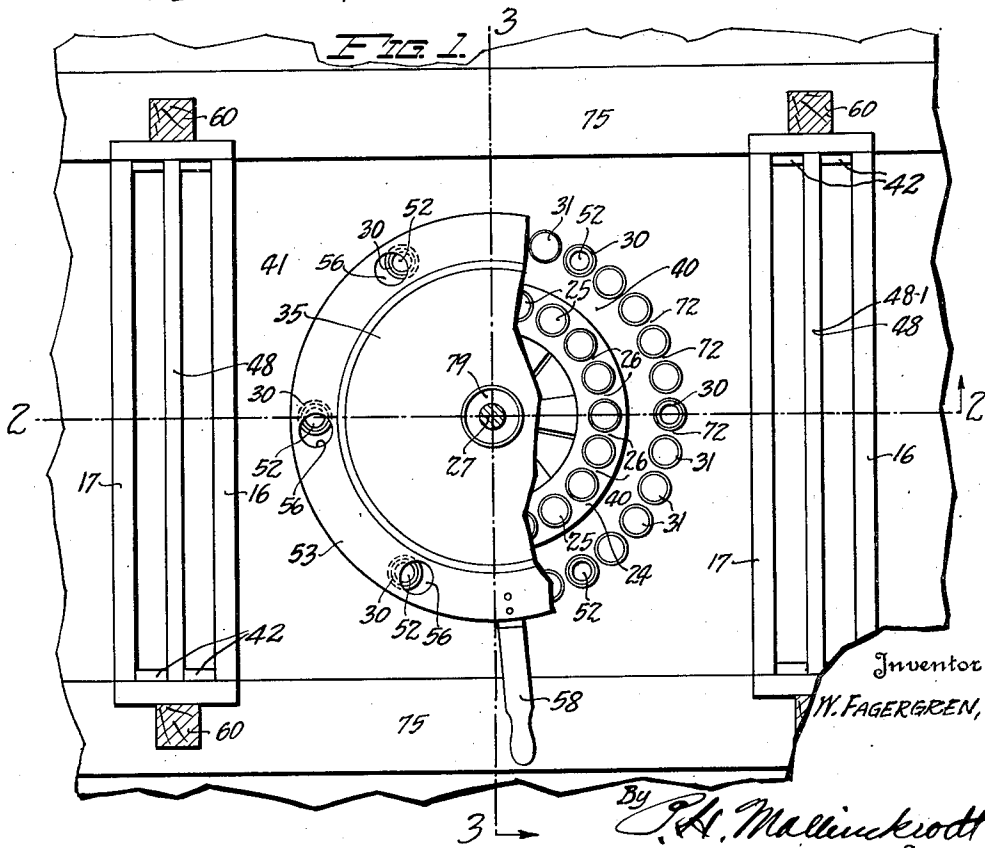
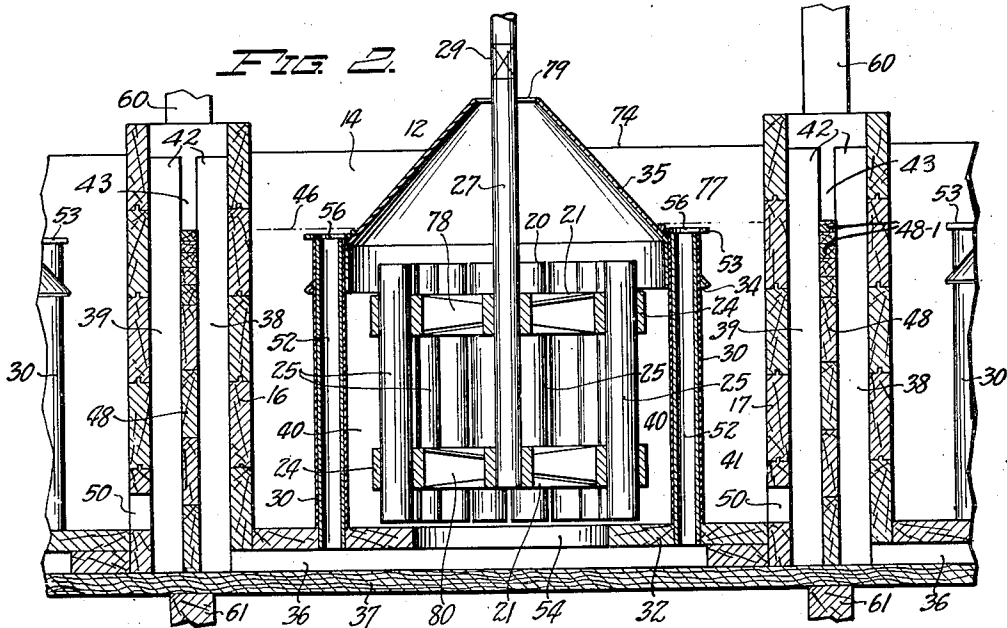
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1,963.122

AERATING MACHINE

Filed Nov. 28, 1930

4 Sheets-Sheet 1



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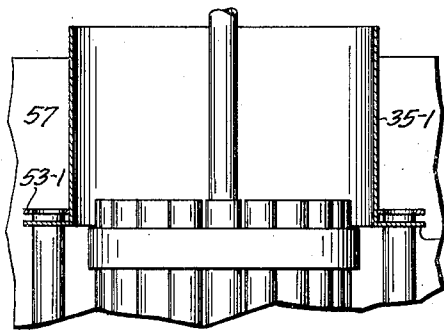
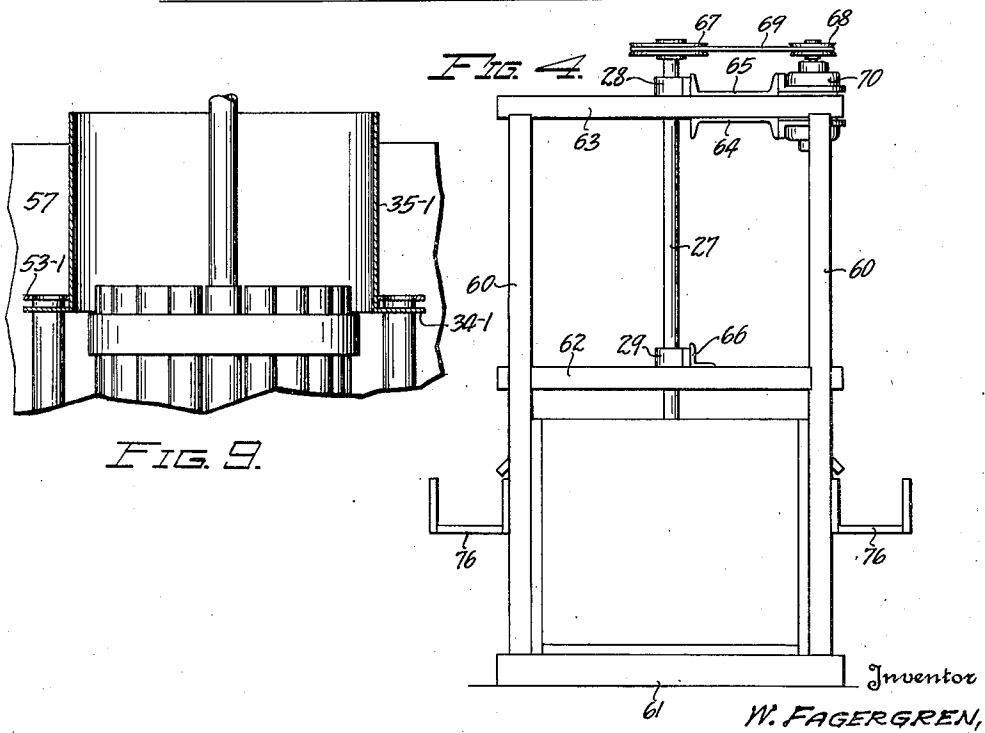
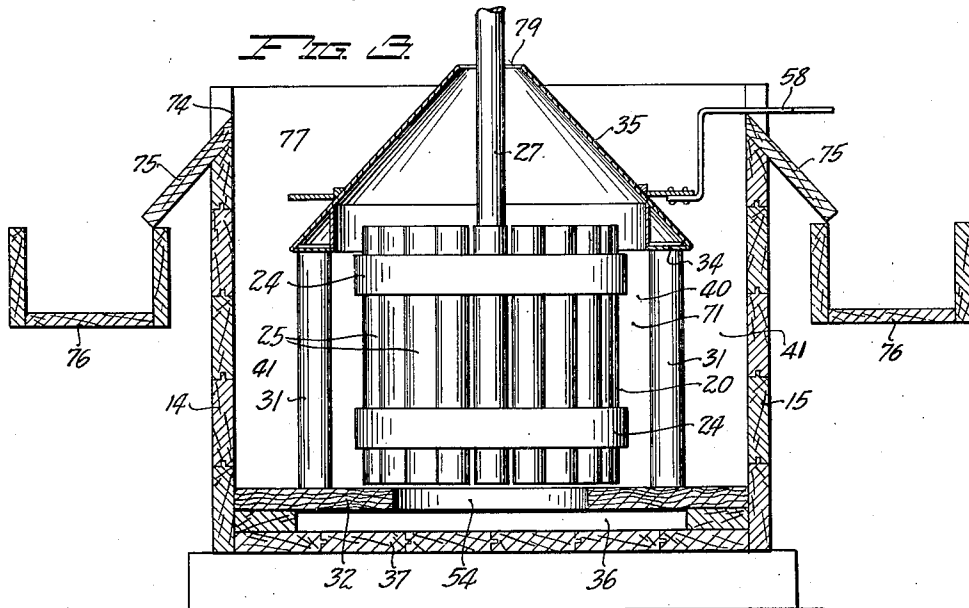
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AERATING MACHINE

Filed Nov. 28, 1930

4 Sheets-Sheet 2



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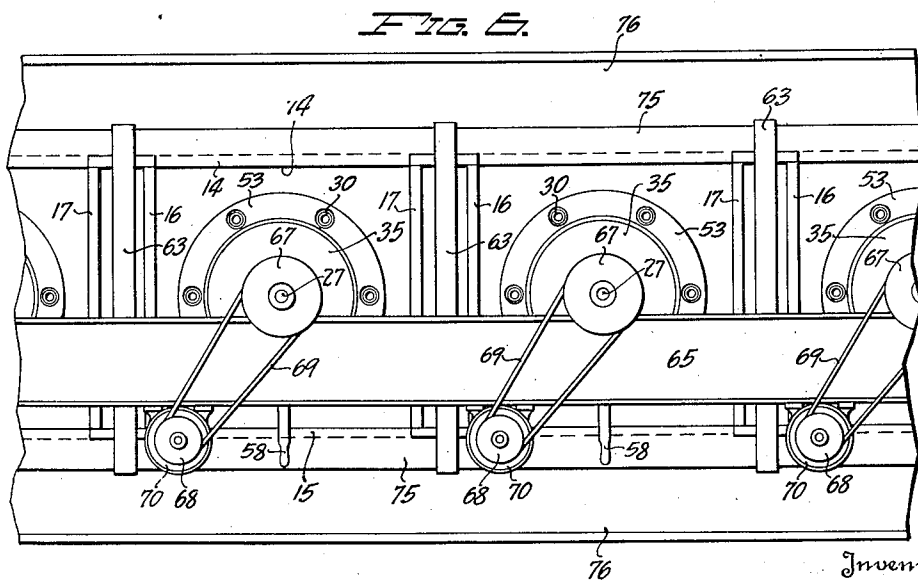
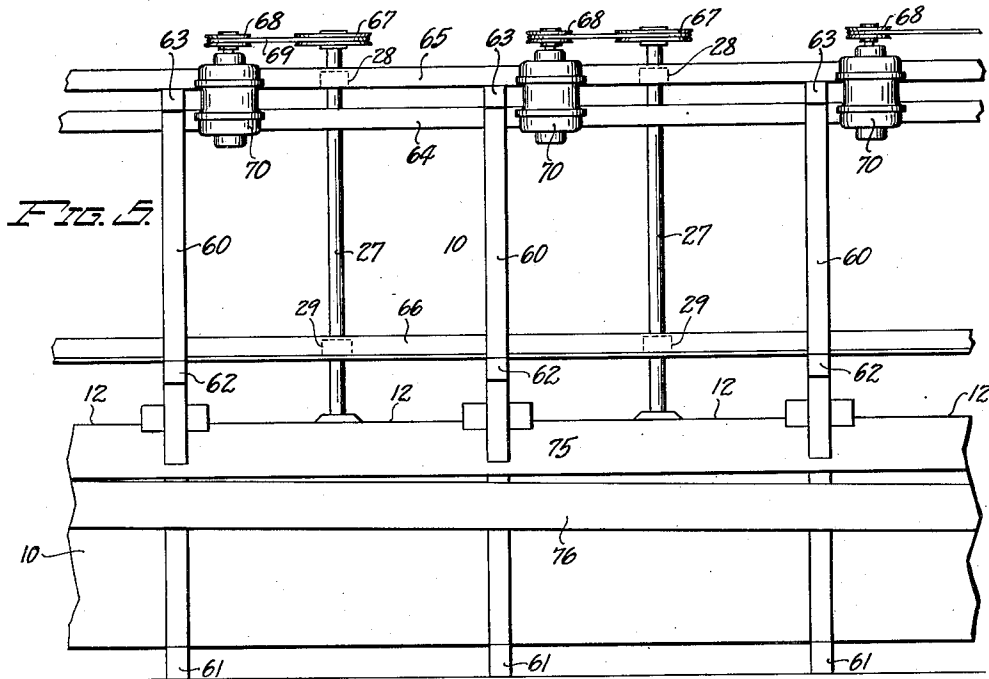
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AERATING MACHINE

Filed Nov. 28, 1930

4 Sheets-Sheet 3



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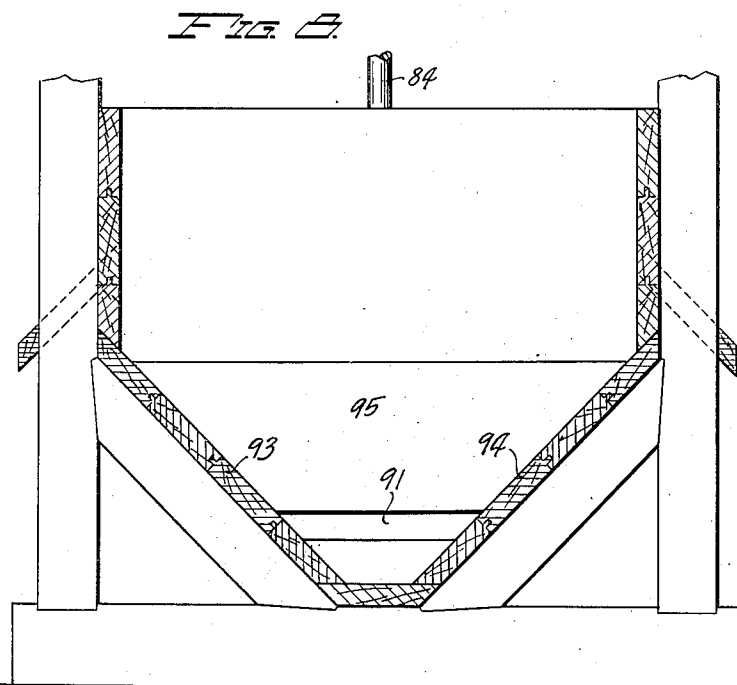
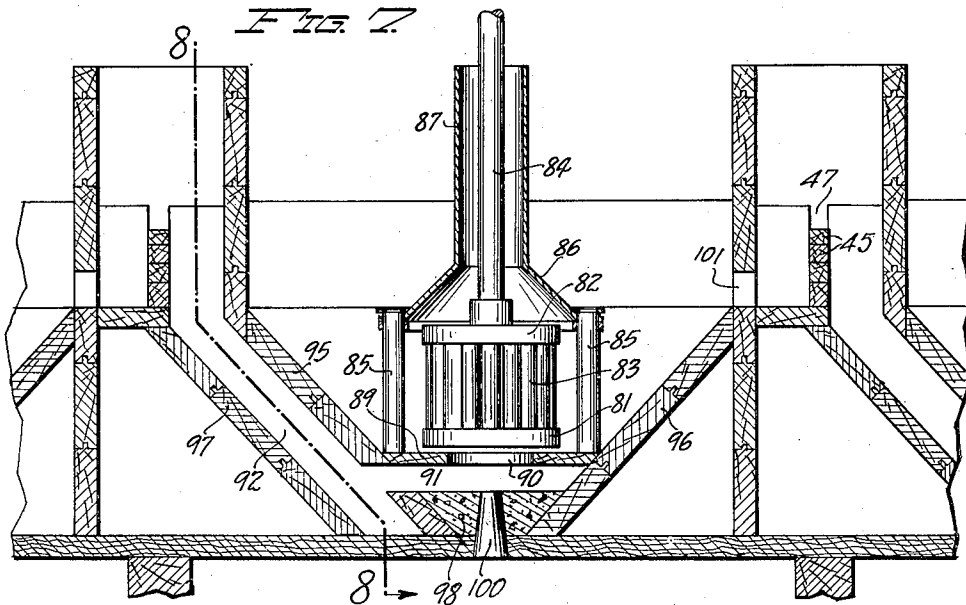
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AERATING MACHINE

Filed Nov. 28, 1930

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UNITED STATES PATENT OFFICE

1,963,122

AERATING MACHINE

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Application November 28, 1930, Serial No. 498,732

19 Claims. (Cl. 209—169)

This invention relates to an improved aerating machine, and more particularly to an aerating machine suited to the treatment of flotation pulp in the recovery of metallurgical values from their ores; therefore, it may also be termed a flotation machine, though its utility is not restricted thereto.

The principal objects of the invention are to obtain:

First, a maximum output at a minimum expense.

Second, a simplified construction.

Third, a saving in power.

Fourth, a wide range in capacity.

Fifth, a thorough circulation of pulp through the machine when treating ores by flotation.

Sixth, a construction occupying a minimum space for a given capacity.

By means of this construction, greatly superior results in operation are attained. In fact, only a comparatively small impeller is required to produce an aeration equal to that of a large impeller in the older construction.

The features of this invention, for which the protection of Letters Patent of the United States is desired, are collectively grouped in the claims concluding this specification.

In the drawings, which illustrate desirable, though merely specific embodiments of this invention as applied in a flotation machine—

Fig. 1 represents a fragmentary top plan embracing one unit cell, parts broken away;

Figs. 2 and 3, vertical sections taken respectively on lines 2—2 and 3—3, Fig. 1;

Fig. 4, an end elevation drawn to a reduced scale;

Fig. 5, a side elevation corresponding to Fig. 4, two complete machines and parts of others being indicated;

Fig. 6, a top plan corresponding to Fig. 5;

Fig. 7, a longitudinal vertical center section of a modified construction;

Fig. 8, a vertical section taken on line 8—8 in Fig. 7; and

Fig. 9, a fragmentary elevation, partly in section, showing an alternate construction of a certain part.

Referring to the drawings, the numeral 10, Fig. 5, indicates a cell structure embracing a plurality of separate flotation cells or machines 12, having side walls 14 and 15, which are preferably continuous, while transverse or end walls 16 and 17 extend individually from one to the other of the side walls.

The number of machines in a single structure

may vary considerably, and is largely determined by the treatment required by particular ores, since it is usually desirable to aerate flotation pulp fractionally, that is to say, in successive stages. Single machines or cells, however, are frequently used.

Each machine has its individual impeller 20, composed of spiders 21, in the rims 24 of which, are mounted staves 25, these staves being preferably circular in cross-section and spaced apart from one another circumferentially of the impeller. The spaces 26 between the staves, are proportioned with regard to the diameters of the staves, and may vary in dimensions from one thirty-second to two multiplied by the diameter of a stave, in other words, the opening in the clear between staves is equal to twice the diameter of a stave or less. Thus I secure the advantages of the V-slots between consecutive staves, as fully set forth in application Serial No. 232,165. Briefly, these advantages consist in the injection of finely divided streams of air and pulp into a receptive surface of pulp dynamically sustained, due to the rotation of the impeller. The spiders are rigidly mounted on the shaft 27, which latter is suspended from a vertical thrust journal bearing 28, and steadied in another journal bearing 29.

Spaced apart radially and outwardly from the impeller staves 25, are stationary staves 30 and 31, which, at their lower ends, may be secured in the false bottom 32, and at their upper ends, in the basal rim portion 34 of a conical hood 35, Fig. 3, or in the rim portion 34—1 of an open cylinder 35—1, Fig. 9, made of any suitable material, for example, sheet metal. Both the impeller staves and the stationary staves may for utility and convenience be made of metal tubing, such as brass, covered on the outside with hard rubber or other suitable material, or if desired, the staves may be of wood, and solid in cross-section (not shown). Certain hollow stationary staves, such as 30, may extend through the hood, as clearly shown in Fig. 2, thereby affording passages 52, for the circulation of pulp down into the feed passage 36 included between the false bottom 32 and the bottom 37. The feed passage is in communication with an inlet passage 38. Circulation through passages 52 may be regulated from zero to maximum by means of a damper 53 having openings 56 registering with passages 52.

Around the grating made up of staves 30 and 31, and inside the cell walls, is formed a sorting chamber 41, which from one viewpoint may be said to include the annular zone 40, between the

impeller and the grating staves, since a certain amount of sorting commences in this zone.

Flotation pulp from any desired source (not indicated) may be led into inlet passage 38 by means of a launder (not shown) as is usual in mill practice, or, where arranged in multiple, the tailings from a previous machine or unit cell may be received through the tailings passage 39.

The passages 38 and 39 may be defined respectively by walls 16 and 17 together with the baffle wall 48 in common. The tailings from one machine may be taken through an outlet opening 50 defined in the respective wall 17 and on through the respective passage 39 over the respective baffle wall 48 into the respective passages 38, and finally through the respective feed passage 36 into the next succeeding machine.

It is to be noted that baffle wall 48 serves virtually as a weir, and that its height is adjustable, first, by taking out one or more flashboards 48-1 of varying widths, or second, by adding one or more similar flashboards (not shown) to those already in place. This is accomplished by loosely holding the flashboards in grooves 43, formed between cleats 42. Naturally, the level 46 of the pulp, will depend upon the height of the tailings overflow weir, in this instance, the one at the right in Fig. 2. It is obvious that the pulp will be maintained at substantially the same level in the inlet passage, in the sorting column, and at the tailings overflow, and that this level is determined by height of the tailings weir. The pulp level is preferably much lower than the froth overflow lips 74, so as to provide ample space for the frothing zone.

Each plurality of machines may be called a battery and may be provided with a continuous framework consisting of bents having posts 60 connected by sills 61, intermediate caps 62, and caps 63. Longitudinal upper girders 64 and 65, and intermediate girder 66, may extend continuously from cap to cap of the various cells. On 64 and 65 may be supported the previously mentioned vertical thrust bearings 28, while bearings 29 are supported on girder 66. On each impeller shaft may be carried a sheave 67 driven from a motor sheave 68, these sheaves being connected to each other by means of a rope or belt 69. The motors 70 may be carried on the girders 64 and 65, in suitable proximity to the respective impeller shafts. Any other suitable driving arrangement may be used.

In operation, pulp to be treated is admitted to the cells to any suitable depth, such as indicated at 46, preferably submerging the tops of the hollow staves 30, the impellers having meanwhile been set in motion. The centrifugal action of the impellers in motion, throws the pulp-feed and air from the inside of the impeller through the spaces 26, out into the annular space 40 between the impeller staves and the stationary staves.

The momentum of the pulp-feed and air causes these to be projected against the stationary staves and through the spaces 72 between them, thereby bringing about another aerating action upon the pulp, as takes place when the pulp similar to that which projected through the V-slots 26 of the impeller. This tends to effect a duplex aerating action, and contributes to an increase in the capacity of the machine. The aerated pulp, as it enters sorting chamber 41, generates a bubble column therein, and as a result of the action in the bubble column, masses of froth are formed in the frothing zone 77, from where the

froth rolls over the lips 74 and down the aprons 75 into launders 76.

The tailings from the successive cells pass out of the respective openings 50 and travel through the battery from one machine to the next, until finally the ultimate tailings are conducted away through a waste launder (not shown).

The upper spiders of the impellers have spokes 78 inclined to the plane of rotation, and tend to draw air, which enters the hood at an opening 79, and travels down into the interior of the impeller. At the same time, lower spokes 80, which are oppositely inclined to the plane of rotation, act to throw the pulp through aperture 54 up into the interior of the impeller. Spokes 80 may be omitted if desired.

Another construction, which embodies a hopper bottom, such for example, as illustrated in Figs. 7 and 8, is equally efficient with the construction previously described herein. The hopper type of construction is especially desirable for laboratory use, since it allows convenient and thorough cleaning where test runs are made. In test runs it is necessary to recover substantially all the material operated upon, which consists of both the froth containing the valuable mineral contents of the pulp, and the separated tailings.

In this construction, the impeller has spiders 81 and 82, these being connected to one another by staves 83. The impeller is suspended by means of shaft 84 and is enclosed by stationary staves 85 in a manner similar to that previously described herein. Above the impeller is a hood connected to the substantially vertical tube 87, through which air is drawn into the impeller. Immediately below the impeller is a false bottom 89 having the opening 90, through which communication is established with the feed passage 91, which in turn is in communication with passage 92. The hopper bottom may consist of inclined sides 93 and 94, which extend preferably the full length of the battery, while the planes of transverse inclined walls 95 and 96, intersect the inclined sides.

An inclined transverse wall 97, together with wall 95, serves to define inlet passage 92. The lowermost part of the hopper may have a filling 98 of concrete or other suitable material, through which may extend a plug 100, which is removable for the purpose of cleaning any sediment or other matter from the hopper. The tailings outlet may be located at 101. For controlling the tailings overflow level, loose flashboards 45 held in grooves 47, are provided.

It may be repeated, that an important consideration in the present invention is the substantially vertical disposition axially, of the impeller, since the sorting chamber may extend around the entire circumference of the impeller, and since it requires much less power to centrifugally maintain the dynamic impregnating surface in this instance, than where the rotative axis of the impeller is substantially horizontal, as is the case in the machine described in application, Serial Number 232,165. A further advantage of the vertical impeller is that it may be made much shorter in stave length than the horizontal type. For example, the stave length may be equal to the diameter of the impeller, or even less, with the attainment of results, in many cases better than with horizontal impellers having three to four times such stave length. Thus, the aforementioned saving in power is obvious.

The actual number of staves 30, affording circulation passages between the upper part of sort-

ing chamber 41 including the bubble column therein, and feed passage 36, as indicated in Figs. 1 and 2, is largely optional and depends upon the size of the opening through the staves and upon the amount of pulp that it is desired to recirculate. Fig. 1 shows every fifth stave so utilized, but this arrangement can be varied greatly so as to either decrease or increase the number of communicating passages. These same remarks apply to the construction shown in Fig. 9.

The damper 53 naturally has the same number of openings 56 as there are passages 52 and is provided with a handle 58, by means of which latter, the damper may be moved to either side thereby regulating the size of the entry orifices leading into passages 52. A similar arrangement involving damper 53—1 may be provided in the construction shown in Fig. 9, thereby placing the upper part of its sorting chamber in communication with a corresponding feed passage (not shown). In the construction shown in Fig. 9, the air-intake passage is inside a cylindrical hood 35—1, while a frothing zone 57 extends around this hood. The passages 52 may be called return passages.

The grating staves 30 and 31 serve to at least partially define the primary aeration zone 40 as well as the secondary aeration zone within chamber 41, and hence, also serve to separate these two zones from each other.

The aerated pulp, after it leaves the impeller, is forcibly projected against and between the grid staves whereby the densifying action upon the pulp is largely repeated. Besides this action, contact of the aerated pulp with the grid staves exercises a pronounced scouring effect, which promotes the emulsification of the pulp with the usual flotation oils and reagents.

While specific embodiments of this invention are herein shown and described, it is to be clearly understood that various changes can be made without departing from the spirit of the claims. Having fully described my invention, what I claim is:

1. An aerating machine, including in combination, an impeller having a substantially vertical axis of rotation and a source of air supply, said impeller including substantially circular staves disposed circumferentially thereof, said staves being spaced apart from one another, substantially circular stationary staves spaced apart radially from said impeller staves, and a housing defining a sorting chamber enclosing said impeller.

2. An aerating machine, including in combination, an impeller having a substantially vertical axis and a source of air supply, substantially circular staves spaced apart from one another circumferentially around said axis, other substantially cylindrical staves spaced apart radially from said impeller staves, means for supporting said other staves at the lower ends thereof, a hood extending over said staves and supporting the upper ends thereof, and a housing enclosing the structure composed of said elements.

3. An aerating machine, including in combination, an impeller having an air inlet and a substantially vertical axis of rotation, stationary staves spaced apart radially from said impeller, said stationary staves being spaced apart from one another, a substantially conical hood having its basal, circumferential portion extending over said stationary staves, and a housing extending around the structure composed of said elements, said housing defining an aerating and circulating

chamber in the lower part thereof, and a frothing zone in the upper part thereof.

4. An aerating machine, including in combination, an impeller having an air inlet and a substantially vertical axis of rotation, said impeller including a plurality of substantially circular staves spaced apart from one another a distance equal to twice the diameter of a stave, said staves being located substantially on a circular line centered in said axis, a false bottom immediately below said impeller, said false bottom having an opening registering substantially with said impeller, a bottom below and spaced apart from said false bottom, means for conducting liquid or semi-liquid into the space between said false bottom and said bottom, and means defining an outlet for liquid or semi-liquid above said false bottom.

5. An aerating machine, including in combination, an impeller having an air inlet and a substantially vertical axis of rotation, substantially vertical staves spaced radially apart from said impeller, a substantially conical hood extending over said stationary staves, said hood being substantially concentric with said impeller, means defining an inlet for pulp immediately below said impeller, and means defining a frothing zone substantially above the base of said conical hood.

6. An aerating machine, including in combination, an impeller having an air inlet and a substantially vertical axis of rotation, a plurality of stationary staves spaced apart radially from said impeller, certain of said stationary staves being hollow, a hood disposed above said impeller, the basal portion of said hood extending to said stationary staves, means defining a frothing chamber around said hood, means defining a sorting chamber around said stationary staves, and means defining a feed passage leading into said impeller, said hollow stationary staves affording communication between the upper part of said sorting chamber and said feed passage.

7. An aerating machine, including in combination, an impeller having an air inlet and a substantially vertical axis of rotation, a plurality of stationary staves spaced apart radially from said impeller, a false bottom below said impeller, inclined walls defining a hopper bottom extending upwardly from said false bottom, means defining a liquid feed passage below said false bottom, a substantially conical hood over said impeller, the basal portion of said hood engaging said stationary staves, certain of said staves having passages defined therethrough, said passages affording communication between the space around said conical hood and the said feed passage, a substantially concentric tube extending above said conical hood, and means defining a bubble column in operative relation to the elements previously mentioned.

8. An aerating machine, including in combination, a housing having walls defining a hopper bottom for containing liquid, a false bottom within said hopper bottom, means defining a liquid feed passage below said false bottom, an impeller having an air inlet and a substantially vertical axis of rotation, said impeller being suspended immediately above said false bottom, a plurality of stationary staves spaced apart from said impeller to define a substantially annular space between said impeller and said stationary staves, a hood connected to said stationary staves, an air inlet comprising a tube leading upwardly from said hood, and means defining an outlet for liquid above said false bottom.

9. In combination, a structure defining a plu-

- rality of aerating cells, each cell having a false
 bottom, a bottom spaced apart therefrom to de-
 fine a liquid feed passage, an inlet passage in
 communication with said feed passage, means de-
 5 fining an outlet for tailings above said false bot-
 tom, means defining a tailings passage and inlet
 passage located substantially adjacent each oth-
 er, baffle walls having removable flashboards serv-
 ing to adjustably separate said tailings passage
 10 from said inlet passage, and impellers having sub-
 stantially vertical axes of rotation operably dis-
 posed in said cells, said impellers having inlets for
 air.
10. An aerating machine, including in com-
 15 bination, an impeller having its rotational axis
 substantially vertical, an air inlet for the im-
 peller, means defining a liquid feed passage for
 said impeller; a grating having staves at least
 20 partially defining an aeration zone between itself
 and said impeller, and a wall extending around
 said grating so as to at least partially define a
 bubble column, certain of said staves having
 return passages affording communication between
 said bubble column and said feed passage.
- 25 11. An aerating machine, including in com-
 bination, an impeller having its rotational axis
 substantially vertical, an air inlet for the impeller,
 means defining a liquid feed passage for said im-
 30 peller; a grating having staves at least partially
 defining an aeration chamber between itself and
 said impeller, means defining a bubble column
 around said grating, certain of said staves having
 return passages affording communication between
 35 said bubble column and said feed passage, and a
 damper operative to regulate the entry orifices
 of said passages.
12. An aerating machine, including in combina-
 tion, an impeller having its rotational axis sub-
 stantially vertical, said impeller including a plu-
 40 rality of substantially circular staves spaced apart
 from one another a distance equal to twice the
 diameter of a stove, said staves being located
 substantially on a circular line centered in said
 45 axis, means defining a liquid feed passage lead-
 ing into said impeller, an air inlet for the im-
 peller, means defining an aerating zone around
 said impeller, means defining a bubble column
 suitably positioned with reference to said aerating
 50 zone, and means defining return passages leading
 from said bubble column into said feed passage.
13. In an aerating machine, the combination
 with an impeller having a substantially vertical
 rotational axis, said impeller including a plu-
 55 rality of substantially circular staves spaced apart
 from one another a distance equal to twice the
 diameter of a stove, said staves being located
 substantially on a circular line centered in said
 60 axis, of a grating around said impeller, said grat-
 ing being spaced apart from said impeller to at
 least partially define a primary aeration zone
 and a secondary aeration zone.
14. An aerating machine, including in combina-
 tion, an impeller provided with an inlet for air,
 and an intake opening for material to be aerated,
 65 said impeller having a substantially vertical axis
 of rotation with staves disposed around the cir-
 cumference of a circle centered in said axis, said
 staves defining V-shaped openings between them,
 each of said openings being equal to twice the
 70 diameter of a stove, or less, and a housing around
 said impeller, said housing having a bottom, and a
 false bottom spaced apart from said bottom, said
 false bottom having an aperture registering sub-
 stantially with the intake opening of said impeller.
15. An aerating machine, including in com-
 bination, an impeller having a substantially ver-
 tical axis of rotation, said impeller including a
 plurality of substantially circular staves spaced
 85 apart from one another along the circumference
 of a circle centered in said axis, the openings in
 the clear between said staves being equal to twice
 the diameter of a stove, or less, an air inlet for
 the impeller, a structure for rotatably supporting
 90 said impeller, and a structure defining an aera-
 tion zone around said impeller.
16. An aerating machine, including in com-
 bination, an impeller having a substantially ver-
 tical axis of rotation, said impeller including a
 plurality of staves disposed around the circum-
 95 ference of a circle centered in said axis, said
 staves defining V-slots between consecutive ones
 thereof, said V-slots in the clear, having a dimen-
 sion equal to twice the diameter of a stove, or less;
 an air inlet for the impeller, means for introduc-
 100 ing liquid into the impeller, and a structure defin-
 ing a bubble column chamber around said im-
 peller.
17. An aerating machine, including in com-
 bination, an impeller having a substantially ver-
 tical axis of rotation, said impeller including a
 plurality of staves disposed around the circum-
 105 ference of a circle centered in said axis, said staves
 defining V-slots between consecutive ones thereof,
 said V-slots in the clear having a dimension equal
 110 to twice the diameter of a stove, or less; an air
 inlet for the impeller, a structure containing liquid
 in which said impeller is operative, means for
 introducing liquid from an exterior source into
 the impeller, and an overflow weir for maintain-
 115 ing a predetermined level of liquid in said liquid-
 containing structure.
18. An aerating machine, including in com-
 bination, an impeller having a substantially ver-
 tical axis of rotation, said impeller including a
 120 plurality of staves disposed around the circum-
 ference of a circle centered in said axis, said staves
 defining V-slots between consecutive ones there-
 of, said V-slots in the clear, having a dimension
 equal to twice the diameter of a stove, or less;
 125 an air inlet for the impeller, means for feeding
 liquid into the impeller, means at least partially
 defining a bubble column chamber around said
 impeller, and means for conducting liquid from
 the bubble column back into the liquid feed.
19. An aerating machine, including in com-
 bination, an impeller having a substantially ver-
 tical axis of rotation, said impeller including a
 plurality of staves spaced apart from one an-
 130 other along a circular line centered in said axis
 of rotation, said staves having a cross-sectional
 shape effective to define the convergence of said
 spaces from inside to outside of said impeller, the
 extent of said spaces in the clear at the constricted
 135 points being equal to twice the diameter of a stove
 or less; an air inlet for the impeller, means for
 introducing liquid into the impeller; and a struc-
 140 ture in which said impeller is rotatably disposed.

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