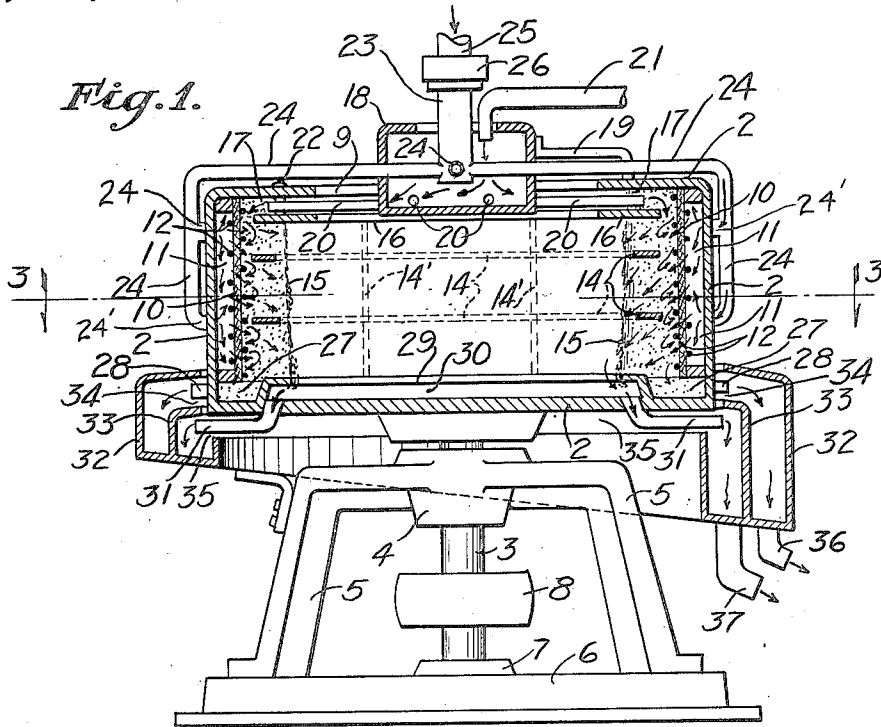
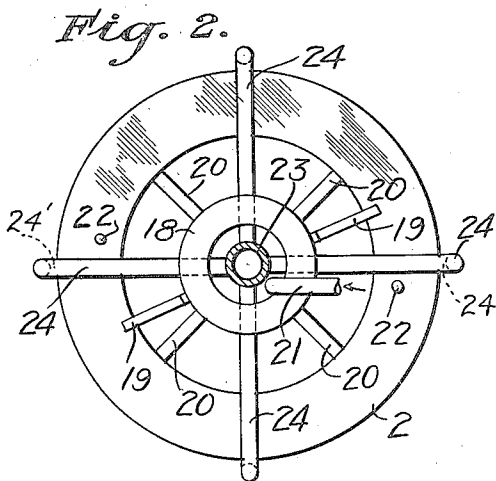
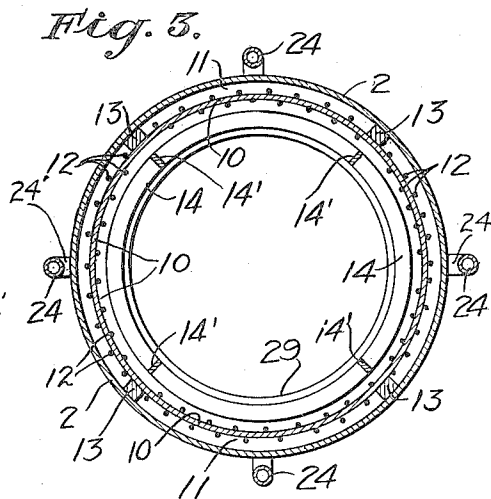


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DIFFERENTIAL FLOTATION SEPARATOR.
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DIFFERENTIAL FLOTATION SEPARATOR.

1,420,139.

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To all whom it may concern:

Be it known that I, WILBUR H. PECK, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Differential Flotation Separators, which I desire to designate as a Differential Flotation Separator; and, in the main, such invention consists of means embodying or comprising rotatable cells with certain necessary cooperating facility adapted to employ in separation of such minerals suitable flotation emulsion, comprising water and appropriate oils, acids, or other reagents, and at the same time to operate in conjunction with the action of centrifugal force to effect a relative division or differential separation of such particles.

To effectuate the above ends, I have devised my invention which mainly consists in the relative association of means and mechanism by which the floating energy of flotation emulsion on the mixed particles of different degrees of specific gravity, can be coordinated with the energy of centrifugal forces, such energies or forces operating in opposite or opposing lines whereby the particles will be differentially separated, notwithstanding neither of such forces alone would effect such separation.

In the accompanying drawings,

Fig. 1 is partly a vertical transverse central section, and partly an outside elevation of my concentrating apparatus.

Fig. 2 is mostly a top plan of the rotatable parts shown in Fig. 1, somewhat reduced in size.

Fig. 3 is a cross-section of the apparatus shown in Fig. 1, on line 3, 3 of Fig. 1, looking in the direction indicated by the arrows.

In making my improved concentrating apparatus, I have in this instance employed an annular rotatable vessel 2, adapted to contain a body of flotation emulsion, or liquid flotation medium, while in operation, and to serve the purpose of a flotation cell in differential separation of normally floatable mineral particles of different degrees of specific gravity.

The vessel 2, which I will herein term a cell, is made of form and size to serve the purposes required, as illustrated in the drawing. It is provided with a bottom por-

tion through which it is mounted on a vertical shaft 3, by which it is supported and may be rotated.

The shaft is journaled at its upper end in a box 4, attached to a supporting frame 5, which at its lower extremity is mounted on a part 6, which serves as the base plate of the separator. The lower end of the shaft is laterally maintained by a journal box 7, of suitable type, adapted also to serve as a step bearing for the lower end of the shaft to bear the vertical weight of the same with its superimposed burden. The shaft is provided with a pulley 8, through which rotation may be imparted.

The upper, or top end of the cell is partly closed, leaving a central opening 9, of desired size, as indicated in the drawings, the outer partly closed circumferential portion of the vessel serving as the separating cell wherein, during operation, the flotation emulsion or liquid medium is maintained by the energy of centrifugal force, with a substantially free and unobstructed surface or wall facing the axis of rotation and approximately parallel to it, allowing such free movement of the floated material on said surface as is necessary.

Within the vessel adjacent to the inner surface of its circumferential wall or peripheral bottom, but a comparatively short distance from the same, I have provided a mat 10, which is formed of suitable fabric pervious to air under pressure, leaving or forming a chamber 11, between said bottom or wall of the vessel and the outer wall of the mat. The mat is held to place partly by wire netting 12, and partly by vertical supporting pieces 13, Fig. 3, in number and positioned to maintain the mat in proper place during operation.

Within the cell I have located annular rings or baffles 14, of desired width or size, so their outer diameters will be somewhat smaller than the inner diameter of the mat 10, as illustrated in Figs. 1 and 3, and so their inner diameters will be a desired distance under the surface of the flotation emulsion within the cell when the same is in operation. The normal surface or inner wall of this emulsion when in ordinary conditions or inner wall of operation, is indicated approximately by the numeral 15, in

Fig. 1. I have also provided vertical baffles 14', supported in the cell as shown.

Both the baffles 14, and 14', serve to maintain the emulsion in synchronous rotation 5 with the rotating cell during operation, as well as to assist in deflecting and guiding the flow of such emulsion properly through the cell.

I have also provided an annular ring or 10 diaphragm 16, in the upper portion of the cell, positioned a short distance from its top, as shown in Fig. 1, which extends somewhat nearer the axis of rotation of the cell than the normal surface of the emulsion, and also 15 considerably below such surface to a position near the mat, leaving, however, a passage between its outer diameter and the mat, through which feed material for separation and the emulsion may pass into the more active separating part or zone of the cell. This 20 diaphragm, together with the top portion of the cell, forms a feed chamber 17, located between these two parts.

Centrally mounted above the upper end 25 of the shaft is a feed bowl 18, having a closed bottom and a partly open top. The bowl is attached to the vessel by a part or arm 19, so that it is held in position and rotated with the vessel.

30 Radiating from the lower part of the side walls of the bowl are feed pipes 20, with their outer ends extending into the feed chamber 17, to a point preferably below the normal surface of the flotation emulsion 35 while in operation, and as means for introducing emulsion laden with mixed mineral particles to be separated, I have provided a feed pipe 21, with one of its ends extending into the open part of the feed bowl. This 40 feed pipe may have its opposite end connected with any suitable source of supply of material and emulsion to be operated on.

The diaphragm 16, is held in position to the top of the bowl by stays 22, connecting 45 the two parts.

As a means for supplying air or suitable gas to the flotation cells for aerating the emulsion during operation, I provide a rotatable pipe 23, as specially shown in Fig. 50 1, passing down into the bowl where it diverges into branch pipes 24, which respectively extend out to the outer circumference of the cell and down along its outer circumference. These pipes are connected at 24' 55 with the chamber 11, under the mat, whereby air may be introduced into such chamber 11, and driven through the mat.

Connecting with the pipe 23, I have provided a fixed pipe 25, which communicates 60 with any suitable source of air or gas supply under pressure. These pipes are joined through the medium of an ordinary swivel connection 26, enabling the one to be rotatable while the other remains fixed.

65 The lower end of the mat in the cell is

stopped off a short distance below the bottom of the cell, forming an annular pocket 27, from which discharge pipes 28, radiate for discharge of heavier particles of mineral when separated. 70

At the bottom of the cell in suitable position is provided an annular ring or ledge 29, of shape to form a chamber 30, between it and the bottom of the cell, as illustrated in Fig. 1. This ring or ledge has a central 75 opening of diameter slightly greater than the desired normal level or surface of the emulsion in the cell, approximately parallel with the axis while in operation, thereby providing an overflow or discharge passage, 80 opening towards the axis enabling the separated lighter minerals, carried by the froth, to flow over this edge of the ring and into the chamber 30, from whence it will pass through suitable discharge pipes 31, which 85 communicate with the chamber 30, as illustrated in Fig. 1. This ring also maintains the surface or level of the emulsion in the cell at a predetermined distance from the axis of rotation. 90

As means for catching the respective differentially separated materials and emulsion discharged from the pipes 28 and 31, I provide a housing 32, having an annular partition 33 and annular openings 34 and 95 35, in radial alignment with the pipes 28 and 31, so that material discharged from these pipes will be caught in the housing 32, and may then be delivered therefrom through spouts 36 and 37, attached to said housing, 100 for final disposition.

In operation of my concentrator, the concentrating cell or vessel is rotated at a speed sufficient to effect the differential separation and other purposes desired, ordinarily at a 105 speed to develop approximately an average centrifugal force of 3 on the emulsion and mineral particles being treated in it.

During this time flotation emulsion suitably prepared and preferably containing the 110 mixed mineral particles which it is desired to separate, is flowed into the feed bowl 18, through the pipe 21, from any suitable source of supply, the quantity of such feed being such that the body of emulsion which 115 will accumulate in the cell, will be sufficient to maintain the surface of the emulsion in direction towards the axis, to a level or position that will enable a part of the emulsion with the separated lighter mineral particles 120 which rise to the surface largely in the nature of froth, to flow downward over the edge of the annular opening 29, into the channel 30, and out to discharge through the pipes 31, as has been herein above explained. 125

During this time air or suitable gas for aerating or equivalently effecting the emulsion in the cell, is introduced by the pipe 25, with its intermediate connections, into the chamber 11, under the mat 10, whence it is 130

forced up through the mat into and through the emulsion in the cell, in finely divided currents, as indicated by the arrows in Fig. 1.

The emulsion and mineral particles for separation being fed through the radial pipes 20, from the feed bowl, enter the feed chamber 17, and are deflected below the surface of the emulsion, in a flow downward, largely between the outer edges of the annular baffles 14, and the inner surface of the mat 10, where, as well as in other parts of the cell, it is subjected to the vigorous energy of the aerated emulsion to collectively raise and float the mineral particles.

This floating force or energy of the aerated emulsion during this time is being opposed by the action of centrifugal force, which acts to drive the particles outward in opposing lines to the inward floating energy, and should be developed to such a degree, through rotation of the cell, as to effectively resist or overcome the floating energy on the heavier particles which it is desired to prevent from being floated, but not of sufficient intensity to overcome the floating energy on the lighter particles, which it is desired to float, thereby precipitating the heavier particles, while permitting flotation of the lighter to the surface of the emulsion, and resulting in differential separation of these materials.

The heavier particles which are driven outward against the floating energy of the emulsion, gradually pass downward along, or close to the surface of the mat, being assisted by the action of gravitation and the flow of emulsion towards the lower end of the cell, as well as by the disturbing current of air or gas through the mat, and are discharged through the pipes 27, into the housing 32, from whence they are flowed for final disposition through the pipe 36.

It will be understood that the feed to the cell through medium of the pipe 21, and its associated parts, and the size of discharge opening in the pipe 28, will be proportioned to maintain the desired accumulation of emulsion within the rotating cell.

In my application for process of differential separation of normally floatable materials by combined flotation energy and energy of centrifugal force, filed July 20, 1921, Serial Number 486237, I have disclosed and claimed said process, but do not claim the main features of the apparatus for carrying such process into effect, which are shown and claimed in this application.

What I regard as new and desire to secure by Letters Patent, is,

1. In a differential flotation separator, a rotatable vessel adapted to contain a liquid flotation medium during operation and to maintain such medium in position with a

substantially unobstructed flotation surface facing in direction of the axis of rotation, and to serve as a cell in differential separation of normally floatable mineral particles of different degrees of specific gravity through simultaneous energy of the flotation medium and centrifugal energy on said particles, operating in diametrically opposing lines, in combination with rotatable means adapted to supply pneumatic agitating currents from the peripheral bottom of said cell and means adapted to support and rotate the vessel, substantially as described.

2. In a differential flotation separator, a rotatable vessel adapted to contain a liquid flotation medium during operation and to serve as a cell in differential separation of normally floatable mineral particles of different degrees of specific gravity by simultaneous energy of the flotation medium and of centrifugal energy on said particles in diametrically opposing lines, while at the same time maintaining said medium in the vessel with a surface free for floated material, in direction of the axis, in combination with means adapted to support and rotate the vessel, means for supplying said flotation medium and material for separation to the vessel, a pervious member in said cell adjacent to its peripheral bottom, and rotatable means for pneumatically agitating said flotation medium in the vessel during operation, communicating with the cell beneath the pervious member, substantially as described.

3. In a differential flotation separator, a rotatable vessel adapted to contain flotation emulsion during operation, and serve as a cell in differential separation of normally floatable mineral particles through simultaneous energy of a liquid flotation medium and centrifugal energy on said particles in opposing lines, while at the same time maintaining said medium with a surface for floated material in direction of the axis of rotation, in combination with means adapted to maintain said surface a predetermined distance from the axis and to afford a discharge passage for floated material, means adapted to support and rotate the vessel, means for supplying said medium with the material to be separated to the vessel, a pervious member within the vessel adjacent to its peripheral bottom and means for aerating said liquid medium, through a rotatable conduit communicating under the pervious member in the vessel, substantially as described.

4. In a differential flotation apparatus adapted to differential separation of normally floatable mineral particles of different degrees of specific gravity through opposing forces of flotation emulsion and centrifugal energy, the combination of a rotatable flotation cell, means for supporting and rotat-

ing said cell, feed means for supplying flotation emulsion and mineral for separation, to the cell, embodying a rotatable receptacle communicating with said cell, a pervious member in said cell adjacent to the peripheral bottom of the cell, means for
5 aerating the emulsion in said cell while in operation through a rotatable conduit passing through the wall of the feed receptacle and communicating under said pervious member and means for discharging the differentially separated materials from the cell,
10 substantially as described.

WILBUR H. PECK.