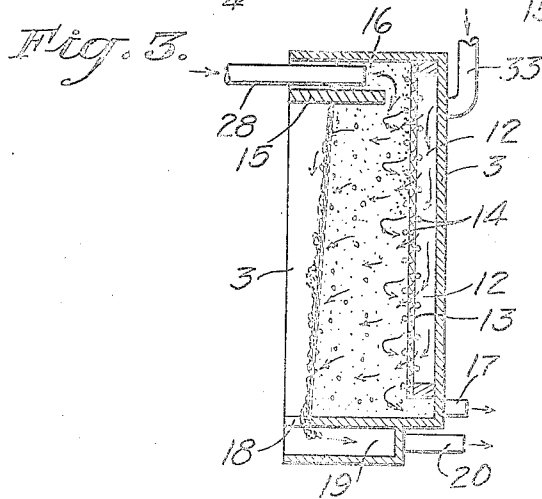
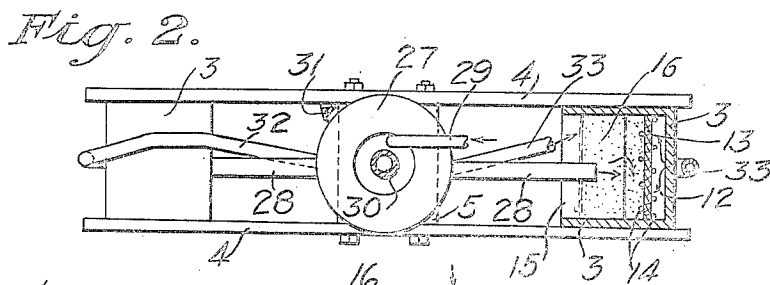
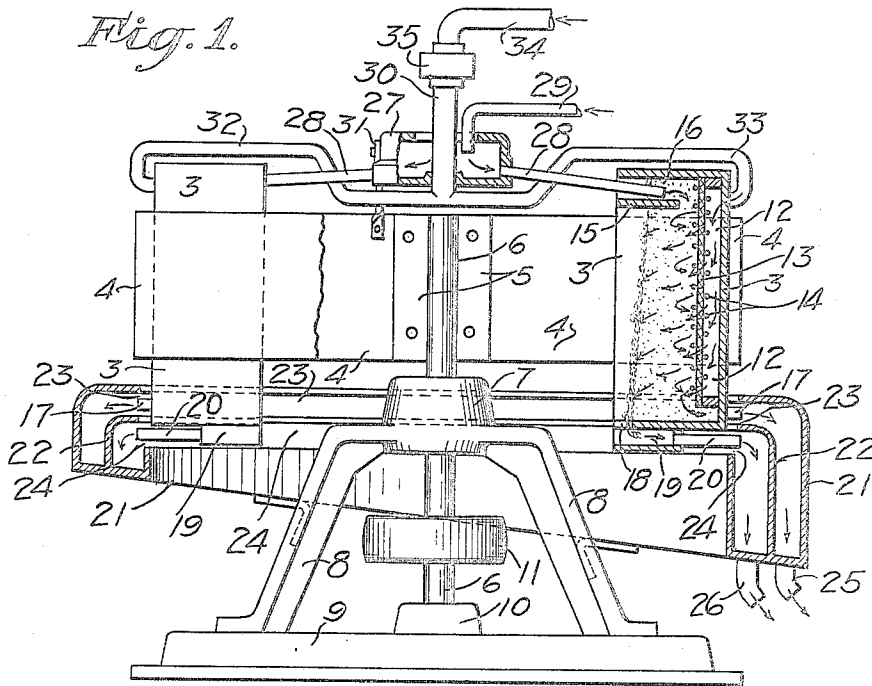


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 PROCESS OF SEPARATING MIXED MINERAL PARTICLES OF DIFFERENT DEGREES OF SPECIFIC GRAVITY  
 APPLICATION FILED JULY 20, 1921.

1,420,138.

Patented June 20, 1922.



INVENTOR;  
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# UNITED STATES PATENT OFFICE.

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## PROCESS OF SEPARATING MIXED MINERAL PARTICLES OF DIFFERENT DEGREES OF SPECIFIC GRAVITY.

1,420,138.

Specification of Letters Patent. Patented June 20, 1922.

Application filed July 20, 1921. Serial No. 486,237.

*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, State of California, have invented certain new and useful Improvements in Processes of Separating Mixed Mineral Particles of Different Degrees of Specific Gravity, of which the following is a specification.

My invention relates to the process of separating such mineral particles of different degrees of specific gravity, which are amenable collectively and severally to the well known ordinary methods of flotation, by subjecting such mixed particles at the same time to the opposing forces of floating energy of suitable aerated or gasified flotation emulsion or liquid flotation medium and centrifugal force, the latter force of sufficient intensity to overcome the floating energy on the heavier particles, but insufficient to overcome such energy on the lighter particles, resulting in the lighter being floated while the heavier are precipitated.

It is well known that ordinarily in concentration of mixed mineral particles through medium of the usual methods of flotation, which employ aerated emulsions of water with various mineral or vegetable extracts, or oils and acids, or other equivalent reagents or substances separately or together, mixed in proportion to best suit the conditions under operation, such concentration is operative on substantially all of the mineral particles which are susceptible of such action, with a result that most, or to a very considerable extent all such minerals are floated collectively or together as a mixed concentrate, and that it is usually very desirable, although ordinarily very difficult to satisfactorily separate two or more of these minerals, as lead and zinc sulphides, into concentrates of their respective kinds, and to this end I have devised my process herein described and claimed, and where I have used the term "aerated emulsion", I intend it also to include gasified emulsion, if gas is employed.

In the drawings Fig. 1 is partly a central vertical cross-section and partly a side elevation of an apparatus or machine by which I carry my process into effect.

Fig. 2 is partly a top plan and partly a

horizontal cross-section of the rotating parts of Fig. 1.

Fig. 3 is an enlarged vertical longitudinal section in direction radial from its axis of rotation, of a detached flotation cell, like that illustrated in the right-hand side of Fig. 1.

To carry out my process, any form of flotation cell which may be adapted to ordinary methods of flotation and the production of requisite flotation energy, and at the same time, to be mounted in a suitable manner to be rotated for development of the degree of centrifugal force required, may be employed.

In this instance I have utilized two cells 3, in the form of rectangular boxes which may be made either of wood or metal, and be of sufficient depth to accomplish the purpose designed.

I have mounted these boxes, which I will herein term cells, in a vertical position with their open, or what would in ordinary horizontal practice be considered their top sides, in direction towards the axis of their rotation, and have provided means as suitable parts 4, connecting and holding these two cells relatively in position by clamping or fastening the parts 4, to the outside of the cells, as illustrated.

The parts 4, are provided with a centrally positioned block 5, preferably clamped between parts, which is adapted to securely engage the upper end of a shaft 6, so that the parts 4, carrying the cells may be rotated by said shaft.

The shaft is journaled at 7, to a frame part or stand 8, which is mounted at its lower extremity to a bed plate 9, to serve as a base plate of the machine.

The shaft is laterally maintained at its lower end by a journal box 10, which is also adapted to support the vertical weight of the shaft and its burden. There is a pulley 11, mounted on the shaft through which rotation may be imparted as desired.

The flotation cells 3, are provided at their bottom or outer parts with a chamber 12, which is formed mainly by the bottom of the cells, and preferably by a suitable fabric mat 13, which is pervious to air and adapted to effect a comparatively fine division of the air currents which are forced through it

during operation, as indicated by the arrows. The mat may be held in place largely by wire netting 14, on either side.

5 Preferably near the top end of the cell I provide a baffle 15, extending from a point near the top edge of the cell down to within a comparatively short distance of the mat, as illustrated, leaving a passage between the lower side of the baffle and the mat, through  
10 which material fed to the cell during operation may flow. The purpose of this baffle is to form a chamber 16, which may be termed a feed chamber, and prevent material being fed from flowing directly over or along the  
15 surface of the emulsion in the cell, but necessitate its entrance to the more effective part of the cell in separation, at a point considerably below the surface of the emulsion, preferably in suspension a compara-  
20 tively short distance from the mat. While this may not in all instances be necessary, it is preferable.

At the lower or opposite end of the cell, I have stopped off the mat, substantially seal-  
25 ing the lower end of the chamber 12, under the mat at this point, and have provided discharge means, as a short pipe 17, of suitable size for discharge from the cell, of the separated heavier minerals, while at this end of  
30 the cell I have also provided means for discharge of the floated lighter particles of material, which mainly occur in the form of ordinary mineral flotation froth, by here cutting down the top edge of the cell at 18,  
35 the desired distance for this purpose, and have formed a chamber 19, of suitable size, into which the froth may flow, and from it, have supplied an appropriate pipe 20, for delivery of such material from the chamber 19.

40 As means for collecting separately the minerals and liquid discharged from the respective pipes 17 and 20, I have provided an annular housing 21, which may be of sheet metal or other suitable material, and have  
45 divided the same by a partition 22, forming two annular compartments with annular openings 23 and 24, positioned in suitable radial alignment with the respective discharge pipes, so that material from such  
50 pipes will be thrown off or delivered radially into their appropriate openings, and thereby collected separately. The housing 21, is provided with discharge spouts 25 and 26,  
55 through which the separated materials may be flowed for further disposition, as desired.

As means for supplying material to be separated by my process, I have provided a bowl shaped feed receptacle 27, suitably  
60 super-mounted at the central part of the apparatus, as illustrated in Figure 1, which is partly closed at its top side, and from this feed bowl I have provided pipes 28, with their outer ends extending into the feed compartments 16, of the cells, as illustrated.  
65 The outer ends of these pipes preferably ex-

tend well under the surface of the emulsion while in operation.

As means for supplying feed to the bowl 27, I provide a pipe 29, which should be connected with any suitable source of supply of  
70 material to be separated.

Preferably such material comprises a mixed mineral charged emulsion suitably prepared for effecting flotation of the mineral particles collectively in the ordinary  
75 way, so that the same enters the rotating cells ready for treatment by my process.

In order to aerate the emulsion in operation, I have provided a rotatable pipe 30, supported on the rotating parts 4, by any  
80 ordinary means as a stay 31. This pipe passes through the bottom of the feed bowl, and below such a bowl diverges into branches 32 and 33, which connect with the respective chambers 12, under the mat 13, in the bottom  
85 of the flotation cells.

The rotatable pipe 30, is connected to a suitable fixed pipe 34, by means of an ordinary swivel joint or connection 35, adapted  
90 to this purpose, and such pipe 34, is connected with an appropriate source of air supply under required pressure for forcing air through the respective pipes into the chambers under the mats 13, in the calls, and up  
95 through such mat for purposes of aeration of the flotation emulsion during operation, as indicated by the arrows in the drawings. The pressure of such air may be regulated to best suit the requirements of the operation  
100 being performed.

In operation, sufficient flow of the flotation emulsion, with the mixed mineral particles suitable for the purpose, is introduced into the feed compartments 16, to maintain a  
105 supply in the flotation cells, as indicated in the drawings, so that the level or surface of such supply, with respect to the axis of rotation, will be maintained at a point to enable the froth, or surface accretion, of the lighter particles to flow over and out through  
110 the passage 18, at the lower end of the cell, to be delivered through the discharge pipe 20, in the manner herein above already explained, it being understood that the discharge opening in the pipe 17, is sufficiently  
115 small to enable maintenance of that quantity of emulsion in the cells, and yet of sufficient size to permit of suitable discharge of the heavier separated particles.

In carrying out my process the cells, with  
120 the other rotatable parts of the required mechanism, are revolved at a speed which will develop the amount of centrifugal force desired to effectuate the process, and at the same time emulsion with the mineral particles properly prepared to be separated is introduced into the cell, and preferably air  
125 under suitable pressure, by means above described, is supplied to the cells through the mat 13, the air assisting in producing the  
130

usual flotation energy, or medium, by which the particles ordinarily are raised to the surface of the emulsion, and at the same time such particles, through agency of the centrifugal force being exerted on them, have an accentuated tendency to be precipitated radially, or in the opposite direction from the floating energy exerted on such particles to raise or float them.

10 The rotation of the cells should be sufficient to develop a centrifugal force, which, in effect, will accentuate or increase the specific weight or gravity of the heavier particles to a degree in excess of the floating energy of the emulsion on them, and at the same time to maintain such accentuated resistance of the lighter particles within the floating energy of the emulsion, enabling the latter to be floated.

20 This will result in a separation of these respective particles, the former being precipitated to the bottom of the cell, and the latter being raised or floated by the emulsion in the form of mineral laden froth, which may, through medium of gravity and gradual flow of emulsion from the upper toward the lower end of the cell, be discharged at the passage 18, as has been explained, while the heavier particles will through means of the gradual flow of the emulsion toward the lower end of the cell, assisted by gravity and the action of the air currents being forced through the mat, gradually travel along close to the surface of the mat downward and be discharged through the pipe 17.

35 It will be understood that the centrifugal force on the emulsion, notwithstanding the same is liquid or mobile in the cells, and that the cells are vertical, will hold such emulsion in position approximately parallel to the axis of rotation during the operation.

40 As a graphic illustration which will more clearly portray the action and effect of my process in separation of mineral particles, I will state, as is well known, that the specific gravity of zinc sulphide is substantially 4, and that of lead sulphide is substantially 7, both of which when properly prepared under ordinary conditions of flotation will be floated as a mixture concentrate. The weight of both minerals being within the floating energy or power of the flotation emulsion, which power, for the purpose of illustration, may be taken under suitable conditions as equivalent to 16 specific units.

50 By treating these mixed materials in a rotating cell under the action of centrifugal force of 3, and at the same time to the floating energy of flotation emulsion, all of the mineral particles will, in effect, be increased in specific weight or resistance three times their normal, which will result in the lead sulphides affording a resistance equivalent to 21 specific units against the floating energy 16, of the emulsion. Therefore, the

resisting force of these heavier particles under such opposing influences, being greater than the floating force of the emulsion, said heavier particles will be precipitated, while the lighter or zinc sulphides, at the same time having their specific weight of 4, in effect, accentuated by the centrifugal force of 3, will afford a resistance of only 12, which will be within the floating power, 16, of the emulsion, and consequently will be floated to the surface, and may be discharged, as has been hereinabove described.

These minerals are used as an illustration, but for the separation of minerals of different relative gravities, the speed and consequent centrifugal force developed by the apparatus should be adjusted within the difference of the minerals which it is desired to separate.

In the claims it will be noted that the expression "normally floatable particles" or "normally floatable material" are used, and by this it is intended to include materials which have by treatment been rendered floatable, although the same may not have previously been in such state.

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

1. The process of differentially separating substances of different degrees of specific gravity which are normally floatable by aerated emulsion of water, oil and reagents, which consists of subjecting such materials to floating action of such emulsion, and at the same time, to the action of centrifugal force of sufficient intensity to, in effect, accentuate the specific gravity of the heavier of such particles beyond the floating energy of the emulsion, yet maintaining the resistance of the lighter particles to such force within the floating energy of the emulsion, whereby the heavier of such particles are precipitated through the emulsion, and the lighter particles are floated by the emulsion, substantially as described.

2. The process of differentially separating normally floatable mineral particles of different degrees of specific gravity which consists of subjecting such particles while in an aerated flotation emulsion, to the floating energy of such emulsion and at the same time to the action of centrifugal force of sufficient intensity to precipitate the heavier of said particles through the floating energy of said emulsion, while maintaining the centrifugally accentuated resistance of the lighter particles within the floating energy of said emulsion, whereby the former are precipitated against the floating energy and through said emulsion, while the latter are floated by said emulsion, substantially as described.

3. The process of differentially separating mixed normally floatable mineral particles of different degrees of specific grav-

ity, which consists of simultaneously sub-  
jecting such particles in a rotating cell to  
the floating energy of aerated flotation  
emulsion and the opposing energy of cen-  
5 trifugal force, said opposing energy on the  
heavier particles being in effect greater than  
the floating energy, and on the lighter par-  
ticles, less than the floating energy, whereby  
differential separation is effected, the heavier  
of said particles being precipitated in the 10  
emulsion against the floating energy, and  
the lighter of said particles being floated by  
said emulsion against the energy of centrif-  
gal force, and removing the respective differ-  
entially separated particles separately, sub- 15  
stantially as described.

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