No. 887,841. PATENTED MAY 19, 1908.

P. F. PECK.

CENTRIFUGAL SEPARATOR.

APPLICATION FILED JUNE 3, 1907.

2 SHEETS—SHEET 1.

Fig. 1

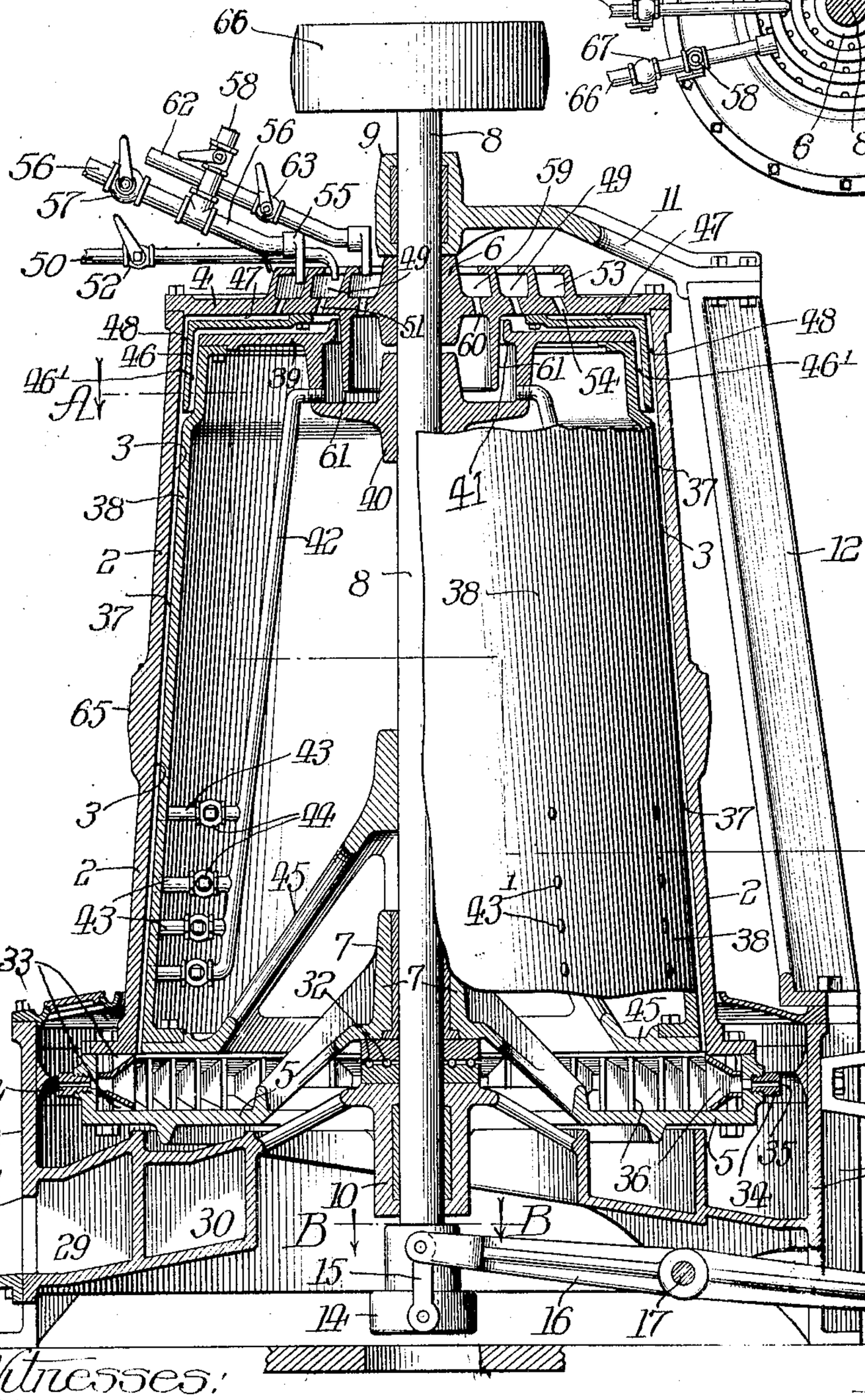
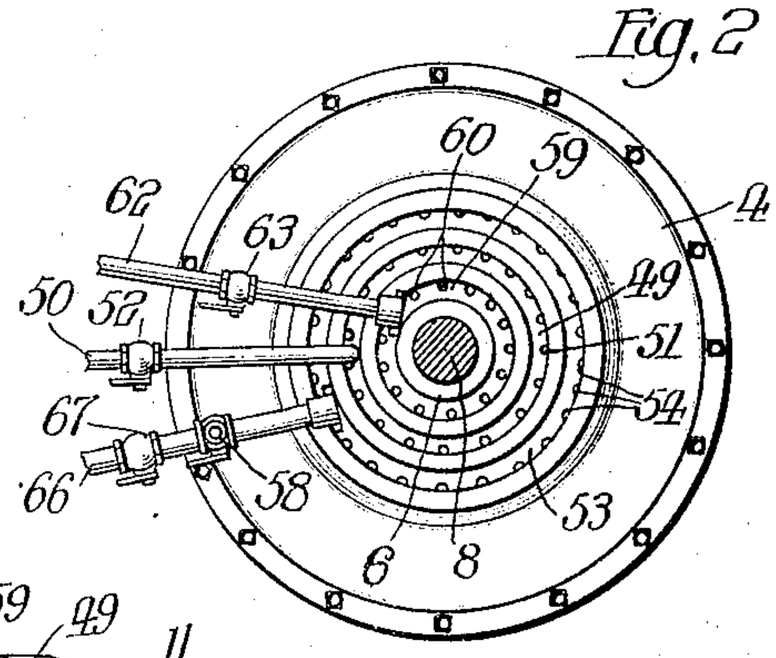


Fig. 2



Witnesses:

H. G. Barnett

M. Peck.

Inventor:

Philip F. Peck

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Fig. 3

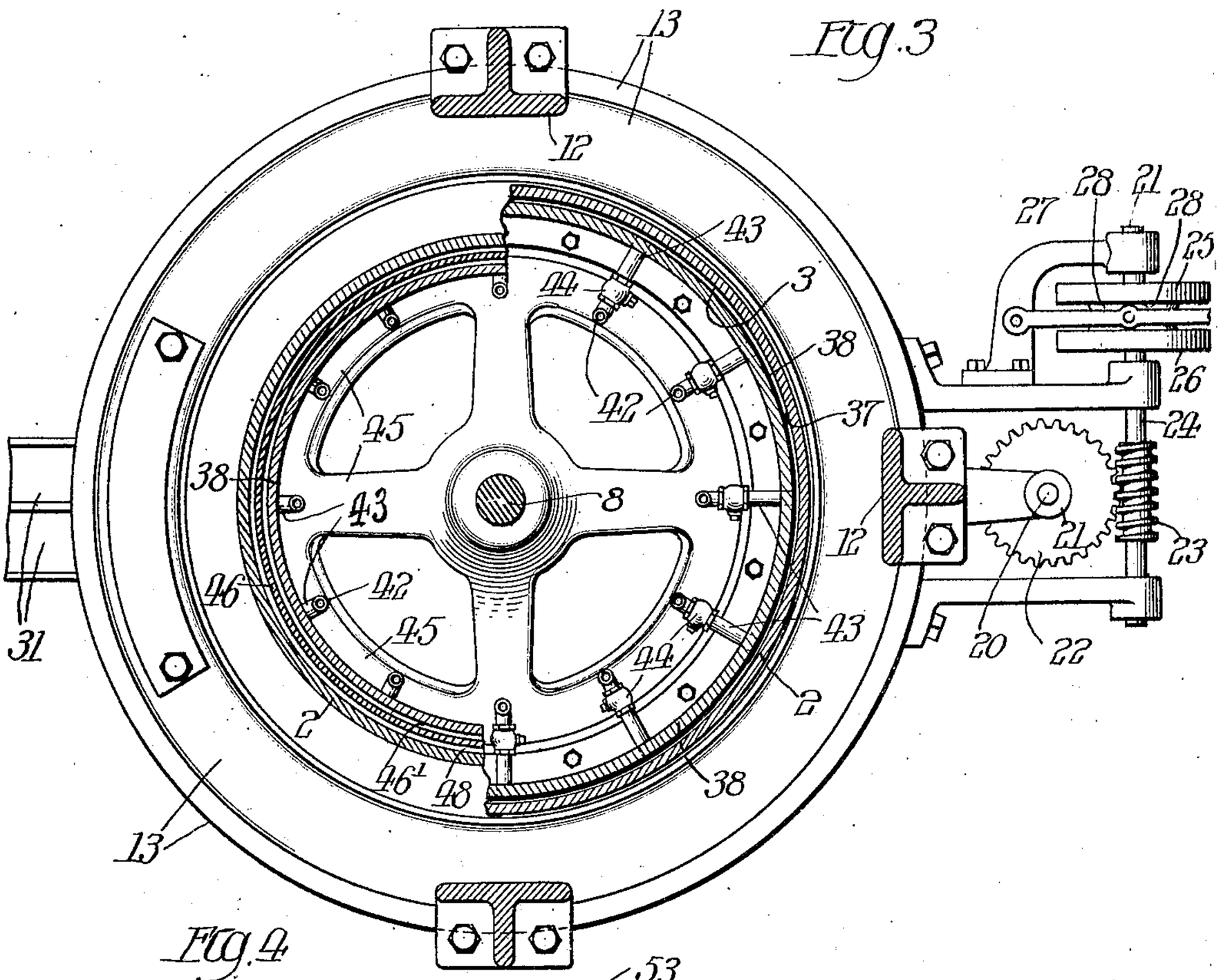


Fig. 4

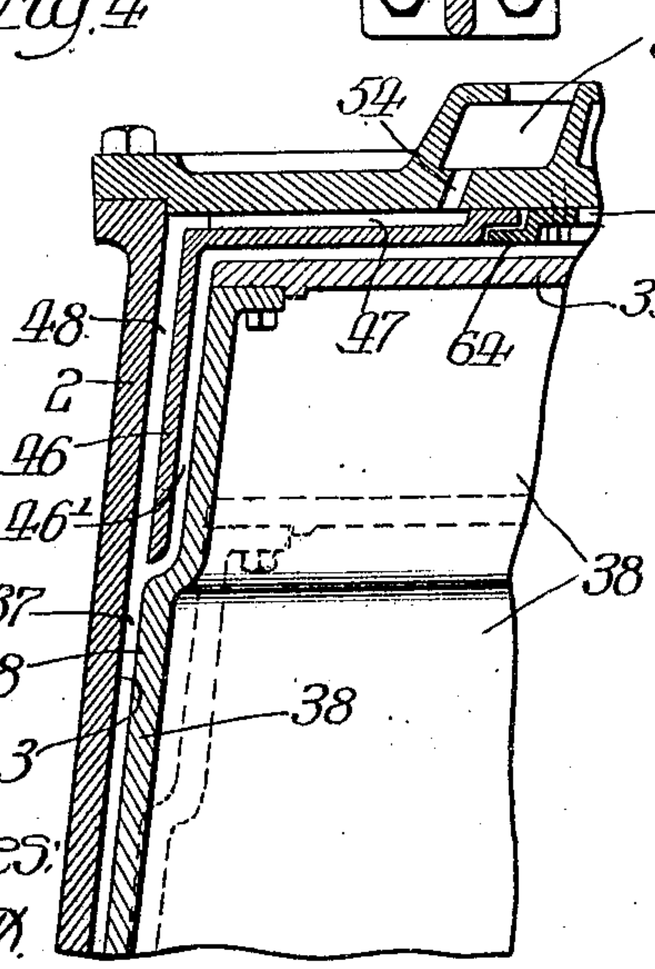
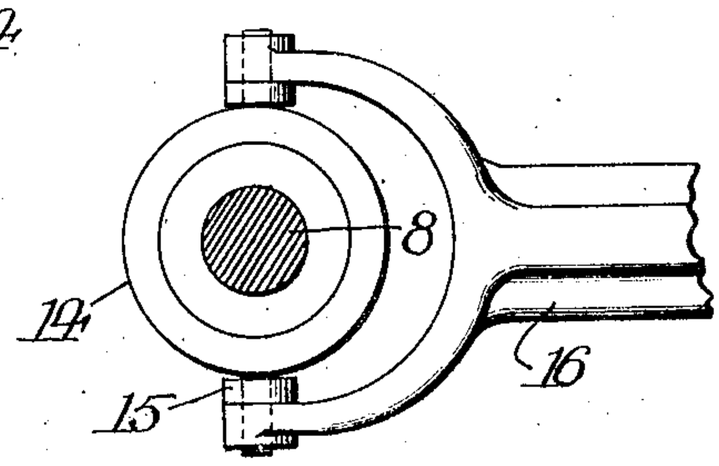


Fig. 5



Witnesses:
H. G. Bauch.
M. Peck.

Inventor:
Philip F. Peck.

UNITED STATES PATENT OFFICE.

PHILIP F. PECK, OF CHICAGO, ILLINOIS.

CENTRIFUGAL SEPARATOR.

No. 887,841. Specification of Letters Patent. Patented May 19, 1908.

Application filed June 3, 1907. Serial No. 376,941.

To all whom it may concern:

Be it known that I, PHILIP F. PECK, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Centrifugal Separators, of which the following is a specification.

My invention relates more particularly to centrifugal separators for the separation of ores, or similar materials, of different degrees of specific gravity while in a pulverized state and mixed with water, of the class having a rotatable portion or vessel with a separating surface on its inner wall and a differentially rotatable longitudinally-travelable inner deflector or core—the two together forming a separating channel variable in size, and which separator in its operation alternately accumulates a charge or load of concentrates and middlings and then discharges them; and my invention consists in the features, details and combinations of construction and in the association of parts hereinafter described and claimed.

In the accompanying drawings—Figure 1 is chiefly a vertical central longitudinal cross section of my separator, showing, however, a part of the deflector and some other portions in side elevation. Fig. 2 is a top plan view—reduced in size—of the treatment vessel below the upper journal box, showing the location of the several annular feed chambers, the supply pipe, and some other parts. Fig. 3 is a plan cross section of my separator, taken on the varied plane shown by line A A of Fig. 1, looking in the direction of the arrows. Fig. 4 is an enlarged detail sectional portion of the upper left hand part of the vessel and some other parts, similar to those illustrated in Fig. 1, with the exception that the means for holding certain internal parts to place in the vessel are modified. In this figure there is also indicated in dotted lines the drawn or traveled out position of the deflector. Fig. 5 is an enlarged top plan detail, taken on line B B of Fig. 1 looking in the direction of the arrows, showing the relative position of the forked end of the lever under the separate and associated parts.

In making my improved centrifugal ore separator, I provide a rotatable portion 2, which I term a "treatment vessel", having preferably a smooth interior circumferential wall forming a separating surface 3. I prefer to have this treatment vessel in the form or of the nature of a strong frusto cone-shaped metal tube or tapering shell, and to locate it in a vertical position, as shown in the drawings. It may be made of one or more pieces, and need not be in the form of a vessel, as the term is usually applied, but should be of a nature, when the separator is assembled and in operation, to maintain the separating surface in a submerged state, and otherwise to subserve the purpose for which it is intended.

The treatment vessel is provided with or formed in part of heads or ends 4 and 5, having central hollow hubs or trunnions 6 and 7, respectively. I also provide a substantial shaft 8 extending through said hubs, around which they are rotatably journaled, thus affording bearings for lateral support of the treatment vessel. This shaft, in turn, is laterally supported by suitable journal boxes 9 and 10, the top of one of which is attached to a casting 11 above the upper hub, which casting is supported by columns 12 that are securely mounted on the base housing 13 of the separator.

The lower journal box 10 engages the shaft below the lower hub, and is secured to the base housing, as shown. The shaft is mounted in its journal boxes 9 and 10 in a manner adapted to be slid or traveled longitudinally, as desired, and is made long enough to extend through such boxes sufficiently—as shown in Fig. 1—to permit of a desired extent of longitudinal travel. It is stepped at its lower end in a suitable box 14, preferably of an anti-friction character, in a manner to substantially maintain it therein against relative longitudinal movement to the box either up or down, so that, by the movement of this box, the shaft will be forced with it either up or down as the box may be moved. This box 14 is pivotally attached through links 15 to the forked end of the lever 16, as shown in Figs. 1 and 5, which lever is fulcrumed at 17 to the base housing of the separator. The opposite end of the lever is secured by links 18 to an internally threaded nut 19, which engages a substantial depending rod 20 with its lower end threaded, and which is securely and rotatably mounted in suitable journal boxes 21.

To the rod 20, between its journal boxes, is rigidly attached a worm wheel 22, for rotating the rod. This worm wheel contacts at its hubs with the inner end of the journal boxes, thus maintaining the rod against longitudinal travel.

Meshing with the teeth on the worm wheel is a worm 23 carried and rotated by an adequate suitably journaled shaft 24, which may be rotated in either one direction or the other by loosely mounted clutch pulleys 25 and 26. These pulleys may be driven in opposite directions by belts—not shown—running in such manner that the movement of the lever 27 brings the clutch 28 into engagement with either one or the other of the said pulleys, and thereby revolves the threaded rod in the direction desired, thus forcing the nut 19 up or down and rocking the lever 16 correspondingly and effecting a desired longitudinal movement or travel of the shaft 8 and the deflector.

The base housing of the separator is provided with two spirally inclined troughs or compartments 29 and 30, as shown in Fig. 1, terminating in a two-compartment spout 31, which serves to catch the water and material discharged from the treatment vessel and flow them from the separator.

The weight of the treatment vessel is preferably carried by a roller bearing 32, on which the lower end of the hub 7 is seated, the bearing being mounted on the upper end of the journal box 10.

The lower end of the vessel is, preferably, somewhat enlarged diametrically for a comparatively short distance of its length, as shown in Fig. 1, making an internal annular recess or chamber 33. This chamber communicates with a row of nipples 34, threaded through the wall of the vessel around the outer circumference of the enlargement, which nipples are provided with small holes or openings 35 for the discharge of material and water from the vessel. Within the recess or chamber formed by said enlargement of the vessel I prefer to provide a suitably shaped ring 36, containing a series of funnel-shaped depressions or pockets with large openings nearest the axis, and outwardly converging to small openings registering with the discharge nipples 34, as shown in Fig. 1. The object of this enlargement and the chambered ring is to facilitate the discharge of material and water and to prevent undue lodgment of parts of said material at this point.

Within the treatment vessel and to operate in conjunction with it and its separating surface and form with such vessel a separating or concentrating channel 37, I provide a differentially rotatable longitudinally-travelable cone or core 38, which I will call a deflector. This deflector, as will be seen, preferably forms the inner wall of the said separating channel.

The upper end or head of the deflector 39 is preferably in the nature of a plate, of desired size and irregular form, as illustrated. It is well secured at its outer circumferential portion in any suitable way—as by tap-bolts—to that end of the deflector wall, and at its central portion has a substantial hub 40, fixedly engaging the shaft 8, as shown in the drawings. This head, near its central part, is depressed inward—as shown in Fig. 1—a desired distance and for a suitable diameter—said depression having preferably a depth somewhat greater than the distance of longitudinal travel of the deflector. Around the upper outer circumferential edge of and within this depression I provide a ring 41, extending sufficiently in over the depression to form an annular water chamber within the depression. I prefer that the ring 41 should at its inner bore be flanged or extend upward a desired distance above the upper surface of the head to prevent water introduced into the separator for other purposes from flowing into the depression.

The chamber in the depression of the upper head 39 has a desired number of water pipes 42 communicating with it, which extend down into the deflector a desired distance, as illustrated, and preferably have several branch pipes 43 connected to them, which are secured in appropriate holes or passages 43′ through the wall of the deflector, opening into the separating channel. In this way water can be flowed or forced under the impulse of centrifugal energy, from the depression in the upper head of the deflector, down through the said pipes, and out through the lower portion of the circumferential wall of the deflector into the separating channel.

The several pipes 43 are preferably provided with suitable valves or stop cocks 44, which may be used to stop the flow of water through any desired pre-determined or particular ones of these pipes, enabling the water to be delivered into the separating channel at the desired and pre-determined distance from the lower end of the separating surface, for removal of middlings, as hereinafter described, thereby governing the longitudinal extent or distance on the lower end of the separating surface, from which said middlings will be separately removed and discharged from the separator.

The lower end of the deflector is provided with a head 45, more or less open toward its central part. It has its outer circumferential portion, for a sufficient distance toward the center, preferably made in the nature of a comparatively flat ring, and has a substantial hub at its central portion, the hub and ring portions being solidly connected by spokes, leaving a sufficient space between them so that in a large separator the operator can enter into the deflector, if desired, when the separator is in a quiescent state.

The ring portion of this lower head at its outer circumferential portion is securely fastened to the lower end of the wall of the deflector, and its hub portion is elevated or raised upward sufficiently above the ring por-

tion to make desired room for other parts of the separator around this zone, as illustrated.

The hubs of the upper and lower heads of the deflector are rigidly secured to the shaft 8, so that they hold the deflector in suitable relative positions in the treatment vessel, and not only rotate the deflector with the shaft, but travel it longitudinally with said shaft when the shaft is so traveled, as hereinabove explained.

The circumferential wall of the deflector is preferably made of amply strong but comparatively thin metal, similar to the wall of the treatment vessel. It serves best when made of length to extend over substantially all of the separating surface while in a position nearest the feed or small end of the treatment vessel, and then also to extend a short distance beyond or below the opposite end of such surface, yet leaving room for its longitudinal travel, a distance substantially equivalent to the width of the enlargement or chamber 33 in the enlargement at the discharge end of the vessel, thereby insuring that the deflector at all times covers the entire length of the separating surface.

The outer circumferential walls of the deflector are, preferably, made smooth and of shape to substantially conform to the shape or contour of the separating surface, but somewhat smaller in diameter, so that when the deflector is in position nearest the small or feed end of the treatment vessel there will be a comparatively small annular space or channel around between the separating surface and the exterior of the deflector, which space constitutes the said separating channel.

During operation of a centrifugal ore separator of this class, having a reciprocatory deflector, as heretofore constructed the deflector in its longitudinal travel from the small end of the treatment vessel leaves an unoccupied space in said small or feed end, which permits a part of the unseparated material, as it is introduced, to lodge or pile up in this unoccupied part of the vessel, which condition is very objectionable because such unseparated product, when the concentrates are periodically removed during the cycle of operation, is also removed and commingled with the concentrates, rendering them of lower grade and increasing their quantity, and consequent cost of smelting or other subsequent treatment. To overcome this difficulty I have provided a feed chamber or passage 46′, of constant size, located in a position radially outside of the small end of the deflector, and preferably extending from the feed end of the vessel a somewhat greater distance than the extent or distance of longitudinal travel of the deflector, so that the small end of the deflector will at no time be so great a distance from the feed end of the vessel as is the delivery end of said feed channel, through which material for separation passes before it reaches the separating channel, and the separating surface is formed in part by the travelable deflector. In this way the small end of the deflector is preferably at all times, to a greater or less degree, in a telescoping state with the said feed channel and the parts forming it. I preferably form this feed channel, as illustrated in Fig. 1 of the drawings, by employing a part 46, somewhat in the nature of a comparatively shallow secondary vessel with an open bottom and with a suitably sized hole in its top, and having the border portion around said hole or opening suitably swaged outward, as illustrated, to serve as means by which this secondary vessel portion may be secured by bolts, or in other desired and suitable way, to the inside of the upper head of the treatment vessel—as illustrated in Fig. 1—and at the same time to hold the bottom of the secondary vessel portion sufficiently away from the head to form a radial space or channel 47 between them, communicating with the feed channel 48. The circumferential wall of this secondary vessel is preferably of the form of the wall of the treatment vessel and sufficiently smaller in diameter than the corresponding part of such wall, when the secondary vessel is secured in place, to form the said channel between the outer circumferential wall of this secondary vessel and the corresponding part of the wall of the treatment vessel. I prefer that this channel should be comparatively shallow, although of sufficient size to accommodate flow of a desired amount of material and water, and I also prefer that it be substantially in alinement with, or a continuation of, the separating channel, and that where it connects with the separating channel, the inner wall of this feed channel shall not be of greater diameter than that of the adjacent or connecting part of the separating surface, so that the material in flowing from this channel into the separating channel or on the separating surface, within the separating channel, will not be forced to move towards the axis of rotation against the action of centrifugal force.

In my preferred arrangement I appropriately form the feed end of the deflector smaller than its other parts, as shown, to telescope with slight clearance inside of the secondary vessel 46, and from the fact that the secondary vessel forming the inner wall of the feed channel 48 is longer than the extent of longitudinal travel of the deflector, the latter is at all times to a greater or less degree telescoped into the secondary vessel, so that material fed into the separator down through the feed channel 48 and into the separating channel 37 has little tendency, except dirty water, to flow back towards the feed end of the vessel into the unoccupied space caused by the travel of the deflector. As means for

preventing the backward flow of said dirty water in this space, and the resultant precipitation and deposit here of some of the solid matter that said water contains, I provide a suitable annular clear water-receiving chamber 49, located on the top head or end of the vessel, and provide a means of supplying clear water to it, as by an appropriate pipe 50, and I also provide holes or channels 51 from said chamber, communicating with the space in the vessel between its feed end and the small end of the deflector, and during operation clean water can be introduced in such moderate quantity as may be desired, which will flow into the small end of the vessel and through the passage 46′, between the telescoping part of the deflector and the inside wall of the secondary vessel 46, down into the separating channel, and thereby prevent the dirty water or any solid matter from flowing up into, or back into this unoccupied space between the feed end of the vessel and that end of the deflector. The supply of this clean water may be from a sufficiently elevated tank or other suitable source to enable it to flow by gravity into the chamber 49; and its volume or quantity may be governed by any suitable means, as a valve 52, which may be located in the pipe 50.

To enable the introduction or feed of material into the separator, I form or provide a suitably shaped, properly located annular chamber 53 on the upper head of the treatment vessel, with holes or passages 54 extending from it down into the space 47, to pass into the feed channel 48. I also provide facility, as a suitably shaped feed casting 55, registering with the annular opening in the upper side of the chamber 53; and I connect said feed casting to a suitable feed pipe 56, which communicates with any suitable source of supply of properly commingled water and material for separation. The flow of the said commingled water and material may be governed by a valve 57, which may be placed in the feed pipe. In this feed pipe I also preferably connect a branch pipe 58 for supply of clean water when the flow of material for separation is temporarily discontinued and it is desired to remove accumulated concentrates.

On the upper head of the treatment vessel, nearer the axis than either the chamber 49 or 53, I provide an annular water-receiving chamber 59, suitably located to supply water, when desired, down into the depression in the upper head of the deflector. From this chamber 59 I provide holes or channels 60 through the upper head of the treatment vessel, located in position to deliver water down into the depending ring or flange 61, which is of size and in position to telescope down into the depression in the upper head of the deflector and deliver water from the holes 60 into said depression, from which said water flows, actuated by gravity and centrifugal force, down through the pipes 42, and through the predetermined ones of the pipes 43, depending upon which of said pipes has its stop cocks or valves 44 open, and effects removal of middlings to the extent desired.

The depending part or flange 61, like the part 46, is somewhat longer than the extent of longitudinal travel of the deflector, so that at all times it is telescoped to a greater or less extent into the depression in the upper head of the deflector, and so that water will be properly delivered by it into said depression.

I supply water to the chamber 59, in the upper head of the deflector, by means of a fixed pipe 62 with a suitably shaped end to make delivery into the annular opening in the upper side of this chamber, as illustrated. The flow in this pipe can be from any suitable source of supply and can be governed by a suitable valve 63, that may be placed in the pipe. This clean water is for use only when it is desired to remove middlings, at which time the flow or introduction of material for separation is discontinued.

In Fig. 4 I have shown in enlarged detail a part of the feed end of the treatment vessel and deflector, and some other parts, illustrating the means of holding to place the secondary vessel 46, as, for instance, a ring 64 engaging said flanged or swaged portion around the opening in the bottom of said secondary vessel. This ring fits sufficiently tight to maintain the secondary vessel in place, but at the same time to permit of its rotary movement with respect to the treatment vessel. This rotary movement is more or less effected by the impact or resistance of material and water to assume faster rotation as it is introduced into the space 47, between the top end of the secondary vessel portion 46, and the head of the treatment vessel so that said secondary vessel portion in that way is revolved differentially to the treatment vessel and the deflector.

In Fig. 4 I have also shown in dotted lines the deflector in position drawn to its fullest extent from the feed end of the treatment vessel, at which time it will be seen that it is in its minimum telescoped state with the secondary vessel 46, and is also in position to leave the greatest amount of unoccupied space between its small end and the feed end of the treatment vessel.

It will be understood that in concentration the heavier, richer, or cleaner, parts of the concentrates will lodge and accumulate nearer the feed end of the separating surface, and the middlings, or less clearly separated parts, will lodge and accumulate nearer the discharge end of the concentrating surface, which is throughout the area radially cov-

ered by the openings or passages of the pipes 43 in their differential rotation to the separating surface through the wall of the deflector into the separating channel.

In operation, the treatment vessel is revolved at the desired speed by use of a belt that may be operated around its belt surface 65—Fig. 1—and the deflector is also revolved by use of a belt that may be operated around its pulley 66, but at a desired differential speed to that of the treatment vessel.

Initially the deflector is moved up in the vessel to its fullest extent, or to the small end of the vessel by its supporting shaft, thereby reducing the separating-channel to proper size for commencement of concentration or separation, and the separating period may commence. The material to be separated while in a finely pulverized state and mixed with the desired amount of water to make it flow freely is then fed into the separator in quantities to fill the separating channel and provide a sufficient body of water within the vessel, preferably from a suitably elevated agitator tank (not shown) through its branch of the feed-pipe 56, and passes into the treatment vessel and separating channel through the agencies hereinabove described, the heavier parts, or the concentrates, lodging on the separating surface and being retained there in the separating channel nearer the feed end; while the lighter, or waste part and the middlings are forced or driven along by the water within the separating channel, the former to discharge and the latter to lodgment toward or nearer the discharge end of the separating surface. The washing or scouring action of the water which effects separation in the separating channel is principally governed by the amount of differential rotation between the treatment vessel and the deflector, which is during concentration adjusted properly to wash off and more the lighter parts along to discharge, but yet to permit the heavier parts to lodge and accumulate on the separating surface, as desired. As the operation proceeds and the accumulation or accretion forms in the channel, the latter would soon become too much contracted or filled, if there were no compensating agency; and to meet this requirement during the concentrating or separating period, the shaft carrying the deflector is slowly traveled longitudinally by the mechanism that has been explained, and with the shaft the deflector is also moved in like manner, and thereby, through the movement of the deflector toward the larger end of the treatment vessel, the separating channel is gradually and uniformly increased in depth or size, which, in turn, is progressively being filled with the concentrates and middlings.

When the deflector has been drawn to its fullest extent toward the larger end of the vessel, the feed of material for separation is discontinued. The speed of the vessel is preferably reduced as desired. The valve in the clean water supply pipe 62 is opened, and such water is flowed down or is driven through the agencies hereinabove described down into the pipes 42 and through their passages in the deflector-wall into the lower portion or middlings zone of the separating channel, by which means middlings are first removed and discharged from the separator. This accomplished, clean water is introduced from the branch pipe 58, and the deflector, through the reverse endwise travel of its shaft, is again moved or traveled up to its initial position in the small end of the treatment vessel. The deflector during such upward travel, assisted by the water being introduced, removes to discharge the accumulated concentrates, or most of them. The remainder soon follows before the speed of the treatment vessel is increased. The supply of water by the pipe should be stopped during unloading of middlings.

After the removal of concentrates has been accomplished, the deflector then having reached its initial position, the vessel is again raised to its speed appropriate for effecting concentration, and the separator is then again ready for feed of material for treatment.

In the specification and claims where I have stated that "the length or distance of a part is substantially as great as the distance of longitudinal travel of the deflector", I do not mean to limit such distance to the distance of travel of the deflector, as the former distance may, without bad result, be considerably greater than the distance of longitudinal travel of the deflector.

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

1. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface, a differentially rotatable longitudinally travelable deflector forming one wall of a separating channel interposed between said deflector and surface, the vessel being provided with a material feed passage communicating with the separating channel a distance from the feed end of the vessel substantially as great as the distance of longitudinal travel of the deflector, having its inner wall a less distance from the axis than that of the adjacent part of the separating surface, and means for feeding material for separation into said feed passages.

2. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface, a differentially rotatable longitudinally travelable deflector forming one wall of a separating channel interposed between said deflector and surface, the vessel being provided with a material feed passage communicating with the separating channel a distance from the feed end substantially as

great as the distance of longitudinal travel of the deflector, having its inner wall a less distance from the axis than that of the adjacent part of the separating surface, the deflector in part forming a water passage at the circumferential portion of its small end communicating from between the small end of the deflector and the small end of the vessel to the separating channel, means for introducing water into the vessel between the small end of the deflector and the small end of the vessel, and means for introducing material into the material feed passage.

3. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface, a differentially rotatable longitudinally travelable deflector with a channel interposed between said deflector and surface, a portion within the small end of the vessel forming part of a feed passage in substantially extended alinement with said separating channel and communicating therewith a distance from the small end of the vessel substantially as great as the distance of longitudinal travel of the deflector, the small end of said deflector adapted to telescope within said portion in the small end of the vessel, the two forming a passage between them communicating from between the small end of the deflector and the small end of the vessel and the separating channel, means for introducing water between the small end of the vessel and the small end of the deflector, and means for introducing material for separation into the material feed passage.

4. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface and an enlarged portion of desired length at its discharge end, a differentially rotatable longitudinally travelable deflector in said vessel forming one wall of a separating channel interposed between said deflector and the separating surface, a portion within the small end of the vessel forming one wall of a feed passage substantially in extended alineiment with said separating channel and communicating therewith a distance from the small end of the vessel substantially as great as the distance of longitudinal travel of the deflector, the small end of said deflector adapted to telescope within said portion in the small end of the vessel, the two forming a passage between them communicating from between the small end of the deflector and the small end of the vessel to the separating channel, means for introducing water within the separating channel for removal of middlings separately from a predetermined part of the separating surface towards its discharge end, means for introducing water between the small end of the vessel and the small end of the deflector, and means for introducing material for separation into the material feed passage.

5. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface, a differentially rotatable longitudinally travelable deflector said deflector and vessel forming a separating channel interposed between them, material feed means adapted to have the small end of said deflector telescope into part thereof and adapted to deliver said material into the separating channel a distance from the feed end of the vessel substantially as great a distance as the distance of longitudinal travel of the deflector, the telescoping part of the deflector and said feed means having a passage between them from the small end of the vessel to the separating channel, and means for introducing water into the small end of the vessel.

6. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface, a differentially rotatable longitudinally travelable deflector forming one wall of a separating channel interposed between it and said surface, material feed means adapted to have the small end of the deflector telescope into part thereof and adapted to deliver material into the separating channel a distance from the feed end of the vessel substantially as great as the distance of longitudinal travel of the deflector, the telescoping part of the deflector and said feed means having a passage between them from the small end of the vessel to the separating channel, means for supplying material into said feed means and for supplying water into the small end of the vessel irrespective of said feed means and for removing middlings separately through the instrumentality of water from a predetermined desired part of the separating surface.

7. In a centrifugal ore separator, the combination of a rotatable vesesl having a separating surface, a differentially rotatable longitudinally travelable deflector forming one wall of a separating channel interposed between said deflector and surface, a portion within the feed end of the vessel forming in part a material feed passage communicating with the separating channel a distance from the feed end of the vessel substantially as great as the distance of longitudinal travel of the deflector, the small end of the deflector being adapted to telescope with said portion in the small end of the vessel, leaving a passage between them communicating with the separating channel, means for introducing water for flow through said last named passage, and means for introducing material for separation into said feed passage.

8. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface, a differentially rotatable longitudinally travelable deflector forming one wall of a separating channel interposed be-

tween said deflector and surface, a removable portion in the small end of the vessel in part forming a feed channel communicating with the separating channel a distance from the feed end of the vessel substantially as great as the distance of longitudinal travel of the deflector, said deflector being of length to at all times extend over substantially all of the separating surface and have its small end telescoping into said portion in the vessel, forming a passage for flow of water from the small end of the vessel around said telescoping end of the deflector to the separating channel, means for introducing material for separation to said feed passage, and means for introducing water between the small end of the vessel and the small end of the deflector.

9. In a centrifugal ore separator, the combination of a rotatable vessel having a separating surface and an enlarged longitudinally extended portion at its discharge end, a differentially rotatable longitudinally travelable deflector of length to at all times cover substantially all of the separating surface and adapted to form one wall of a separating channel adjacent to said separating surface, a portion within the small end of the vessel forming one wall of a material feed passage adapted to deliver material to the separating channel a distance from the feed end of the vessel substantially as great as the distance of longitudinal travel of the deflector, the small end of the deflector being adapted to telescope into the said portion in the vessel leaving a passage circumferentially around said end of the deflector communicating from the small end of the vessel to the separating channel, means for introducing material for separation into the material feed channel, and means for introduction of water between the small end of the deflector and the small end of the vessel.

PHILIP F. PECK.

Witnesses:
MELINDA PECK,
W. H. PECK.