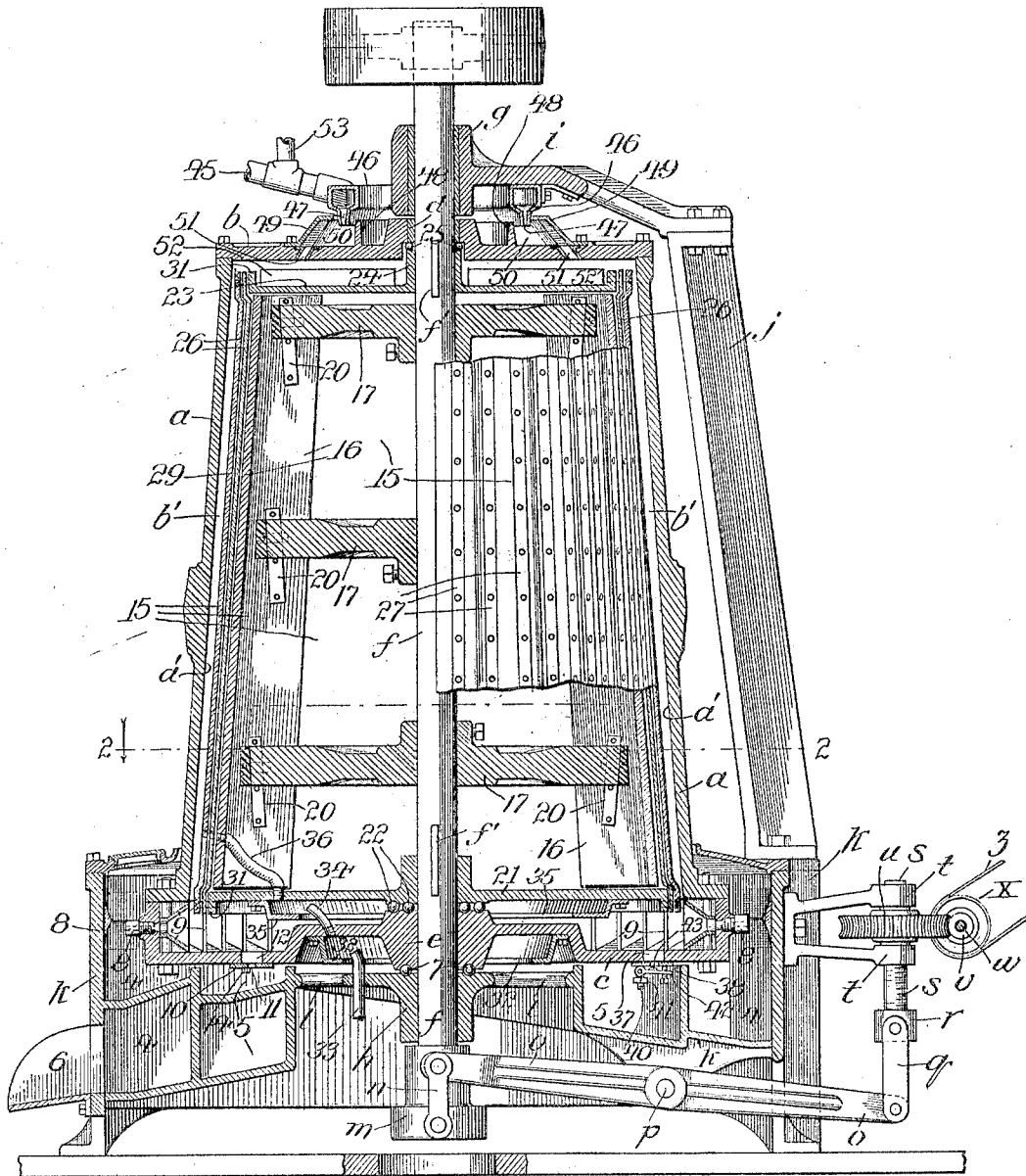


W. H. PECK.
CENTRIFUGAL SEPARATOR.
APPLICATION FILED JUNE 13, 1904.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

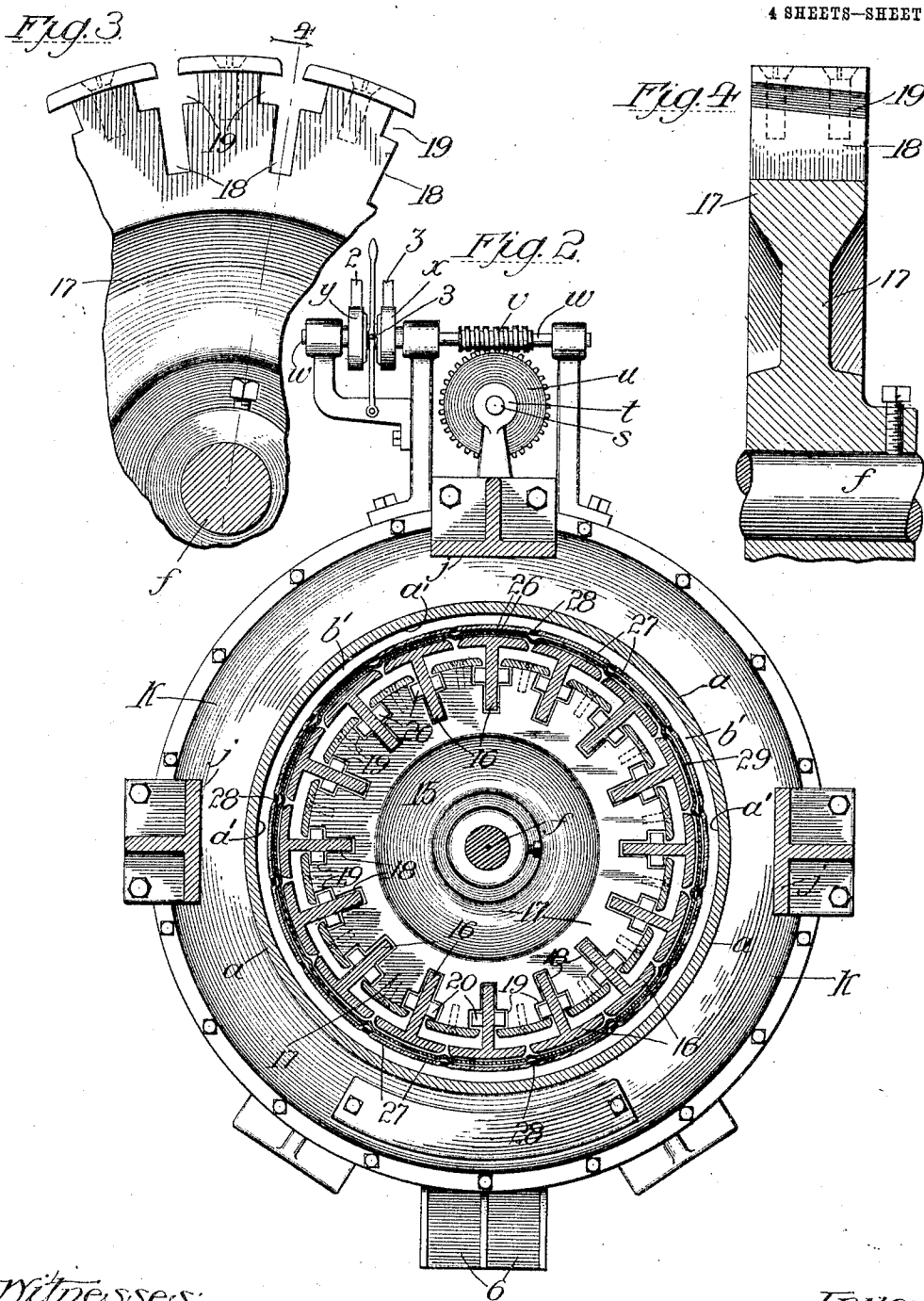
Edw. R. Barrett

Inventor:

Wilbur H. Peck

W. H. PECK.
CENTRIFUGAL SEPARATOR.
APPLICATION FILED JUNE 13, 1904.

4 SHEETS—SHEET 2.



Witnesses:

John C. Allen,
Edw. R. Barrett

Inventor
Wilbur H. Peck

W. H. PECK.
CENTRIFUGAL SEPARATOR.
APPLICATION FILED JUNE 13, 1904.

4 SHEETS—SHEET 3.

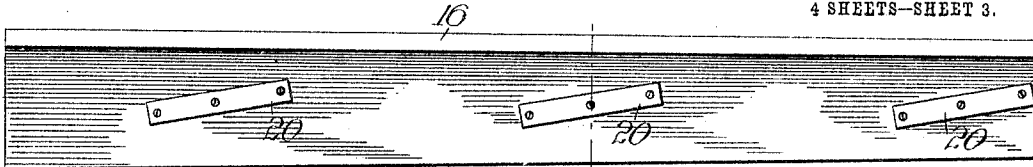


Fig. 5



Fig. 6

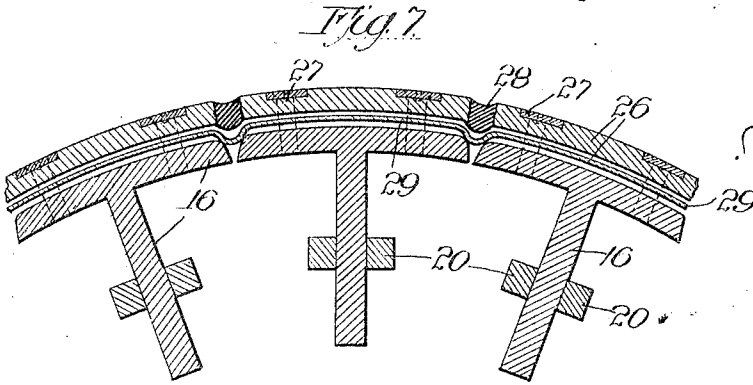


Fig. 7

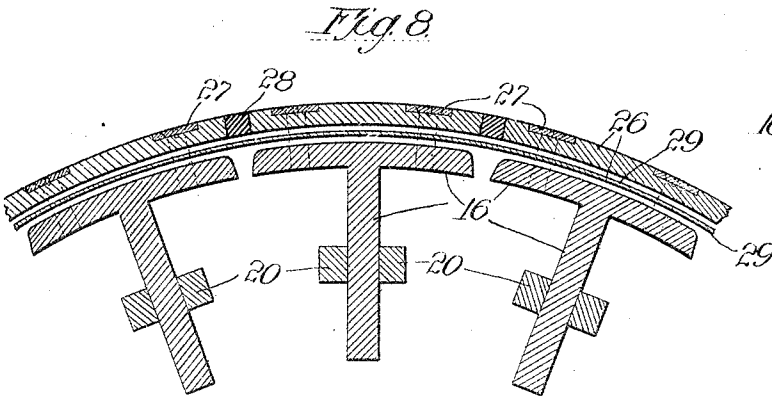


Fig. 8

Fig. 10

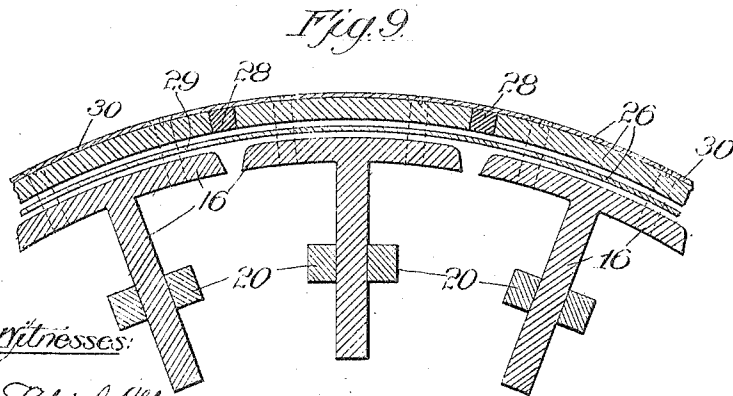
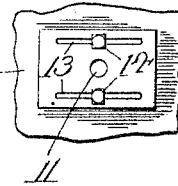


Fig. 9

Witnesses:

John L. Miller,
Edw. P. Barrett

Inventor:

Wilbur H. Peck

No. 802,778.

PATENTED OCT. 24, 1905.

W. H. PECK.
CENTRIFUGAL SEPARATOR.
APPLICATION FILED JUNE 13, 1904.

4 SHEETS—SHEET 4.

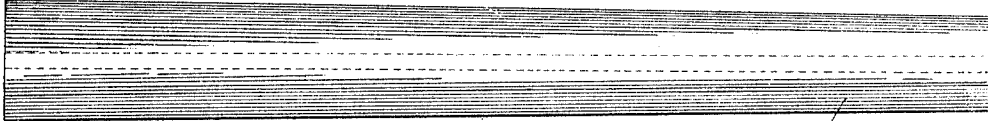


Fig. 17.

16

Fig. 11.

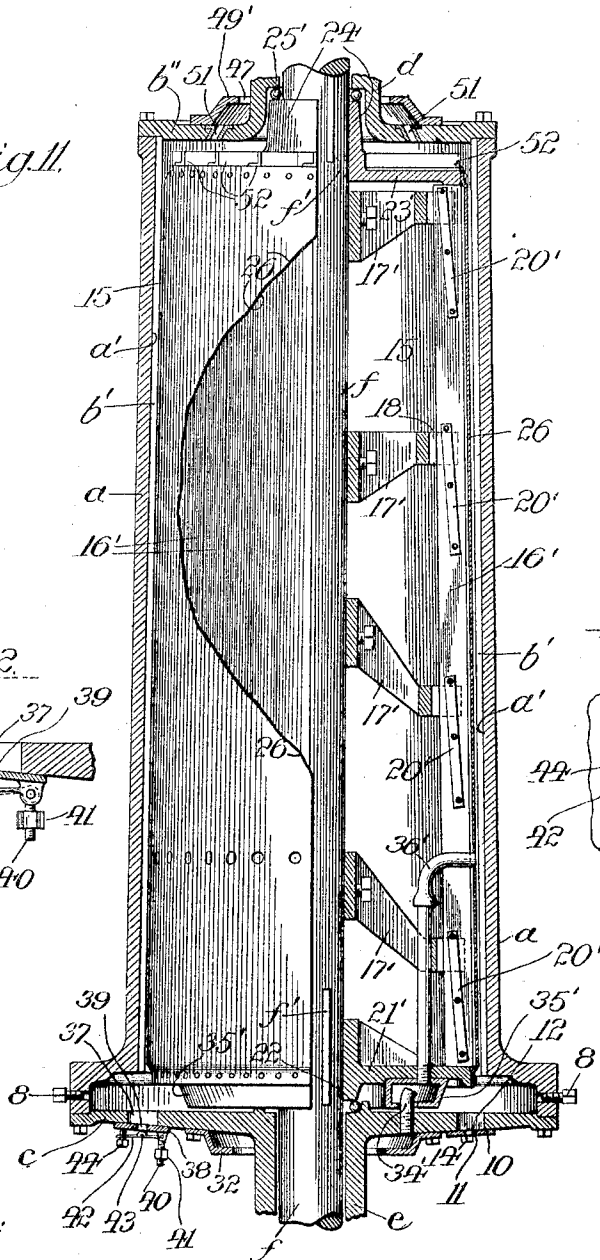


Fig. 12.

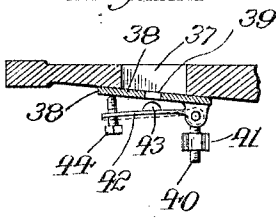
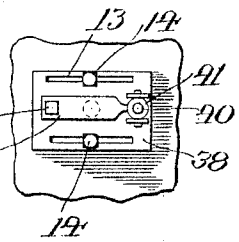


Fig. 13.



Witnesses:

Lester L. Allen
Edw. R. Barrett

Inventor:

Wilbur H. Peck

UNITED STATES PATENT OFFICE.

WILBUR H. PECK, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TITLE OWNERS COMPANY, A CORPORATION OF MAINE.

CENTRIFUGAL SEPARATOR.

No. 802,778.

Specification of Letters Patent.

Patented Oct. 24, 1905.

Application filed June 13, 1904. Serial No. 212,429.

To all whom it may concern:

Be it known that I, WILBUR H. PECK, a citizen of the United States, residing at 1003 Monroe street, Chicago, 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 separation of ores or similar materials of different degrees of specific gravity while in a pulverized state and mixed with water, and belongs to that class having an outer rotatable portion or vessel adapted to contain a body of water while in operation and with a separating surface or area on its inner wall substantially impervious to water and a differentially-rotatable inner portion or core, the two together forming a separating-channel variable in size, which is further described in two applications for Letters Patent for centrifugal separators, Serial Nos. 212,430 and 212,431, respectively, filed by me June 13, 1904, and also in applications Nos. 241,742 and 241,743, respectively, filed by me November 7, 1904; and its objects are mainly to provide means for changing the size or depth of the separating-channel to accommodate lodgment or accretion of concentrates without rendering ineffective a part of the separating-surface, such means to be of a character to adapt them to either a short or comparatively long separating vessel and to one either with the separating-surface parallel to the axis of rotation or oblique to such axis, thus the former condition enabling the maintenance, closely or wholly, of relatively uniform separating forces throughout the length of the vessel, thereby effecting a better separation; and my invention consists in the features and details of construction and combination of parts and the effects hereinafter set forth and claimed.

Figure 1 is a vertical longitudinal section of my improved separator, showing the outer rotatable portion or vessel, as well as some other portions, in central section and the inner rotatable portion or core partly in section and partly in elevation. Fig. 2 is a somewhat-enlarged plan cross-section of my separator on line 2 of Fig. 1 looking in the direction of the arrow. It shows more clearly the assembled position of the several sections and parts that are embodied in the inner portion or core. Figs. 3 and 4 are enlarged details of

certain parts, partly in section and partly in elevation, more fully described hereinafter. Fig. 5 is a side elevation of one of the movable sections or bars embodied in the inner portion or core. Fig. 6 is a cross-section of Fig. 5 on line 6 looking in the direction of the arrow. Fig. 7 is an enlarged cross-section of several of the removable sections with their coverings and some of their carrying parts, the sections being shown in a relatively contracted position. Fig. 8 is the same as Fig. 7, except that the sections are in a relatively expanded position. Fig. 9 is similar to Fig. 8, but somewhat modified. Fig. 10 is an enlarged detail of the means for adjusting the position of the passage for overflow from the vessel during the concentrating period. Fig. 11 is a vertical longitudinal central section of the outer portion or vessel with but little taper or slant and also showing the inner portion partly in section and partly in elevation and some of the parts modified in form. Fig. 12 is an enlarged detail of one of the automatic overflow or drainage devices for overflow purposes during washing out of middlings. Fig. 13 is a plan view of Fig. 12; and Fig. 14 is a plan view of the outer or circumferential side of one of the sections of the inner portion, showing its wedge-shaped form.

In making my improved centrifugal separator I provide a rotatable portion or treatment vessel *a*, which I prefer to locate in a vertical position and to have it with comparatively thin walls, as a tube or pipe, having an internal separating surface or area *a'*. It may be somewhat tapering or larger at one end than the other, if desired, as especially shown in Fig. 1, and is preferably provided with heads *b* and *c* or ends having extended hollow trunnions *d* and *e*, respectively. I also provide a shaft *f*, preferably extending through the trunnions *d* and *e*, around which the trunnions are rotatably journaled, thus forming bearings for lateral support of the outer rotatable portion or vessel. This shaft is in turn supported laterally by suitable journal-boxes *g* and *h*, the top one of which is attached to a casting *i* or equivalent part above the upper trunnion, supported by columns *j*, which are securely mounted on the base-housing *k* of the separator.

The lower journal-box *h* engages the shaft below the lower trunnion and is secured to the base-housing through arms *l*. The shaft is

mounted in its journal-boxes *g* and *h* in a sliding manner and is extended through such boxes sufficiently, as shown in Fig. 1, to permit of a desired longitudinal travel. It is stepped at its lower end in a suitable box *m* in a manner to be substantially maintained therein against relative longitudinal movement to the box either up or down, so by the movement of this step-box the shaft will be forced with it either up or down, as the box may be moved. The box *m* is pivotally attached, through links *n*, to the forked end of the lever *o*, which lever is fulcrumed at *p* to the base-housing of the separator. The opposite end of the lever is secured by links *q* to an internally-threaded nut *r*, which engages a substantial depending rod *s*, with its lower end threaded and which is securely and rotatably mounted and well maintained in substantial journal-boxes *t*.

To the rod between its journal-boxes is rigidly mounted a worm-wheel *u* for rotating the rod. The worm-wheel contacts at its hubs with the inner ends of the journal-boxes, thus maintaining the rod against longitudinal travel.

Meshing with teeth on the periphery of the worm-wheel is a worm *v*, carried and rotated by an adequate suitably-journaled shaft *w*, which is rotated in either one direction or the other by the clutch-pulleys *x* and *y*, the two being driven in opposite directions by belts *z* and *2*, respectively, Figs. 1 and 2, that may be operated in different directions, so that by engagement of the clutch 3 with either one or the other of said pulleys the threaded rod will be revolved in either direction desired, thus forcing the nut *r* up or down and rocking the lever *o* correspondingly and effecting a desired longitudinal movement or travel of the shaft *f*.

The base-housing of the separator is provided with two spirally-inclined troughs or compartments 4 and 5, as shown in Fig. 1, terminating in a two-compartment discharge-spout 6. (Shown in Fig. 2.)

The treatment vessel or outer portion *a* is preferably supported vertically at its lower end by a thrust-bearing 7, mounted on the upper end of the journal-box *h*, and is secured against upward movement by contact of its upper trunnion against the journal-box *g*. The lower end of the vessel is preferably somewhat enlarged for a short distance of its length, as shown in Fig. 1, and is provided with a row of nipples 8, having small discharge-openings around the circumference of the enlargement for the discharge of material and water from the vessel. Within the recess or chamber formed by said enlargement I prefer to provide a suitably-shaped ring 9, containing a series of depressions or pockets with large openings at the inner side and converging to smaller openings registering with the discharge-nipples 8 of the vessel, as most clearly shown in Fig. 1. The object of this

recessed or chambered ring is to prevent undue lodgment of material at this point.

On the lower head of the vessel, Figs. 1, 10, and 11, I have provided plates 10, containing holes or passages 11, registering with elongated holes or openings 12 through the head. The plates are also provided with properly-located elongated openings or slots 13, as shown in Fig. 10, of suitable size to receive cap-screws 14, which are threaded into the head of the vessel in suitable relation to the elongated openings in the head so the cap-screws will when tightened securely hold the plates 10 over the openings 12 in the head, effectually covering them except at the holes 11 in the plate, which holes then may serve as overflow-channels for the vessel. By loosening the cap-screws the plates may be moved toward or from the axis of rotation within the limits of the slots in the plate and carry the holes 11 correspondingly in or out, thus constituting adjustable or movable overflow-channels to the vessel for the purposes hereinafter more fully described.

Within the vessel or outer portion *a* and to operate in conjunction with it and its separating-surface to assist in effecting separation and differentially rotatable to said vessel and surface I provide an expansible and contractible inner portion 15, which is preferably in the nature of a hollow core or deflector, which is substantially unadapted to or non-susceptible of relative longitudinal movement to the treatment vessel. This core, deflector, or inner portion preferably embodies movable sections or bars 16, which may be of any suitable shape; but I prefer them in the form of substantially inflexible T-shaped bars or ribs, as shown, extending lengthwise to the separating-surface or axis of rotation and at their outer or circumferential sides lying comparatively close to each other with interposed spaces between them of less width than the width of the outer or head part of the separate sections and with their stem portions extending toward the axis of rotation and their heads farthest from the axis, so that together or collectively they form a circumferential area or surface at least approximately round and preferably quite closely conforming to the contour or shape of the separating-surface and with the outer portion or vessel forming a separating-channel *b'* next to said surface. These bars or sections preferably have their outer diametrical surfaces turned or formed convex, so as to present collectively a more nearly round smooth circumferential area.

Mounted rigidly on the shaft *f*, within the vessel, at suitable places, as illustrated, are hubs, flanges, or outwardly-extended portions 17, provided with radiating slots or channels 18 of proper size and suitably located, as illustrated, to receive with slight clearance the stem portion of the T-shaped sections and preferably at each side of these slots.

Located longitudinally to them and opening into them are undercut ways or channels 19, having suitable bearing-surfaces extending diagonally or obliquely to the axis of rotation, as shown most clearly in Figs. 3 and 4.

Secured on the sides of the stem portions of the sections or bars 16 at the points where they enter the channels 18 are diagonal or obliquely-located strips 20, also having suitable bearing-surfaces of size and shape and properly located to register with and suitably enter in a sliding manner the diagonal or oblique ways 19, so that by their engagement therein the bars or sections are held from radial movement except through the relative longitudinal movement of the shaft carrying the parts 17. The bars are thereby concertedly and automatically moved toward and from the axis through the longitudinal movement or travel of the shaft. These sections or bars 16 preferably extend nearly the entire length of the vessel, leaving, however, room at the lower end for a plate, disk, or ring 21, with which the ends of the bars contact in a radially-sliding manner. The plate is somewhat removed from the lower head of the vessel, as shown in Figs. 1 and 11, and between the two is interposed a bearing 22, which is preferably of the roller or ball type and serves as means for assisting to support the plate and its superimposed parts and in preventing relative longitudinal travel of the sections of the core and the outer portion or vessel.

At the upper end of the vessel the bars are short enough to permit of the introduction of a ring, disk, or plate 23, which contacts with the sections at their upper ends. Thus the two plates form heads or ends for the collective sections of the inner portion.

The upper plate 23 is provided with an upwardly-extended hollow flange or collar 24 near its central part, which surrounds the shaft f' and preferably extends up into an annular chamber in the lower part of the trunnion d . Within this chamber and between the end of the flange on the plate and a shoulder on the trunnion is located a differential thrust-bearing or journal 25, preferably also of the ball or roller type, which at this end serves to prevent relative longitudinal travel between the sections that collectively form the inner part or cone and the vessel. The plates 21 and 23 are mounted on the shaft sufficiently loose to slide on it and are splined at f'' so as to be revolved by and with the shaft. It follows that through the instrumentality of the upper and lower plates and the bearings 22 and 25 relative longitudinal travel between the plates and sections and the outer portion or vessel is prevented, while at the same time these parts are differentially rotatable to the vessel or outer portion, while the shaft f' , with its rigidly-mounted parts 17, is longitudinally movable to the vessel and sections. The travel of the shaft longitudinally may be effected by

the mechanism that has been hereinabove described, driven by the belts z and 2.

It will be seen that by traveling the shaft f' , with its rigidly-mounted parts 17, lengthwise the diagonally-located parts 20 will be traveled in the ways 19 and be forced toward or from the axis of rotation, thereby positively moving the sections or bars uniformly either in or out, and through such concerted movements of the sections the inner portion or core will be positively, unyieldingly, uniformly, and automatically expanded or contracted in size diametrically and circumferentially and through its approach or recession from the separating-surface will decrease or increase the size of the separating-channel. The parts 17 are somewhat modified in form in Fig. 11 and are there designated as 17', but their duty and effect is the same in both instances.

The degree of angle of the parts 20 and the distance of longitudinal travel of the shaft f' are suitably proportioned to secure the amount of expansion and contraction desired, and the sections are preferably so sized that when in a recessed or contracted position their adjacent edges at their collective circumference will be quite close together, preferably not quite touching each other. It then follows that in an extended or expanded position these edges will be somewhat farther apart, but with less space between them than the width of the outer part of the separate sections, the two relative positions being most clearly illustrated in Figs. 7, 8, and 9.

The core or deflector in my present invention extends over and covers substantially the whole of the separating-surface and is not drawn relatively endwise to the vessel to effect enlargement of the separating-channel for accommodation or accumulation of material therein, which facts are very important, because by procuring enlargement and contraction of the separating-channel by means of radial expansion and contraction of a core or deflector, as in my present invention, instead of traveling a rigid core or deflector endwise, as has been the practice heretofore in separators of this class, there is practically no space or area left uncovered on the separating-surface or that is subjected to such state while in operation; but the said surface is substantially all maintained under the separating influence of the core or deflector, which condition does not permit waste material to accumulate on an uncovered portion thereof, as is ordinarily the case consequent to traveling a deflector lengthwise, and, further, the avoiding of said difficulty consequent to traveling a deflector or core in a treatment vessel enables the practical use of a treatment vessel and a deflector having less proportionate taper, for the reason that with a vessel having slight taper and employing a relatively longitudinally travelable deflector the difficulty above

explained is proportionately increased, because the distance of longitudinal travel necessary to produce the required enlargement of the separating-channel is increased as the degree or proportion of the taper of the vessel is decreased, therefore rendering it impracticable to employ a vessel and core or deflector in this way without a considerable degree of taper.

On the other hand, it will be understood that a radially expansible and contractible deflector or core can be used equally well in a vessel with slight taper as in one with much taper. This fact is further important because centrifugal force developed in separation by rotation of a vessel varies throughout its length in an absolute or substantially constant ratio to the variance in the diameter of the vessel, and the washing or scouring force of the water therein caused by the differential rotation of the core or deflector also varies throughout its length in consequence of the taper and differential movement; but such variance is not in the same ratio as that of the centrifugal force, and it therefore follows that a treatment vessel and a deflector or core having a small amount of taper, proportionate to their diameter, afford more nearly uniform separating forces severally and relatively throughout their length, and consequently enable the obtaining of better separation of the products operated upon and better practical results.

It will be understood that the treatment vessel is adapted to contain a body of water while in operation, and I prefer in most instances to prevent water and material from entering the inside of the core or deflector formed by the several sections, partly for the reason that by maintaining it free from such occupation its aggregate outward pressure or stress under centrifugal action can be largely neutralized or counterbalanced by the inward pressure or force of the body of water in the vessel during concentration on the outer surface of the core, and for securing this action to the degree desired the amount or body of water retained in the vessel can be regulated through adjustment of the overflow-passages 11, so that the parts 20 are largely relieved from sustaining the said outward stress. This will also enable the shaft *f* to be moved more easily lengthwise and the parts operated by it to be subjected to less wear.

I further desire to prevent water and material from flowing through the cracks to the interior of the core, for the reason that such flow would remove that material out of the separating-channel and so far from the separating-surface as to prevent its proper separation. As means for accomplishing this purpose I prefer to cover the cracks or spaces between the sections by wrapping or covering the sections around their collective circumferential area by or with a preferably substantially water-tight flexible cover 26, which cover should be secured to the sections in a

suitable way, which in this case is by metal strips and screws 27, inlaid or depressed in the covering, as especially shown in Figs. 7 and 8.

I prefer that the covering, which I have designated in its collective parts by 26, should have elastic or stretchable parts 28, approximately registering with the spaces or cracks between the sections, so as to stretch or yield to expansion or contraction of the sections in operation. If desired, the larger part of said covering may be of combined cotton or similar fiber and rubber, made as ordinary rubber belting or fabric of such general character and comparatively non-elastic.

As a means of protection from or preventing abnormal distorting or what is known as "bladdering" of the elastic portion of the cover through the cracks or spaces between the sections at times when the cover is being subjected to inward pressure of water during operation I prefer to provide a comparatively thin substantially non-elastic under cover 29, of canvas or other suitable flexible material, lying near to the sections. It is preferred that this under cover should not be adhered to the elastic parts, at least throughout the zone of the several cracks, so that the elastic portion can be expanded or contracted, and so yieldable within the limit desired, irrespective of the non-elastic under covering, which is supplied at these points with sufficient slackness to permit of the desired expansion. To guard against and prevent undue wearing or abrading of the covering at the outer diametrical edges or corners of the several sections along the spaces or cracks between them, I prefer to have such corners removed, preferably rounded, as shown in Figs. 7, 8, and 9. If desired, there may also be an outer flexible comparatively non-elastic covering 30, shown only in slightly-modified Fig. 9, preferably of comparatively light material somewhat similar to the under layer or covering 29. Both of these non-elastic layers or parts must be supplied with sufficient looseness to permit of the expansion of the sections. In the slightly-modified Fig. 9 I have omitted the metal retaining or fastening strips shown in some other figures of the drawings and indicated by 27 and in their stead employ other means, as rivets or screws, for this purpose.

To prevent leaking or flowing of water under the covering at its ends, flanges 31 are provided at the outer diameter of the plates 21 and 23, to which the covering is well secured, as shown, sufficient slackness being provided, however, to permit of the desired movement of the section in their expansion and contraction. If desired, other facility may be provided instead of the flanges 31 to which the ends of the covering may be secured in any suitable desired way to effect the results sought.

In most of the figures of the drawings, and

especially in Figs. 7, 8, and 9, I have illustrated the several layers of the covering somewhat apart from each other and also somewhat spaced from the sections. This, however, is done only for the purpose of more clearly illustrating them, and in practice they are not only laid closely against the sections, but also against each other.

In instances where the vessel or outer portion is tapering I prefer to make the bars or sections with their outer circumferential parts wider at one end than the other, or somewhat wedge-shaped, as shown in Fig. 14, so that they will collectively form a tapering internal portion, core, or deflector to conform to the shape of the separating-surface of the vessel and at the same time maintain the cracks or spaces between them more nearly of the same width throughout their length.

As a means of first removing material from that portion of the separating-surface nearest the discharge end of the vessel after the separator has been charged with concentrates and middlings I provide on the outside of the lower head of the vessel, as shown in Fig. 1, an annular flanged ring 32, (this ring is also shown in Fig. 11,) opening toward the axis of rotation and forming a chamber adapted to receive water delivered by a hydraulic pipe 33 during operation while such material is being removed. Communicating with the chamber in the ring 32 and located to receive water from it are one or more pipes 34, threaded into holes through the vessel-head *c*, as shown. These pipes extend upward with their terminal ends registering with a flanged ring 35, similar to the ring 32. Although shown as pipes in the drawings, they may be of any suitable shape to serve the required purpose of water-conduits. On the inside of the plate 21, in position to draw water from the chamber in the ring 35, are nipples connecting with a flexible tube 36, which extends to the wall of the core or deflector and is connected with and through such wall by hollow nipples or by other suitable means in a manner so that water may be passed during operation from the pipe 33 out through the wall of the core, and thus be delivered into the separating-channel and on the separating-surface up some distance from the discharge end, enabling at the desired times lodged material or middlings to be removed separately from that portion of the separating channel and surface nearest the discharge end. This separate removal of the middlings is desired just prior to removal of the cleaner material or concentrates. The pipes 34, the ring 35, and the tubes or pipes 36 are somewhat modified in form in Fig. 11 and are indicated therein by 34', 35', and 36', respectively.

The middlings can be removed from the separating-surface with much more ease if there is water accumulated in the separating-channel throughout the extent from which it

is desired to effect such removal, and it is also important that there should not during this time be an accumulation of water largely over other portions of the separating-surface, as such accumulation would tend to wash out the cleaner concentrates. It will be understood, as hereinafter explained, that the vessel is operated at a slow speed of rotation during the unloading period, and to meet the conditions just explained as to the presence of water and to facilitate removal of middlings I provide through the lower head *c* of the vessel, as shown in Figs. 1, 11, and 12, elongated holes 37 and over these holes supply adjustable plates 38, similar to plates 10, with passages 39 through them, which I will term "drainage-passages." To these plates 38 I mount a hinged angle-piece with its part 40, being a threaded outward extension and carrying an adjustable internally-threaded weight 41, and with its other extension or part 42, preferably of spring metal, extending over the drainage-passages and carrying a stopper 43 in position to register with and when desired close the passage over which it extends. Through the spring portion 42 is a screw 44, contacting with the adjustable plate 38, and by adjustment of the screw the nearness of the spring and stopper to the drainage-passage when the spring is in a normal position can be regulated, so that the energy required to deflect the spring and stop the passage may be thereby governed. At the same time the amount of centrifugal energy applied for this purpose can be regulated by the position of the weight 41.

To deflect the spring portion 42 and stop the drainage-passage, as above explained, centrifugal force is relied upon to carry the said weight out radially, which radial movement is resisted by the spring, and as the effectiveness of the weight at any consequent speed of rotation of the vessel will depend on the distance of the weight from the hinged point of the angle parts carrying it said weight can be so adjusted that the spring will be sufficiently either deflected or relieved to automatically open or close the drainage-passages at any respective speeds of rotation of the vessel that may be desired. It is intended that this adjustment should be such that the drainage-passages will be closed at the speed required during the concentrating period, which speed is comparatively fast or high, and opened at the unloading period when the speed of rotation of the vessel is comparatively slow. It follows that by the said adjustment the respective speeds of the vessel at which said passages will be opened and closed can be predetermined.

To determine the extent to which the drainage-passage will abstract the water from the separating-channel during operation for removal of middlings and to adjust this condition, the plate 38 can be moved or adjusted

radially as desired, carrying with it the drainage-passage. Therefore it will be seen that such passage or passages are adjustable, as well as the means for opening and closing them being adjustable.

Fig. 11 of the drawings is on a different scale from other figures and, as before stated, is somewhat modified, showing many of the parts of different proportions and forms. The treatment vessel and core, inner portion, or deflector are shown with less taper, and the bars or sections 16' are of the same construction as in Fig. 1, but are of different proportions, and their obliquely-laid parts 20' are located with a reverse angle to the corresponding parts in Fig. 1, and the ways in the parts 17' in which they slide or operate are located or placed at an angle suitable for the parts 20'.

The flexible covering 26 shows in elevation in Fig. 11 an outer substantially non-elastic layer similar to that designated by 30 in Fig. 9, and there are no metallic fastening-strips for the cover present, as is the case in Fig. 9; but, like in Fig. 9, rivets or screws are employed for fastening the cover to the bars.

In Fig. 11 the enlargement at the lower end of the vessel and the chamber formed by it are somewhat different in shape than those shown in Fig. 1, and the chambered or recessed ring is omitted from said enlargement.

The material-feed chamber at the feed end of the vessel is formed by an outer ring 49', similar to that shown in Fig. 1, and by the hub δ .

The plates or parts forming the ends of the core are designated in Fig. 1 as 21 and 23, respectively, but are somewhat different in form in Fig. 11 and are designated in the latter figure by 21' and 23'. They, however, serve the same purposes in both instances. 23' is shown partly in elevation and with part of its wings 52 in perspective. The parts 34', 35', and 36', Fig. 11, have been hereinbefore described.

As means for feeding or supplying material for separation a pipe 45, Fig. 1, is used, connecting with a fixed hollow casting 46, having an annular opening 47 at its lower side registering with an annular opening between the rings 48 and 49, which together form a feed-chamber 50 on the upper head of the vessel. From this feed-chamber are holes 51 through the upper head of the vessel, communicating with the space within the vessel between its upper head and the plate 23. On the said plate are radial wings 52 for quickly forcing the material and water around as it is introduced into the vessel. The pipe 45 is provided with a suitable valve (not shown) to govern the flow of material to the separator, and there is a branch pipe 53 for supplying clean water, when desired, also provided with a suitable valve. If desired, however, other suitable means may be employed for supplying water and material to the separator.

In operation the treatment vessel or outer

portion is revolved at a desired speed of rotation and the inner portion, core, or deflector is also revolved, but at a desired different speed. Initially the core or inner portion is expanded to its full extent, reducing the separating-channel to its proper size for commencement of concentration, and the concentrating period may commence. The material to be separated, while in a finely pulverized or crushed state and mixed with the desired amount of water to make it flow freely and best facilitate separation, is then introduced or fed into the separator, preferably from a suitable agitator-tank (not shown) through the feed-pipe 45, and passes into the separating-channel through the agencies described, the heavier parts or concentrates and the middlings lodging on the separating-surface, the former nearer the feed end and the latter nearer the discharge end thereof, while the lighter or waste parts are forced or driven along by and with the water through the separating-channel to discharge.

The washing or scouring action of the water in the separating-channel is one of the main forces or agencies that effects separation and removal of the material within the vessel and is principally generated through or by frictional contact with the body of water within the separating-channel with the core or deflector and is consequent to the differential rotation of said deflector to the vessel, (the inner and outer portions.) The water therefore becomes the means or instrumentality by which said force consequent to said differential rotation is transmitted and made effective for separating purposes in the separating-channel. The current or line of such force is principally in a circumferential course; but the material being separated and the water are diverted from such course to a spirally-inclined course through the separating-channel toward the discharge end by the tapering form of the vessel and by the longitudinal flow of water through the channel. The centrifugal force acts within the vessel while in operation mainly in a way tending to strongly carry and hold all particles of the material being treated toward and on the separating-surface in proportions relative to their respective weights, and thereby serves to greatly widen or magnify the margin of difference in their adhering or lodging tenacity, within which widened margin of difference the said separating, washing, or scouring force of the water can be more easily adjusted for effecting separation and removal of the lighter from the heavier of said particles. The intensity of said washing or scouring force is controlled or governed by the amount of differential revolution between the inner and outer portion, which is during concentration adjusted properly to wash off and move the lighter parts along to discharge, while permitting the heavier to lodge and accumulate on the con-

centrating or separating surface. 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 condition during the concentrating period the inner shaft is traveled longitudinally, as has been hereinabove explained, and thereby the core, inner portion, or deflector is contracted gradually, and thus uniformly increasing the depth or size of the separating-channel, which in turn is progressively being filled with concentrates and middlings. When the inner portion, core, or deflector has been fully contracted, the feed of material for separation is discontinued, the speed of the vessel considerably decreased, and a flow of clean water, preferably introduced by the pipe 33, for washing out and removing the middlings accumulated on the lower end of the separating-surface, and after this has been accomplished clean water is introduced by the pipe 53 and flowed through the separating-channel, and at the same time the inner portion or deflector, through the reverse lengthwise travel of the shaft f , is expanded to its initial or maximum size, during which time and shortly after the concentrates in the upper part of the channel are washed out to discharge, after which the vessel may be restored to proper speed for effecting separation. All material and water passed through the separator and caught in the troughs or compartments 4 and 5 of the base-housing are flowed out through the spout 6, although the several products at different times, as they are separately periodically discharged from the vessel, and from there diverted by a suitable shifting launder (not shown) to points desired. The discharge-orifices in the nipples 8 from the vessel are intended to be small enough to back up or accumulate and retain a body of water within the separating-channel and to some extent between the plates 21 and 23 and the heads b and c during separation, such body of water rising or approaching to a position so there will be an overflow of excess water through the adjustable passages 11, thereby said passages limiting the extent of the said accumulation. This accumulated water actuated by centrifugal force will exert an inward pressure on the core, inner portion, or deflector and counterbalance the outward stress of the parts forming the wall thereof, as has been explained. The extent of said pressure inwardly is regulated by the quantity of water being retained in the vessel, and as this quantity is limited by the position of the adjustable plates, carrying the overflow-passages 11, it follows that the position of these plates with their overflow-passages can be adjusted to meet the requirements in this respect and form means for regulating or predetermining the inward pressure of the water on the core or deflector.

I do not desire to confine myself to the exact construction hereinabove described, as variations in this respect may be made and still embody the broader and more useful features of my invention. I do not broadly claim as my invention means for automatically opening and closing overflow or drainage passages in the vessel of a centrifugal separator for purposes of facilitating removal of middlings separately or otherwise; but I do claim these means adjustable toward and from the axis of rotation and means combined with such automatic devices for regulating or adjusting them to open or close at a predetermined or desired speed of rotation of the vessel, thereby serving the very important and useful purposes hereinabove described. I desire also to state that where in the specification and claims I have used the words "water-tight" or "substantially water-tight" I mean that part of the core, deflector, or covering which comes within the zone of contact with the water in the vessel while in operation, and by such expressions have reference to and mean such parts and such water within the vessel only, and also that I do not in this application claim a covering to a core or deflector in this class of separator substantially impervious to or proof against decomposition by natural acid solutions of ores which is herein disclosed by the use of rubber, as such character of covering is disclosed and claimed in my pending application, Serial No. 241,743, filed November 7, 1904.

In using the term "material" in the specification and claims I mean ores or any other solid or semisolid material having such characteristics, sufficiently crushed or pulverized, and containing parts of different degrees of specific gravity.

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

1. In a centrifugal separator the combination of a rotatable treatment vessel adapted to contain a body of water while in operation, and having a separating-surface therein adapted to a flow of water and material thereover, for separation; an expansible and contractible differentially-rotatable core in proximity to said surface and means for effecting substantially uniform expansion and contraction of said core.

2. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to be submerged in water while in operation and to a flow of material for separation thereover; an expansible and contractible differentially-rotatable core within the vessel in proximity to said surface, and means for effecting positive and substantially uniform and substantially unyielding expansion and contraction of said core.

3. In a centrifugal separator the combination of a rotatable treatment vessel having a

separating-surface therein adapted to a flow of water and material thereover for separation; an expansible and contractible differentially-rotatable deflector within the vessel, substantially water-tight to the water within said vessel during operation and means for effecting expansion and contraction of said deflector.

4. In a centrifugal separator the combination of a rotatable treatment vessel provided with a separating-surface therein adapted to a flow of water and material thereover for separation; an expansible and contractible differentially-rotatable deflector within said vessel with an exterior surface conforming approximately to the contour of the separating-surface and means for effecting positive and approximately uniform expansion and contraction diametrically of said deflector and means for introducing water and material for separation into the vessel.

5. In a centrifugal separator the combination of a rotatable treatment vessel adapted to hold a body of water while in operation, having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable expansible and contractible core within said vessel with an exterior surface conforming approximately to the contour of said separating-surface and means for effecting positive and substantially uniform and practically unyielding expansion and contraction of said core.

6. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable diametrically expansible and contractible core within the vessel, means for positively effecting diametrical expansion and contraction of said core and means at the same time for maintaining said vessel and core in substantially the same relative longitudinal positions.

7. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation, a differentially-rotatable diametrically expansible and contractible core within the vessel and means interposed between the vessel and core substantially preventing their relative longitudinal movement.

8. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; an expansible and contractible means for increasing and decreasing the size or depth of said passage and at the same time maintaining substantially all of said passage in an effective state of separation during the separating period.

9. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-channel therein and with a separating-surface adapted to a flow of water and material thereover for separation and a differentially-rotatable diametrically expansible and contractible substantially water-tight means within the vessel for increasing and decreasing the size or depth of said channel and at the same time maintaining substantially all of said channel in an effective separating state during the separating period.

10. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable diametrically expansible and contractible substantially water-tight core therein, embodying a relatively longitudinally movable shaft to assist in effecting expansion and contraction of said core and means for substantially preventing relative longitudinal travel between said vessel and the outer walls of said core.

11. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable expansible and contractible substantially water-tight core within the vessel embodying circumferential walls and a central shaft, the latter relatively movable longitudinally to said walls and a differentially-rotatable bearing interposed to prevent relative longitudinal travel between said walls and the treatment vessel.

12. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable diametrically expansible and contractible substantially water-tight core within the vessel and a central shaft supporting said core and the said vessel and assisting to effect expansion and contraction of said core.

13. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material for separation thereover; a differentially-rotatable diametrically expansible and contractible substantially water-tight core within the vessel; a shaft for supporting both the said vessel and the core, said shaft synchronously rotatable with the core and differentially rotatable to the vessel and means for effecting relative longitudinal travel of said shaft and vessel.

14. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface adapted to a flow of water and material thereover for separation; a central shaft on which said vessel is rotatably journaled; an expansible and contractible differentially rotatable substantially water-tight core in said vessel supported and rotated by said shaft; means through the relative longitudinal movement of parts of said core for ex-

panding and contracting said core, and means for effecting said longitudinal movement.

15 15. In a centrifugal separator the combination of a rotatable treatment vessel adapted to hold a body of water while in operation, having a separating-surface therein; an internal rotatable expansible and contractible substantially water-tight portion embodying sections; a central shaft supporting radially-extended parts having oblique ways engaging oblique parts on said sections whereby, through longitudinal movement of the shaft relative to the sections, the latter are moved toward and from the axis of rotation, and means for effecting said relative longitudinal movement.

16. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein; a rotatable expansible and contractible substantially water-tight core within the vessel embodying T-shaped bars and a central shaft rigidly carrying outwardly-extended parts having radial channels receiving the inwardly-extended parts of said bars and also having oblique ways engaging oblique extensions secured to said bars, whereby the bars are held to place and concertedly moved toward and from the axis of rotation through relative longitudinal travel of the shaft with its rigidly-carried extensions and the oblique parts on said bars and means for longitudinally traveling said shaft.

17. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface adapted to a flow of water and material thereover for separation; an expansible and contractible substantially water-tight core within the vessel embodying substantially inflexible longitudinal sections; means for moving said sections toward and from the axis of rotation during operation of the separator and means for feeding water and material for separation to the vessel.

18. In a centrifugal separator the combination of a rotatable treatment vessel having a separating area and a differentially-rotatable expansible and contractible substantially water-tight core embodying bars collectively forming an exterior to said core approximately conforming to the contour of the separating-surface, means for concertedly moving said bars toward and from the axis of rotation and means for feeding water and material into the vessel.

19. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface adapted to a flow of water and material thereover for separation; a differentially-rotatable expansible and contractible substantially water-tight core embodying sections collectively forming an exterior to said core conforming approximately to the contour of the separating-surface, means for gradually concertedly and automatically moving said sections toward and from the axis

of rotation and means for feeding water and material into the vessel.

20. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface adapted to a flow of water and material thereover for separation; a differentially-rotatable expansible and contractible core within the vessel embodying bars, said bars having convex surfaces which together form an approximately round circumferential area and means for moving said bars toward and from the axis of rotation, the said bars having interposed spaces between their circumferential edges of less width than the width of the outer portion of the separate bars.

21. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface adapted to a flow of water and material thereover for separation; a differentially-rotatable expansible and contractible substantially water-tight core embodying T-shaped sections collectively forming a wall to said core with a circumferential area approximately conforming to the contour of the separating-surface and means for feeding water and material into the vessel.

22. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water thereover with material for separation; a differentially-rotatable diametrically expansible and contractible substantially water-tight core within the vessel embodying sections having oblique surfaces engaging in a sliding manner with oblique surfaces of a portion supported by a central shaft forming means for assisting to maintain such sections in place and for assisting in effecting expansion and contraction of said core and means for feeding water and material into the vessel.

23. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a substantially water-tight core within the vessel embodying sections provided with attached oblique parts engaging in a sliding manner with oblique surfaces of a portion supported by a central shaft, forming means for assisting to maintain said sections in place and for moving them toward and from the axis of rotation, and means for feeding water and material into the vessel.

24. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; an inner substantially water-tight core, embodying sections provided with oblique parts engaging in a sliding manner with flanges having oblique surfaces thereon, and supported by a central shaft whereby said sections are held to place and moved toward and from the axis of rotation and means for feeding water and material into the vessel.

25. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a substantially water-tight core in the vessel embodying bars, said bars together forming a round external area, and having inwardly-extended parts carrying inclined surfaces, engaging with parts maintained by a relatively longitudinally movable supporting-shaft, whereby through traveling action relatively between said inclined surfaces and the parts maintained by said shaft, said core is expanded and contracted diametrically and means for feeding water and material to the vessel.

26. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable diametrically expandable and contractible core within the vessel; a plate forming an end to said core; means for effecting expansion and contracting of said core; a flexible substantially water-tight covering over the circumference of said core and means for feeding water and material into said vessel.

27. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a differentially-rotatable diametrically expandable and contractible core within the vessel; a plate forming an end to said core; an elastic or yieldable covering over said core and means for feeding water and material into the vessel.

28. In a centrifugal separator the combination of a rotatable treatment vessel adapted to hold a body of water while in operation, and having a separating-surface therein; a differentially-rotatable expandable and contractible core embodying sections collectively forming a circumferential exterior approximately conforming to the contour of the separating-surface; a flexible substantially water-tight covering around the collective circumferential surface of said sections; a portion at the end of said bars collectively, forming an end to said core and having said covering secured thereto and means for feeding water and material into the vessel.

29. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; an internal differentially-rotatable core embodying sections provided with inclined parts engaging in a sliding manner with inclined surfaces in ways of a portion supported by a central shaft, forming means for assisting to maintain said sections in place and for moving them concertedly toward and from the axis of rotation; a substantially water-

tight covering secured around the collective circumference of said sections adapted to yield to expansion of said core and means for feeding water and material into the vessel.

30. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; a central shaft on which said vessel is journaled; an expansible and contractible differentially-rotatable core in said vessel supported and rotated by said shaft embodying sections movable toward and from the axis of rotation of the shaft; a flexible substantially water-tight covering over the collective circumference of said sections and means for feeding water and material into the vessel.

31. In a centrifugal separator the combination of a rotatable portion having a separating-surface; a differentially-rotatable expandable and contractible inner portion embodying sections collectively forming a circumferential area approximately conforming to the contour of the separating-surface, and provided around their collective circumferential area with a flexible substantially non-elastic covering and an elastic covering, and means for effecting movement of the sections toward and from the axis of rotation.

32. In a centrifugal separator the combination of a rotatable portion having a separating-surface; a differentially-rotatable expandable and contractible inner portion embodying bars collectively forming a diametrical exterior approximately conforming to the contour of the separating-surface; said bars collectively provided around their circumferential area with a covering having elastic portions at least approximately registering with the cracks or junctures between said bars, and non-elastic portions interposed between said elastic portions, the non-elastic portions secured to said bars, and means for moving the bars toward and from the axis of rotation.

33. In a centrifugal separator the combination of a rotatable portion having a separating-surface; and a differentially-rotatable expandable and contractible inner portion embodying bars collectively forming a diametrical exterior approximately conforming to the contour of the separating-surface; said bars provided around their collective circumferential area with a covering having an elastic portion approximately registering with the cracks or junctures between the bars, and a substantially non-elastic flexible covering under said first covering, the two unattached to each other throughout the zone of the cracks or junctures between the bars.

34. In a centrifugal separator the combination of the rotatable portion having a separating-surface; a differentially-rotatable expandable and contractible portion embodying bars collectively forming a circumferential exterior approximately conforming to the contour

of the separating-surface; said bars collectively provided around their circumferential area with a covering having elastic portions approximately registering with the cracks or junctures between the bars, and substantially non-elastic portions interposed between the elastic portions and secured to the bars; a substantially non-elastic flexible covering under said first covering, with sufficient slackness to permit of desired expansion and contraction, and means for moving the bars toward and from the axis of rotation.

35. In a centrifugal separator the combination of a rotatable portion having a separating-surface; an expansible and contractible portion in proximity to said surface; a flexible covering over part of the circumferential area of the expansible and contractible portion, said covering having an elastic part, and a substantially non-elastic part on both sides of the elastic part, the elastic parts stretchable irrespective of the non-elastic parts, and retaining devices for securing the covering to place.

36. In a centrifugal separator the combination of a rotatable portion having a separating-surface; a differentially-rotatable expansible and contractible inner portion embodying bars collectively forming a circumferential exterior approximately of the same contour as the separating-surface, said bars collectively provided on their circumferential area with a covering having elastic portions approximately registering with the cracks or junctures between the bars, and a plate forming an end for said bars collectively having the covering secured thereto.

37. In a centrifugal separator the combination of a rotatable portion having a separating-surface; an inner portion embodying sections, said sections forming a round or cylindrical area and having inwardly-extended parts carrying diagonal surfaces engaging with parts maintained by a central shaft whereby said sections may be moved toward and from the axis of rotation and their composite circumferential surface expanded and contracted; a covering secured over the collective circumference of said sections provided with elastic parts, and a substantially non-elastic covering under said outer covering having sufficient looseness to permit of desired expansion, and a head for said sections collectively to which one of said coverings is secured.

38. In a centrifugal separator the combination of a rotatable vessel having a separating-surface on its inner circumferential wall; a differentially-rotatable diametrically expansible and contractible core therein; a covering over the collective circumferential surface of said core practically water-tight, means for feeding water and material into the vessel and means for regulating the overflow of water from said vessel.

39. In a centrifugal separator the combina-

tion of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and material thereover for separation; an expansible and contractible portion within the vessel in proximity to said separating-surface embodying movable sections collectively forming a circumferential area approximately conforming to the contour of the separating-surface; a flexible substantially water-tight covering over the cracks or junctures between said sections, and devices for securing said covering to the sections and means for feeding water and material into the vessel.

40. In a centrifugal separator the combination of a rotatable portion having a separating-surface; an expansible and contractible portion in proximity to said separating-surface, embodying movable sections collectively forming a circumferential area approximately conforming to the contour of the separating-surface; a flexible covering over the collective circumferential area of said sections; said covering having an inner and outer layer, the inner layer substantially non-elastic and the outer layer provided with elastic portions adapted to yield to expansion and contraction, the two layers substantially unattached to each other at the circumferential junctures or cracks between the sections.

41. In a centrifugal separator the combination of a rotatable treatment vessel adapted to hold a body of water while in operation having a separating-surface therein adapted to a flow of water and material thereover for separation; an expansible and contractible core within the vessel in proximity to said surface embodying movable sections, said sections collectively forming a circumferential area approximately conforming to the contour of the separating-surface; a flexible covering over said expansible and contractible portion, and devices depressed in said covering for securing the same to the sections.

42. In a centrifugal separator the combination of a rotatable portion having a separating-surface; an expansible and contractible portion in proximity to said separating-surface, embodying movable sections; a flexible non-metallic covering over the circumferential cracks or junctures between said sections, and metal devices embedded in said covering for assisting to secure it to said section.

43. In a centrifugal separator the combination of a rotatable portion having a separating-surface; an expansible and contractible portion in proximity to said surface embodying movable sections; a covering over the collective circumferential area of said sections having elastic parts and a substantial non-elastic part both under and over said elastic part to protect the elastic parts from abnormal distortion during operation, while permitting said elastic parts to yield to desired expansion and contraction.

44. In a centrifugal separator the combination of a rotatable portion having a separating-surface; an expansible and contractible portion in proximity to said separating-surface
 5 embodying movable sections; a covering over the collective circumferential area of said sections having a flexible substantially non-elastic under layer fitted with sufficient looseness to permit of expansion and contraction, and
 10 an outer layer having elastic portions closely fitting over said under layer, whereby expansion and contraction may be had and abnormal distortion of the elastic parts by inward pressure be prevented during operation.

15 45. In a centrifugal separator the combination of a rotatable vessel having a separating-surface on its inner circumferential wall; a differentially-rotatable diametrically expansible and contractible core therein; a covering
 20 over the collective circumferential surface of said core practically water-tight; means for regulating the overflow of water from said vessel, means for introducing water into said vessel and means for removing middlings separately from said separating-surface.

25 46. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and pulverized ore thereover for separation; a differentially-rotatable expansible and contractible core within the vessel embodying sections collectively forming a circumferential exterior approximately conforming to the contour of the separating-surface;
 30 said sections collectively provided around their circumference with a flexible covering, means for the introduction of water and pulverized ore into said vessel for separation and means for removing middlings separately from said separating-surface.

40 47. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface therein adapted to a flow of water and pulverized ore thereover for separation; a differentially-rotatable expansible and contractible inner portion embodying bars collectively forming a circumferential exterior approximately conforming to the contour of the separating-surface; said bars collectively provided around their circumference with a flexible covering, means for the introduction of water and pulverized ore into the vessel for separation and means for removing middlings separately from the separating-surface
 45 embodying flexible water-conduits.

50 48. In a centrifugal separator the combination of a rotatable vessel adapted to contain a body of water while in operation, and provided with a separating-surface; and an internal differentially-rotatable expansible and contractible portion practically water-tight at its outer circumference, and together with said vessel forming a separating-channel adjacent to the separating-surface; said vessel provided with
 60 a movable overflow-passage between its periphery and axis, whereby the approach of water to the axis during operation may be limited as desired, and its resultant pressure on the inner portion during operation may be regulated.

70 49. In a centrifugal separator the combination of a rotatable vessel having a separating-surface; a central shaft on which said vessel is rotatably journaled; an expansible and contractible differentially-rotatable portion in
 75 said vessel, supported and rotated by said shaft, embodying bars movable toward and from the axis of rotation; a plate forming an end portion for said bars collectively, a substantially water-tight yieldable covering
 80 around the collective circumference of said bars, at its ends secured in a substantially water-tight manner to the end portion at the end of said bars, means for introducing water and pulverized ore into the vessel and bearings
 85 interposed between the said collective end portion, and the end of the vessel to maintain an approximately fixed relative longitudinal position of the bars and the vessel.

90 50. In a centrifugal separator the combination of a rotatable treatment vessel having a separating-surface; an expansible and contractible portion in proximity to said surface embodying movable sections collectively forming a diametrical surface conforming approximately to the contour of the separating-surface, said sections having their corners removed at their circumferential cracks or junctures, a flexible covering over said juncture and means for securing the covering to the
 95 sections.

100 51. In a centrifugal separator the combination of a rotatable vessel larger at one end than at the other and provided with a separating-surface therein adapted to a flow of
 105 water and material thereover for separation; an expansible and contractible differentially-rotatable substantially water-tight internal portion embodying movable bars of greater width at one end than at the other, means for moving said bars toward and from the axis of rotation, and means for the introduction of water and material into the vessel.

110 52. In a centrifugal separator the combination of a rotatable vessel adapted to hold a
 115 body of water while in operation, and provided with a separating-surface therein adapted to a flow of water and material thereover for separation; an inner differentially-rotatable substantially water-tight, expansible and contractible portion to said vessel; means for introducing water and material into the vessel for separation; the vessel provided with adjustable overflow-passages, and adjustable automatic means for opening and closing said
 120 passages.

125 53. In a centrifugal separator the combination of a rotatable vessel adapted to hold a body of water while in operation, and provided with a separating-surface; an inner por-
 130

tion to said vessel, embodying movable sections; means for moving said sections toward and from the axis of rotation; the vessel provided with adjustable overflow-passages, and adjustable automatic means for opening and closing said passages.

54. In a centrifugal separator the combination of a rotatable vessel adapted to hold a body of water while in operation, and provided with a separating-surface; an inner portion to said vessel, embodying movable sections; means for moving said sections toward and from the axis of rotation; a flexible covering over the collective circumference of said sections; the vessel provided with adjustable overflow-passages and adjustable automatic means for opening and closing said passages.

55. In a centrifugal separator the combination of a rotatable treatment vessel adapted to hold a body of water while in operation and having a separating-surface therein, an expansible and contractible composite deflector within the vessel having movable sections and a flexible substantially water-tight covering over the collective circumference of the sections, said sections having spaces between their outer edges of less width than the width of the outer or circumferential part of the separate sections.

56. In a centrifugal separator, the combination of a rotatable treatment vessel adapted to contain a body of water while in operation and having a separating-surface therein, a

differentially-rotatable, expansible and contractible deflector forming one side of a covered separating-channel within the vessel, and adapted through the instrumentality of water while in operation to generate a scouring or washing separating force on material depositing within said channel, the intensity of said force controllable by the amount of said differential rotation, means for expanding and contracting said deflector and means for introducing water into the vessel.

57. In a centrifugal separator, the combination of a rotatable treatment vessel adapted to contain a body of water while in operation, and having a separating-surface therein, a differentially-rotatable mechanically expansible and contractible deflector within the vessel forming one side of a separating-channel, and having a substantially water-tight flexible covering around its circumference, and adapted through the instrumentality of water while in operation to generate a scouring or washing separating force on material depositing within said channel, said force controllable by the amount of said differential rotation, means for mechanically expanding and contracting said deflector, and means for introducing water and material into the vessel.

WILBUR H. PECK. [L. s.]

Witnesses:

A. J. HOLTON,
G. P. NORTON.