P. F. PECK.

CENTRIFUGAL ORE SEPARATOR.

APPLICATION FILED OCT. 3, 1908.

917,123.

Patented Apr. 6, 1909.

2 SHEETS—SHEET 1.

Fig. 1

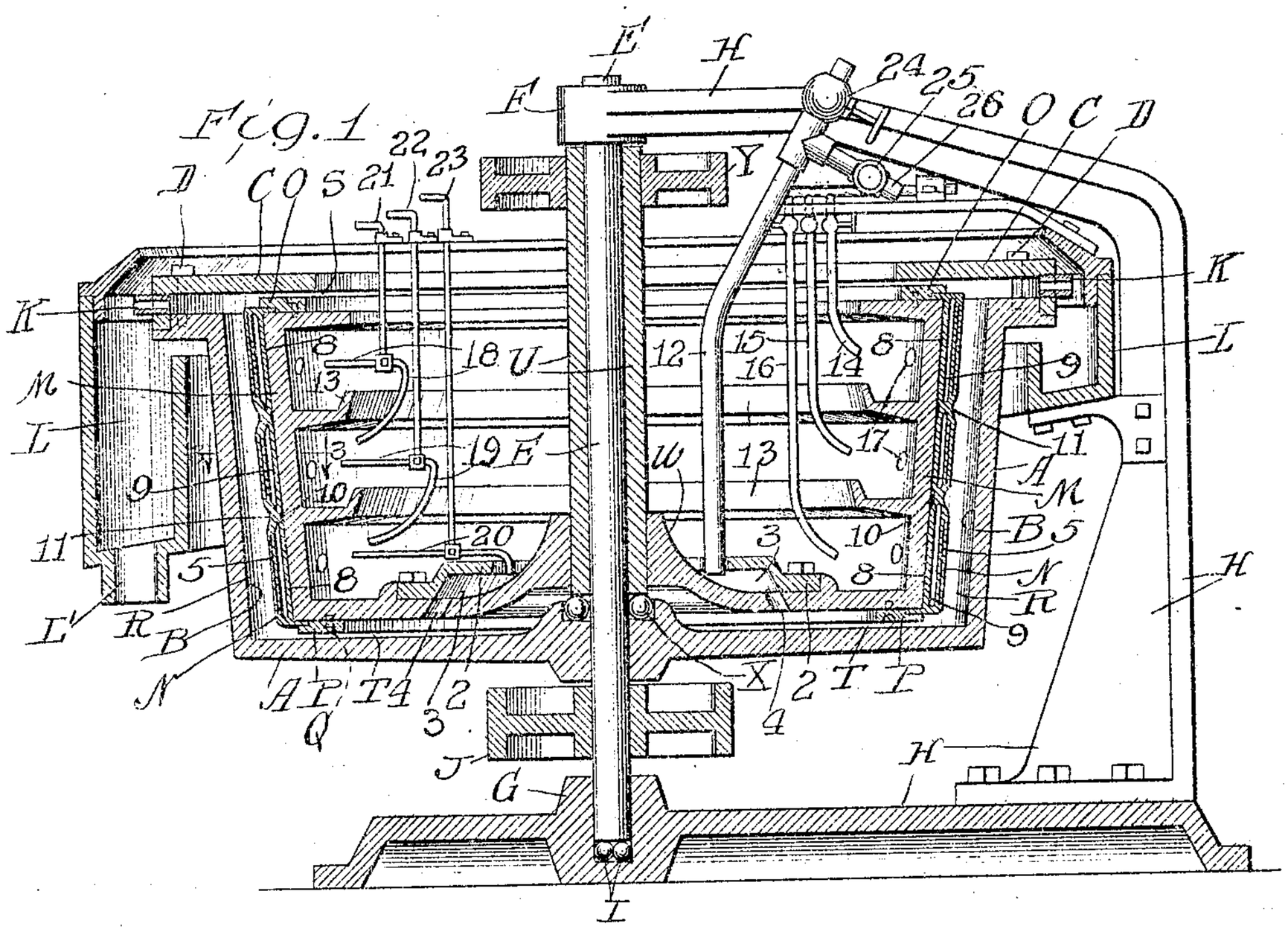


Fig. 2

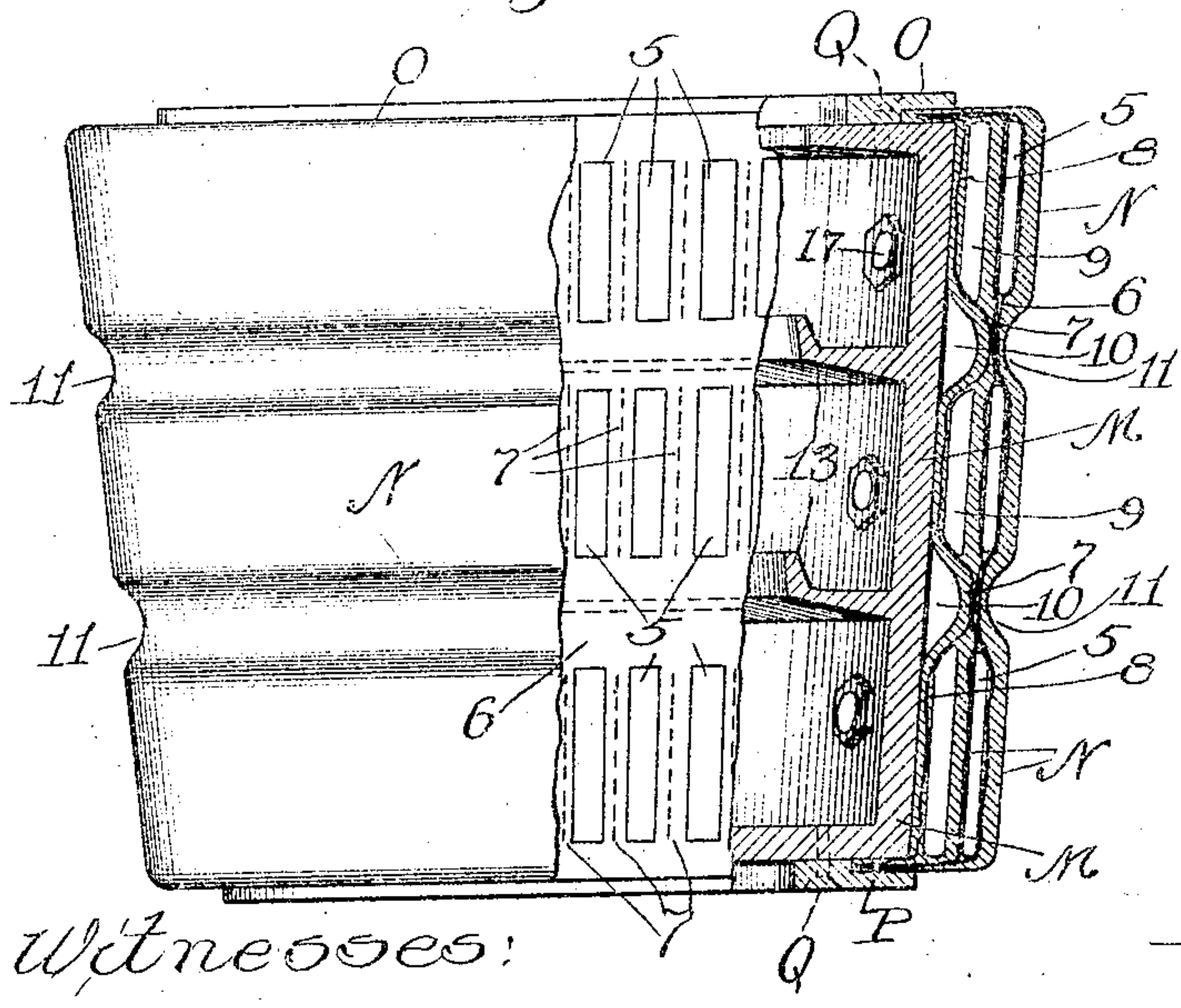
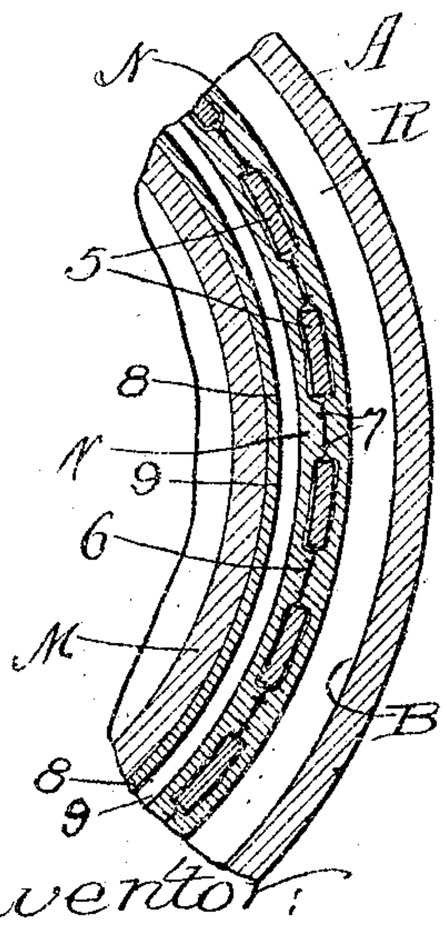


Fig. 3



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2 SHEETS—SHEET 2.

Fig. 4

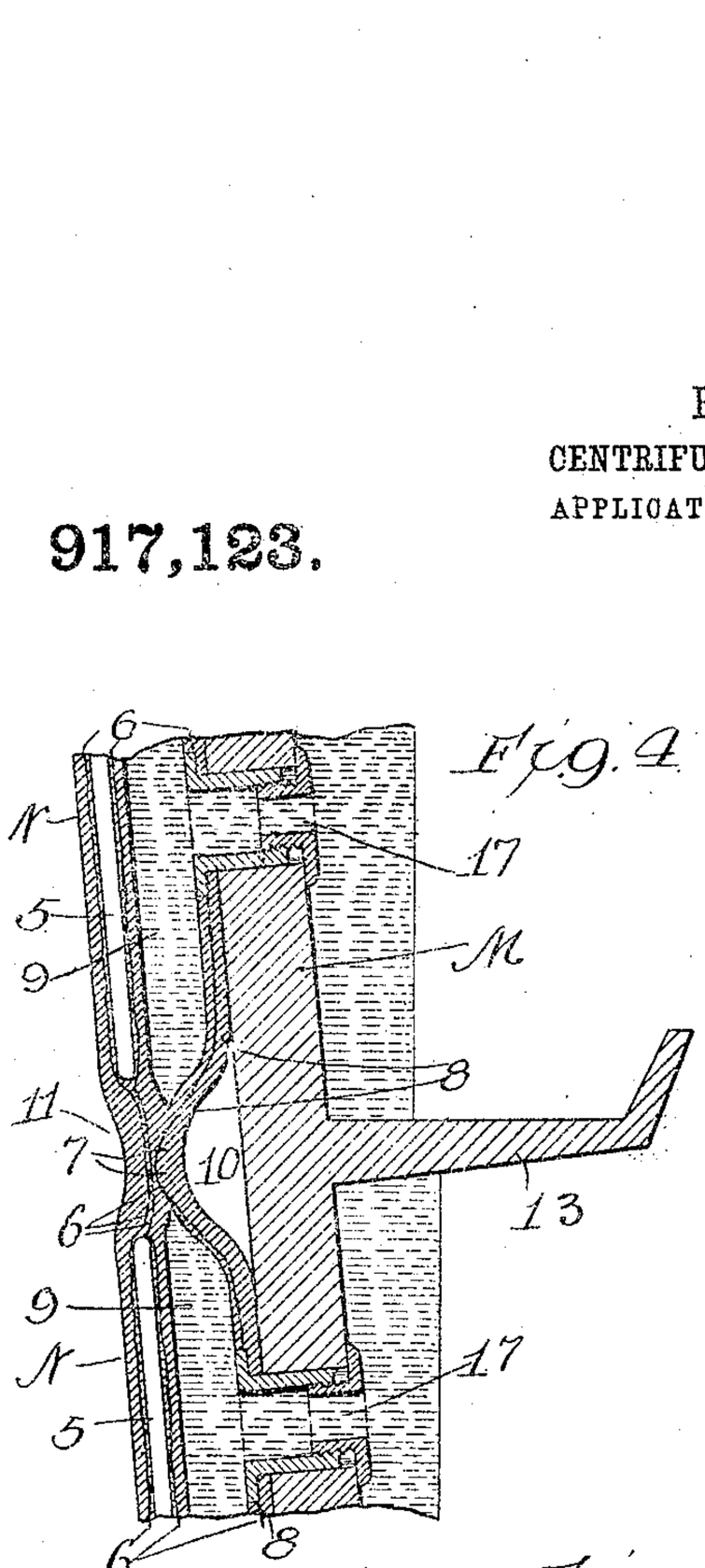


Fig. 5.

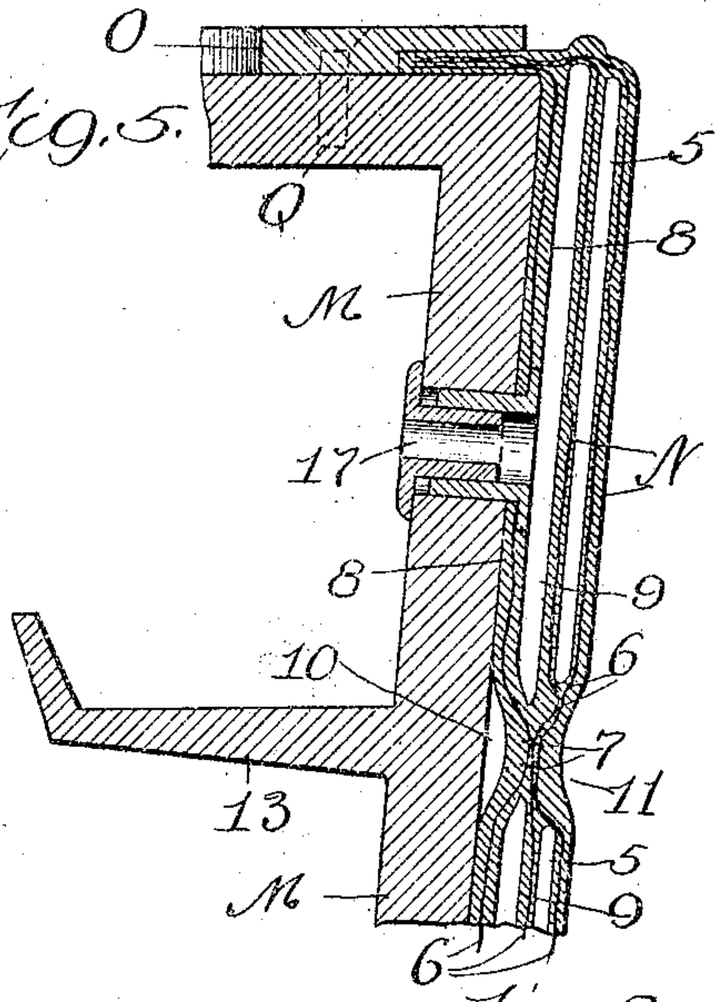


Fig. 6.

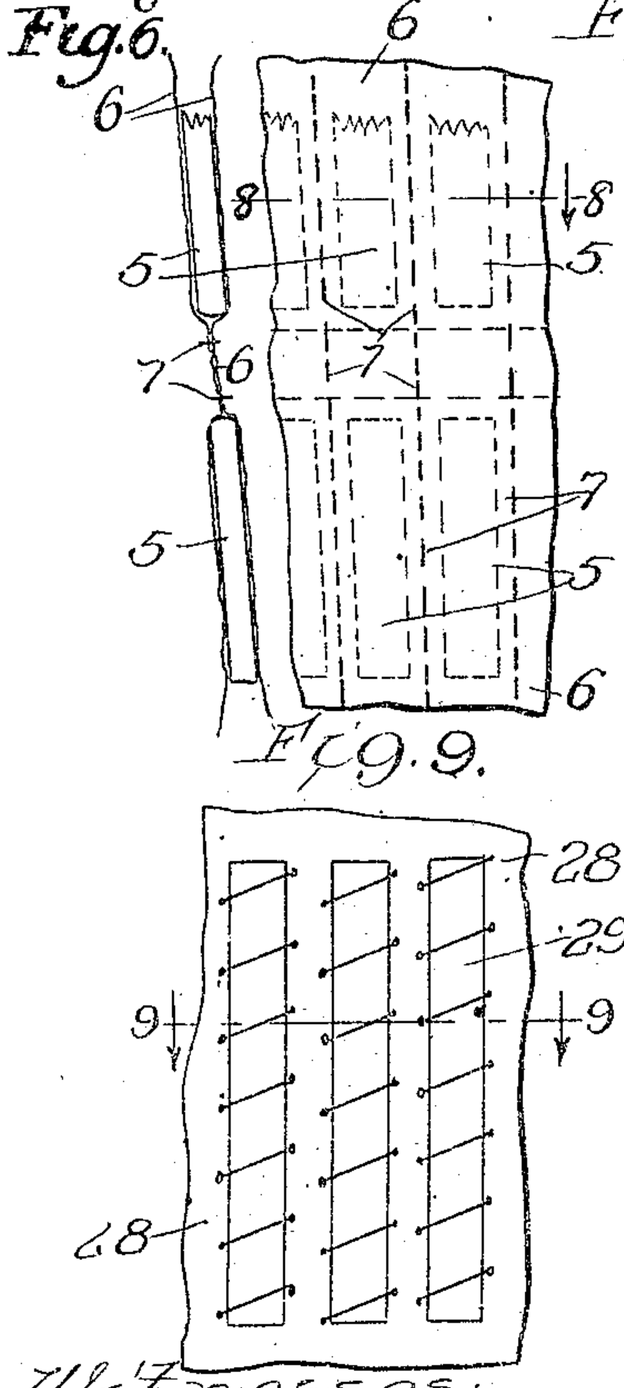


Fig. 7.

Fig. 8.

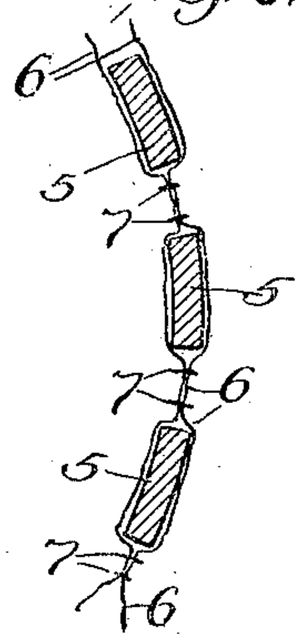


Fig. 9.

Fig. 11.

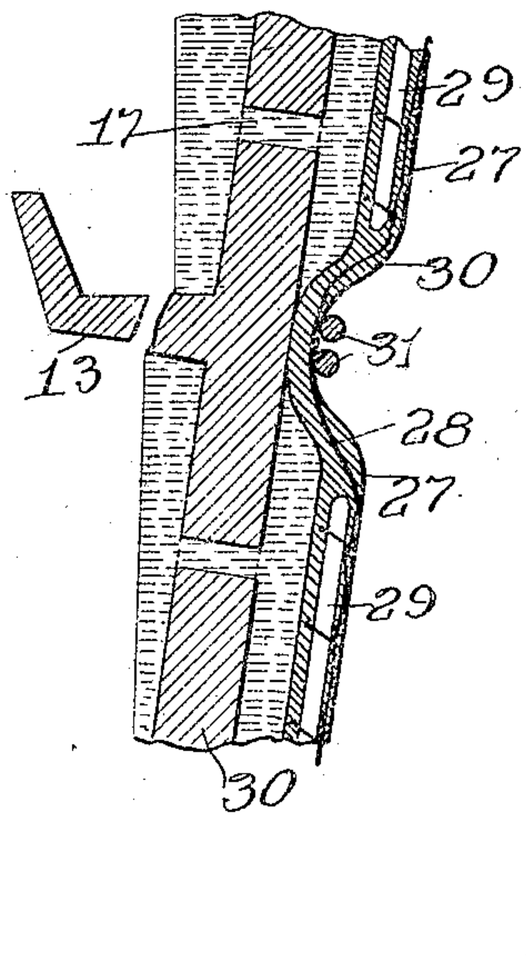
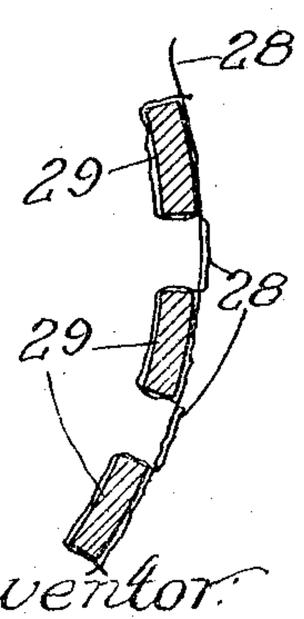


Fig. 10.



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UNITED STATES PATENT OFFICE.

PHILIP F. PECK, OF CHICAGO, ILLINOIS.

CENTRIFUGAL ORE-SEPARATOR.

No. 917,123. Specification of Letters Patent. Patented April 6, 1909.

Application filed October 3, 1908. Serial No. 456,060.

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 Ore-Separators, of which the following is a specification.

My invention relates to centrifugal ore separators of the general class described in my applications for United States Letters Patent, Serial No. 444,787, filed July 22, 1908, and Serial Nos. 453,526 and 453,527 respectively, both filed September 17, 1908, and the objects of my present invention are directed to improving the deflector member in combination with other parts, and especially to the expansible and contractible element of the separator.

In the drawings Figure 1 is mainly a vertical central cross section of my separator, also showing some parts in elevation. The left side of Fig. 2 is an elevation of a part of the outside of the expansible element removed from the separator. The central portion of this figure is a side view of a part of the expansible element with the outer layer of canvas and elastic covering removed, showing the reinforcing pieces in side elevation, and the right side of Fig. 2 illustrates a vertical cross section of the wall of the supporting part of the deflector and the expansible element, the latter in place on the former and in a state of expansion. Fig. 3 is an enlarged cross section of a part of Fig. 1, on line 3—3 of Fig. 1, looking in the direction of the arrows. Fig. 4 is an enlarged vertical cross section of a part of the wall of the deflector vessel and expansible element, similar to such parts illustrated in Fig. 1 with the expansible element shown in place on the deflector vessel, in a state of expansion with expansion liquid illustrated present in operating position. Fig. 5 is a section similar to Fig. 3, but showing the upper corner of the side of the deflector, with the expansible element in a state of nearly complete contraction. Fig. 6 shows a vertical fragmentary section of the canvas part of the wall of the expansible element and an elevation of the edge of part of the reinforcing means or strips, illustrating how the two are associated. Fig. 7 is a side elevation of a part of the wall of the expansible element with only the canvas and the reinforcing means; the latter indicated in dotted lines, and the former sewed together in the spaces between the latter. Fig. 8 is an enlarged cross section of Fig. 7 on line 8—8 of Fig. 7 looking in the direction of the arrow, and showing the ends or edges of the canvas loosely extended. Fig. 9 is a side elevation showing a portion of the canvas and reinforcing structure of the wall of the expansible element, somewhat modified. Fig. 10 is a cross section of Fig. 9, on line 10—10 of Fig. 9 looking in the direction of the arrows. Fig. 11 is a vertical cross section of a portion of the wall of the deflector, showing the modified structure of the expansible element,—the latter being of single, instead of multiple wall form, and being in a state of expansion with liquid illustrated present in operating position.

In making my improved centrifugal ore separator I provide a rotatable member or treatment vessel A, having a suitable separating surface B, on its inner wall, and preferably having its lower end closed, and its upper end contracted or partly closed by a flat ring C, secured to the vessel by suitable screw bolts D. The vessel A, is securely and concentrically mounted on a vertical rotatable shaft E, which is supported in journal boxes F and G, respectively, connected to a general frame H. The shaft is stepped at its lower end on an anti-friction bearing I, to support its weight and is provided with a belt pulley J, by which it may be rotated with a suitable belt (not shown) from any desired source of motive power.

Around the circumference of the ring C, at the top of the treatment vessel, is provided a row of hollow discharge plugs K, through which material and liquid may be discharged from the treatment vessel during operation. I also surround the treatment vessel with a launder L, having an annular opening in alinement with the discharge plugs K, adapted to catch the material and liquid discharged through these plugs.

Within the treatment vessel A, which is adapted to contain a body of liquid while in operation, I provide a deflector member to operate in conjunction with the treatment vessel and separating surface in effecting separation. This deflector embodies a supporting element M, which may also be in the form of a vessel and may be termed a deflector vessel, and around the deflector vessel I provide an expansible and contractible

element N, as a covering or jacket, to be secured to and supported by the deflector vessel. I have formed and illustrated the expansible element with its ends extended and flanged in toward the axis a sufficient distance to pass under rings O and P, respectively, which are clamped or securely held down over these flanged ends, by suitable screws Q, engaging the ends of the deflector vessel. The expansible element is preferably made of the form of the outer circumferential surface of the deflector vessel, and of size to fit closely over it,—this vessel serving as its supporting means or element. The deflector vessel and the expansible element are made somewhat smaller in diameter than the interior of the treatment vessel A, leaving a separating passage R, of desired size between the separating surface and the exterior of the expansible element. The deflector vessel is also made somewhat shorter than the depth of the treatment vessel, to permit of a clearance space S, between the top of the deflector vessel and the under side of the ring C, as well as a comparatively small space T, between the bottom of the deflector vessel and bottom of the treatment vessel.

Around the shaft E, I rotatably journal a substantial sleeve U, of sufficient length and suitable proportions to extend from near the hub in the bottom of the treatment vessel A, to a point somewhat above the top of this vessel, and by means of the hub W, in the deflector vessel, I rigidly secure the deflector vessel to the lower end portion of the sleeve U, and between the lower end of this sleeve and the upper end of the hub in the vessel A, I interpose preferably an anti-friction bearing upon which the sleeve carrying the deflector vessel and expansible element may be rotated differentially to the treatment vessel and separating surface.

At the upper end of the sleeve U, I provide a belt pulley Y, by which rotation may be imparted to the sleeve and the parts driven by it.

In the bottom of the deflector vessel surrounding its hub W, I provide a suitably shaped ring 2 forming a feed chamber 3, into which material for separation with liquid may be fed during operation. From the feed chamber extending down through the bottom of the deflector vessel I have provided a number of holes or passages 4, for the flow of the liquid and material from the feed chamber into the space T, *en route* to the separating passage for travel over the separating surface.

It is important that the exterior circumferential surface of the expansible element during operation, should conform to the contour of the separating surface without arching or bulging in a direction transverse to the course of its rotation, so as not to plow or gouge the bedding concentrates from the separating surface, and in order to here best assist effecting separation of the material under treatment.

In the formation or structure of the expansible element I provide stiff or rigid reinforcing means preferably in the form of metal strips 5, for preventing any damaging material arching or bulging of the expansible element in a direction transverse to the course of rotation, and yet to enable a substantial desired circumferential uniform and yieldable expansion, without material longitudinal extension within the zones of the reinforcing strips. To further this end, I employ a yieldable binder means or material to tie, hold or bind the reinforcing means together, and for this purpose I have used layers of canvas 6, of suitable weight and strength, to subserve the purposes desired, and I prefer to place or dispose one or more layers of the canvas within the zone of the reinforcing strips or means on each side of the said reinforcing strips, laying the strips substantially parallel to the axis of rotation, spacing them a desired distance apart, and to sew, or otherwise secure the layers of canvas together within the zones of the reinforcing means, preferably between the reinforcing strips as indicated by the dotted lines 7. I then preferably cover the canvas with rubber as hereinafter explained. It is intended to provide these reinforcing strips, which are preferably of metal, of sufficient stiffness and with sufficient frequency in the expansible element to necessitate the canvas and rubber of this element to be forced out while under expansion in a substantially straight and even manner without arching or bulging in a direction transverse to the course of rotation. I also prefer not have these strips extend in a single piece the entire length of the expansible element, as it may be advantageous to expand one circumferential area or section of this element, to a somewhat greater degree than other sections, and I therefore provide these reinforcing strips in several appropriate lengths to form different circumferential areas, zones or sections of the element N, as illustrated, which may be expanded in relatively varying degrees.

In Figs. 6, 7, and 8, of the drawings I have illustrated some of the reinforcing strips in place sewed in the canvas 6,—a layer of canvas being placed on opposite sides of the strips and then the two layers being sewed together longitudinally between the reinforcing strips, which is my preferable form of association and connection of these parts. I then prefer to vulcanize a layer of comparatively soft rubber or other sufficiently elastic suitable substance over and through the layers of canvas, to build up a smooth even surface, as especially illustrated in part of Fig. 2 and in Fig. 3.

In Figs. 6 and 7, the reinforcing strips are not illustrated as of full length, but are shown as having their relatively opposite ends broken away. In these figures, part of the edges of the canvas is shown loosely extended. In Fig. 8, I have illustrated in cross section this form of association of the canvas and reinforcing strips.

In the drawings I have shown the expansible member with a back or inside wall 8, making this element with double or multiple walls, having a liquid expansion chamber 9, between them. In Figs. 2, 3 and 4 the expansion element N is shown in a state of complete expansion.

In Fig. 4 expansion liquid is shown in place in the deflector vessel and expansion chambers. In Figs. 1, and 5, the expansible element is illustrated in a state of contraction.

As is illustrated, the back or inner wall of the expansible element has no reinforcing means,—it being adapted to rest against the exterior wall of the deflector vessel and this inner wall of the expansible element is secured to the outer wall, preferably by sewing the two together circumferentially between the ends or zones of the reinforcing strips as shown, so that during a state of expansion, which distends or inflates the expansion chambers 9, and carries the outer wall outward, it will occur that adjacent to where the two walls are sewed together, the inner wall will yield and be drawn or stretched somewhat outward from its position to contact with the supporting element, as especially shown in Figs. 2, and 4 at initial numeral 10, thereby partly compensating for the stretching at 11, of the outer wall which would otherwise be greatly augmented. This structure is further important as by the inner wall yielding and stretching as shown to accommodate expansion of the outer wall, lessening the depth of the grooves or depressions on the outer surface consequent to such expansion, there will be provided the more desirable and effective operating frictional surface for the expansible element.

In operation, it is intended that my separator be alternately adjusted to separate and accumulate a bed or load of concentrates, and then discharge them, and to this purpose the treatment vessel A, is first rotated at the desired rate of speed and the deflector member at a sufficiently different speed to best aid in effecting separation, and material for separation in a desired dilute state with liquid (preferably water) is introduced from a suitable source of supply by a feed pipe 12, into the feed chamber 3, thence passing, actuated by centrifugal force through the holes 4, and into the separating passage R.

While traveling through the separating passage the heavier portions, or concentrates, which it is desired to save, by reason of proper relative adjustment of operating parts, are separated and permitted to lodge or bed on the separating surface while the lighter portion or waste, is driven or move on over the separating surface and to discharge through the plugs K, and into the launder L, from whence it passes to final discharge through the opening L′. During operation a sufficient quantity of liquid should be introduced to keep the separating passage filled, thereby keeping the separating surface fully submerged.

At the beginning of the operation, expansion liquid is introduced into the deflector vessel which vessel is divided into compartments by the internal ring partitions 13, by means of pipes 14, 15 and 16 respectively, and thence, actuated by centrifugal force part of this liquid is driven through the openings 17, in the wall of the deflector vessel, into the chambers 9, of the expansible element, thereby exerting yieldable expanding pressure and effecting yieldable expansion of said element to the extent desired for reducing the separating passage to its minimum desired size for effecting separation at this time. As the operation proceeds and the heavier material beds in the separating passage, contracting this passage, the pressure of the liquid in this contracting passage forces the expansion element to become compressed or contracted, creating additional space in the separating passage to accommodate the accumulating bed of concentrates.

If desired, and it is advantageous during this loading period, liquid may be removed from the deflector vessel to lessen the expanding pressure on the element N, by use of the scoop pipes 18, 19, and 20, which have their open scooping ends movable against the surface of the revolving body of expansion liquid in the deflector vessel, through the instrumentality of their slightly rotatable supporting rods, 21, 22 and 23 respectively, which rods have their upper ends crooked to serve as handles for their manipulation. This separating or loading operation continues until the separating passage has become sufficiently filled with bedded concentrates and the element N, has become contracted substantially to its minimum size. Then the feed of material for separation is temporarily discontinued by closing the valve 24, in the feed pipe, and the valve 25, is then opened in the branch pipe 26, furnishing clean liquid from a suitable source of clean liquid supply, to the feed pipe 12,—the clean liquid then introduced instead of the feed of material, passes up through the separating passage in increased quantities, and at the same time the speed of rotation of the treatment vessel is temporarily lessened, enabling the bedded concentrates to be more easily dislodged, and the quantity of expan-

sion liquid is increased in the deflector vessel, thereby increasing the intensity of washing friction of the expansible element, which several changed conditions of operation serve to quickly dislodge and discharge the accumulated bed or load of concentrates, leaving the separator free from concentrates, ready for separating conditions to be restored and the operation to be repeated.

While I have shown and described my expansible element as embodying the reinforcing means sewed between layers of canvas, I do not wish to confine myself to this specific material or form of association or structure, as canvas pockets for insertion of the reinforcing strips may be woven in the canvas during its manufacture, or if desired the strips may be sewed or otherwise suitably secured to a single layer of canvas, or in place of the canvas any other fibrous flexible material that will subserve the purposes required, may be employed, and the form of reinforcing means may be varied.

In Figs. 9, 10 and 11 I have illustrated somewhat of a modification in structure of my expansible element, which in these figures I have indicated by the numeral 27. Fig. 9 shows a part of the canvas 28, forming the wall of the modification, with the reinforcing strips 29, on it, held to place by sewing over the reinforcing strip, there being canvas only on one side of the strips. Fig. 10 is a cross section, also showing the structure like Fig. 9, and Fig. 11 shows this structure of wall complete with rubber on its sides and in a state of expansion, in place on a portion of the deflector vessel wall 30, there being expanding liquid present. This modification shows a single, instead of a double or multiple wall to the expansible element, which is secured in place on the deflector vessel by strands of wire 31.

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

1. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, and yieldable fibrous material disposed within the zone of the said reinforcing means,—the two combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to automatically yield to relatively varying pressure of said forces and means for subjecting the expansible element to said yieldable expansion and compression forces, substantially as described.

2. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, being multiple strips or bars, yieldable fibrous material disposed within the zone of said strips or bars and elastic substance,—the three combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to automatically yield to relatively varying pressure of said forces and means at the same time for subjecting the expansible element to the said forces, substantially as described.

3. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, being multiple strips or bars, yieldable fibrous material disposed on opposite sides of said strips or bars, and elastic substance,—the three combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to automatically yield to relatively varying pressure of said forces and means at the same time for subjecting the expansible element to the said yieldable forces, substantially as described.

4. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, being multiple strips or bars, yieldable fibrous material disposed on opposite sides of said strips or bars and secured together between them, and elastic substance,—the three combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to yield to relatively varying pressure of said forces, substantially as described.

5. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, and

yieldable fibrous fabric disposed within the zones of the reinforcing means and on opposite sides of said means,—the two combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to automatically yield to relatively varying pressure of said forces and means for subjecting the expansible element to the said yieldable forces, substantially as described.

6. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, being multiple strips or bars, canvas disposed within the zone of said strips or bars and elastic substance,—the three combined and coöperating in formation of the said element, adapted to operate between automatically yieldably expanding and compressing forces and to yield to relatively varying pressure of said forces and means for subjecting the expansible element to the said yieldable forces, substantially as described.

7. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, being multiple strips or bars lying transverse to the course of rotation, yieldable fibrous fabric disposed within the zone of said reinforcing means and on opposite sides of said strips or bars and secured together between them,—the two combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to automatically yield to relatively varying pressure of said forces and means for subjecting the expansible element to the said yieldable forces, substantially as described.

8. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means disposed in multiple zones or areas with spaces between the zones, yieldable fibrous material disposed within said zones, and elastic substance,—the three combined and coöperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces, and to automatically yield to relatively varying pressure of said forces and means for subjecting the expansible element to the said yieldable forces, substantially as described.

9. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, yieldable fibrous material and elastic substance,—the three combined and coöperating in formation of the outer wall of said element, adapted to operate between yieldably expanding and compressing forces and to yield to relatively varying pressure of said forces, said element provided with an inner wall,—the two being anchored together at intervals and the inner wall at such anchorage being yieldable to expansion of the outer wall, substantially as described.

10. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means disposed in multiple zones or areas with spaces between said zones, yieldable fibrous material and elastic substance,—the three combined and coöperating in formation of the outer wall of said element, adapted to operate between yieldably expanding and compressing forces, and to yield to relatively varying pressure of said forces, said element provided with an inner wall, the two walls being anchored together between the reinforced zones, and the inner wall being yieldable at the anchorage to expansion of the outer wall, substantially as described.

11. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, yieldable fibrous material and elastic substance,—the three combined and coöperating in formation of the said element adapted to operate between an expansion body of liquid under pressure and a compression body of liquid under pressure and to yield to the relatively varying pressure of said bodies of liquid.

12. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating

passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means, yieldable fibrous material disposed within the zone of the reinforcing means and elastic substance,—the three combined and cooperating in formation of the said element, adapted to operate between yieldably expanding and compressing forces and to automatically yield to relatively varying pressure of said forces, the said reinforcing means adapted to prevent materials arching or bulging in a direction transverse to the course of rotation, substantially as described.

13. In a centrifugal separator, the combination of a rotatable member having a separating surface, a member differentially rotatable thereto in part forming with said first member a separating passage, the second member embodying an element in proximity to the separating surface, adapted to be expanded by liquid pressure, comprising comparatively non-elastic reinforcing means, yieldable fibrous material disposed within the zone of the reinforcing means and elastic substance, the three combined and coöperating in formation of said element, and means adapted to supply liquid for effecting said expanding pressure, substantially as described.

14. In a centrifugal separator, the combination of a rotatable member having a separating surface, a member differentially rotatable thereto in part forming with said first member a separating passage, the second member embodying an element in proximity to the separating surface, adapted to be expanded by liquid pressure, comprising comparatively non-elastic reinforcing means, being multiple strips or bars adapted to prevent material arching transverse to the course of rotation, yieldable fibrous material disposed within the zone of the said strips or bars and secured together between them and elastic substance, the three combined and coöperating in formation of said element, and means adapted to supply liquid for effecting said expanding pressure, substantially as described.

15. In a centrifugal separator, the combination of a rotatable member having a separating surface, a member differentially rotatable thereto in part forming with said first member a separating passage, the second member embodying an element in proximity to the separating surface adapted to be expanded by liquid pressure, comprising comparatively non-elastic reinforcing means, being multiple strips or bars lying transverse to the course of rotation, yieldable fibrous material disposed within the zone and on opposite sides of said strips or bars and secured together between them, and elastic substance, the three combined and coöperating in formation of said element, and means adapted to supply liquid for effecting said expanding pressure, substantially as described.

16. In a centrifugal separator, the combination of a rotatable member forming one wall of a separating passage, and a member differentially rotatable thereto in part forming the separating passage which is adapted to contain a body of liquid while in operation, the second member embodying an element having walls with multiple layers having an expansion liquid chamber interposed between them, said layers being anchored together at intervals and the outer layer adapted to be expanded by liquid pressure, and to be periodically contracted by pressure of liquid in the separating passage, and the inner layer adapted to stretch to expansion of the outer layer, substantially as described.

17. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means and yieldable fibrous binder means, the latter disposed within the zone of the reinforcing means and on opposite sides of the reinforcing means and secured together within the zone of the reinforcing means,—the two combined and coöperating in formation of said expansible element, adapted to operate between yieldably expanding and compressing forces and to yield to relatively varying pressure of said forces, substantially as described.

18. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element, comprising comparatively non-elastic reinforcing means and yieldable fibrous binder means disposed within the zone of the reinforcing means,—the two combined and coöperating in formation of the said element adapted to operate between an expansion body of liquid and a compression body of liquid and to automatically yield to relatively varying pressure of said bodies of liquid, substantially as described.

19. In the combination of a centrifugal ore separator having a rotatable treatment member with a separating surface, a differentially rotatable member, in part forming with the treatment member a separating passage, and embodying an expansible and contractible element comprising comparatively non-elastic reinforcing means and yieldable

fibrous binding means disposed within the zones of and on opposite sides of said reinforcing means and secured together within the zone of said reinforcing means, the expansible element being adapted to operate between yieldably expanding and compressing forces and to yield to relatively varying pressure of said forces, and means for subjecting the expansible element to said yieldable expansion and compression forces, substantially as described.

PHILIP F. PECK.

Witnesses:
M. PECK,
W. H. PECK.