(No Model.) 4 Sheets—Sheet 1.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

No. 560,635. Patented May 19, 1896.

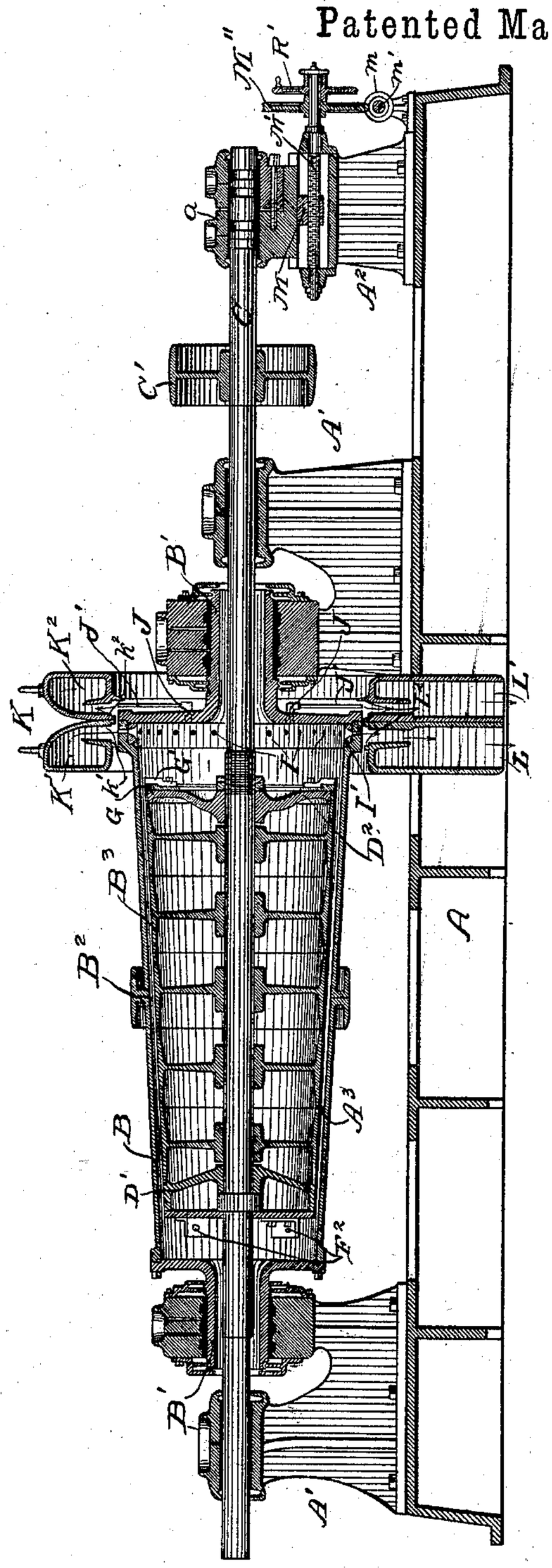

Fig. 1.

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Orrin B. Peck

(No Model.) 4 Sheets—Sheet 2.

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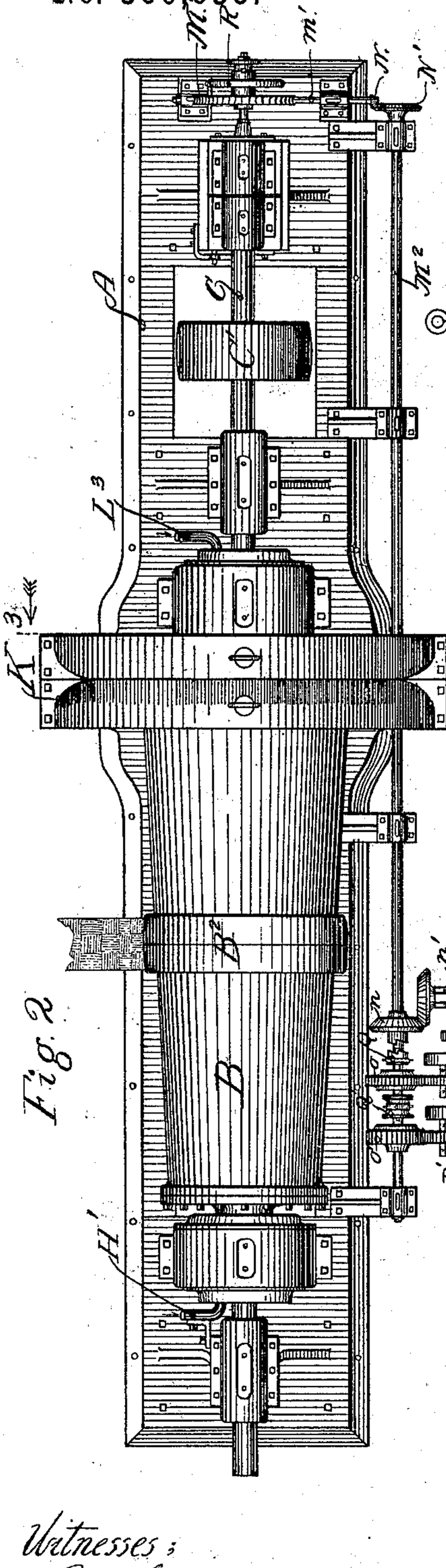

Fig. 2.

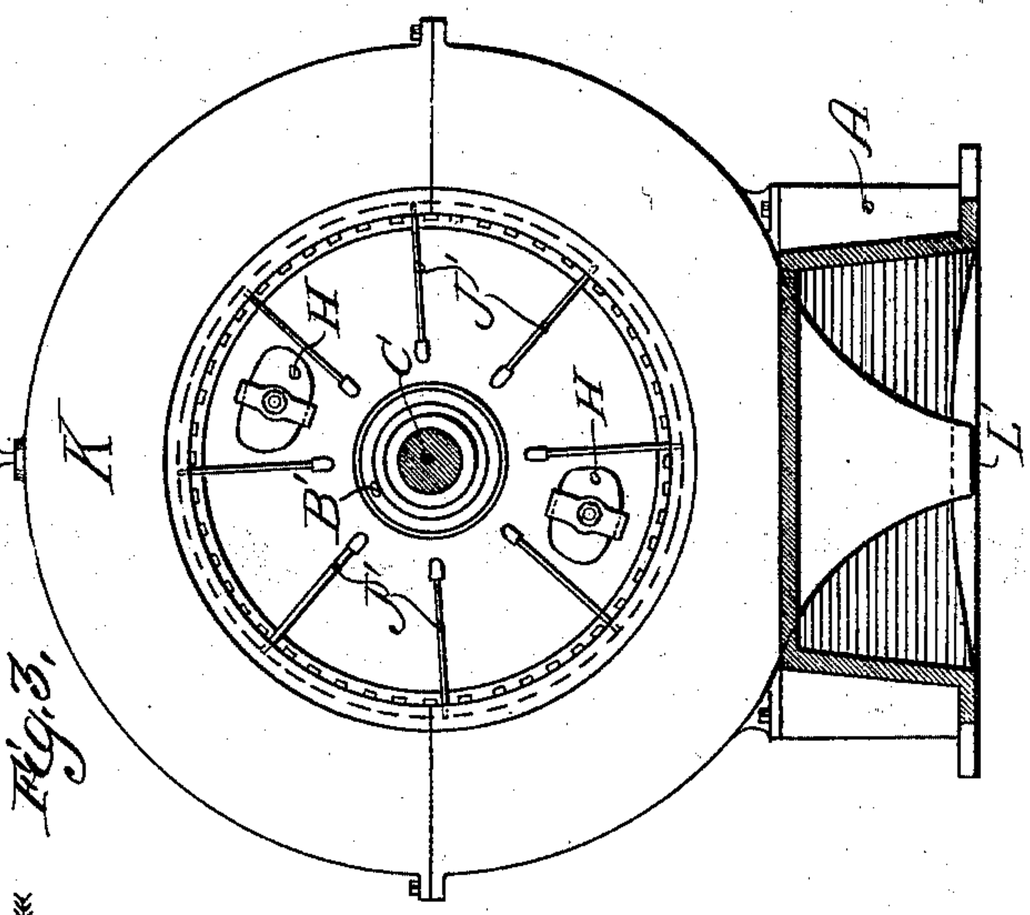

Fig. 3.

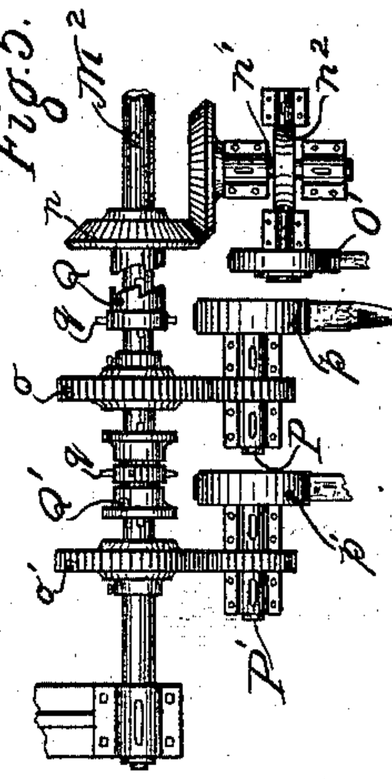

Fig. 5.

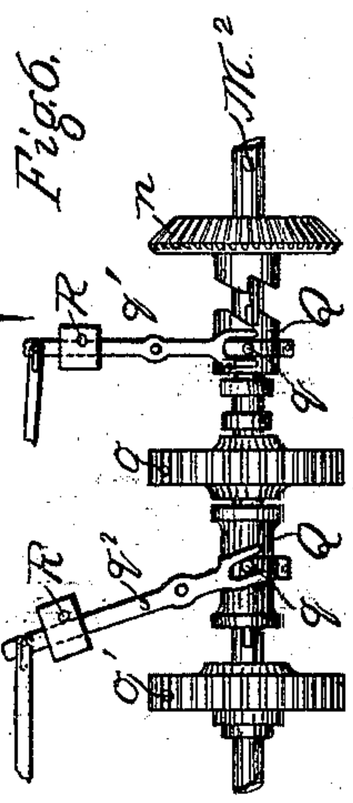

Fig. 6.

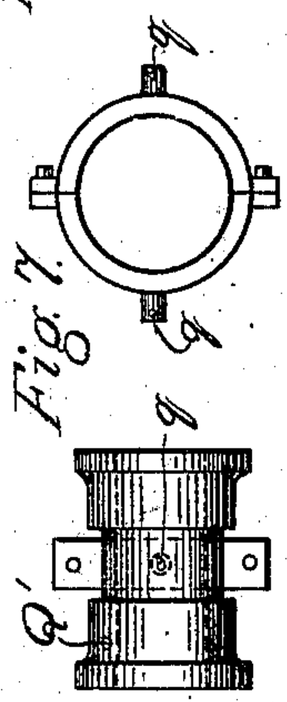

Fig. 7.

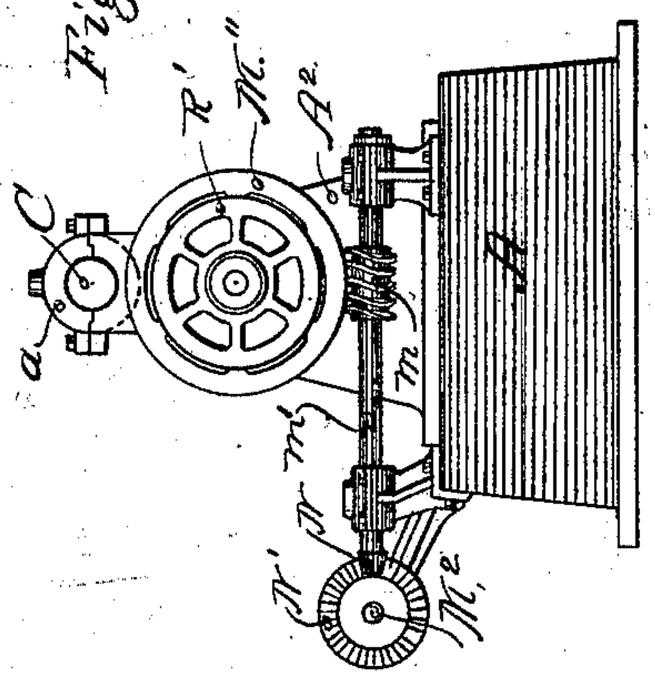

Fig. 4.

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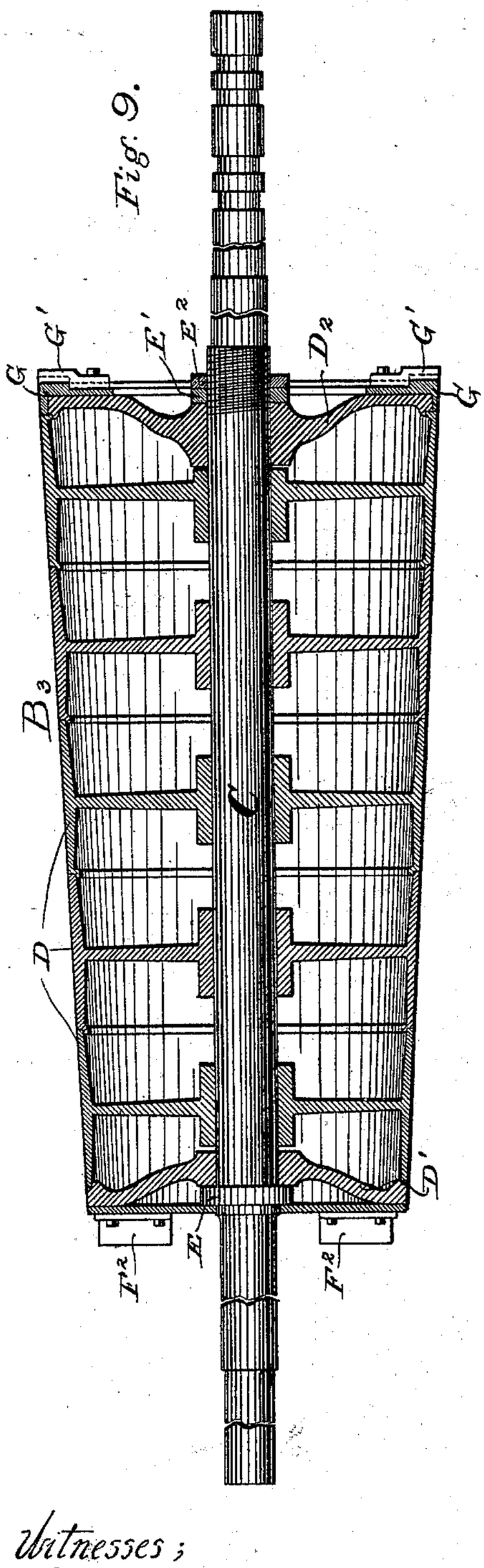

Fig. 9.

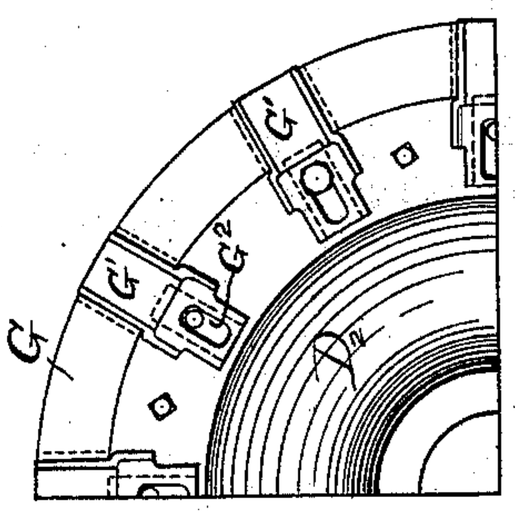

Fig. 12.

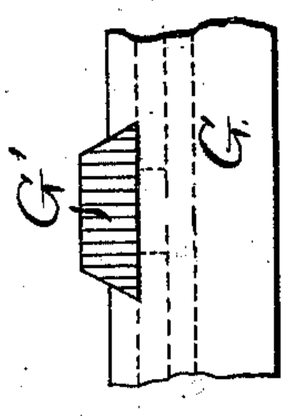

Fig. 11.

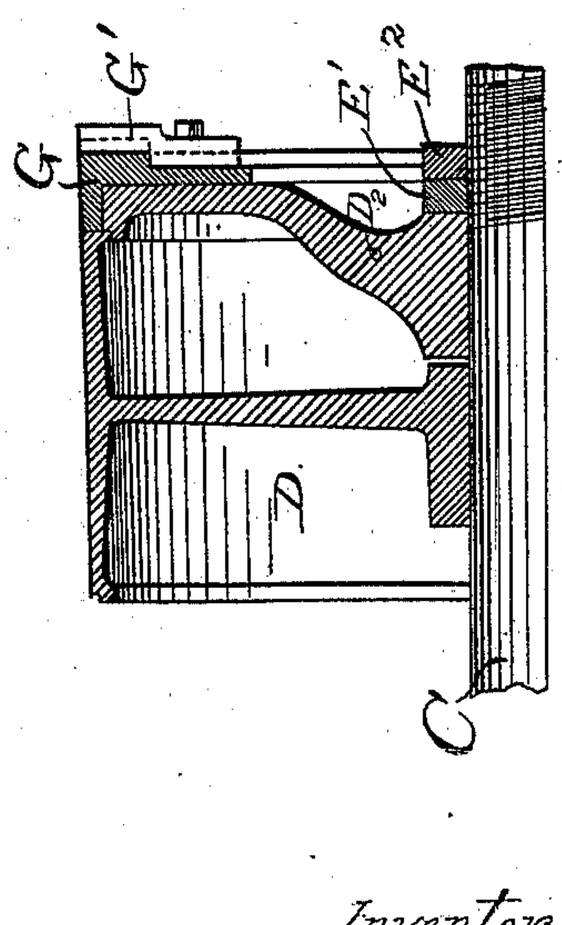

Fig. 10.

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(No Model.) 4 Sheets—Sheet 4.

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CENTRIFUGAL SEPARATOR.

No. 560,635. Patented May 19, 1896.

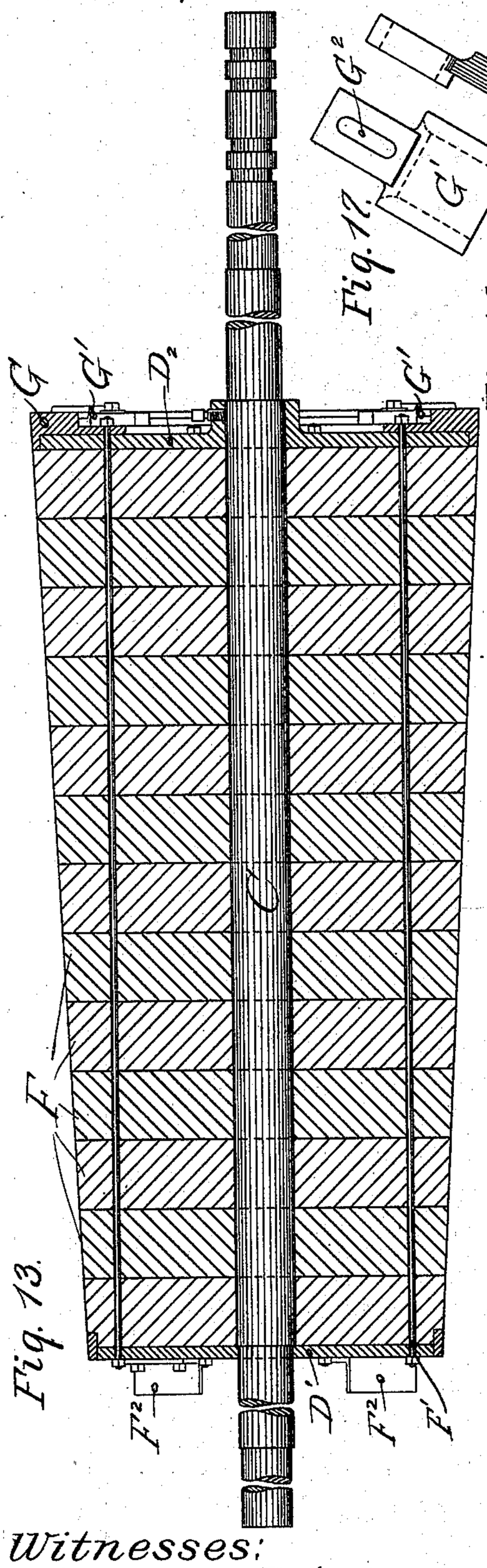

Fig. 13.

Fig. 17. Fig. 18.

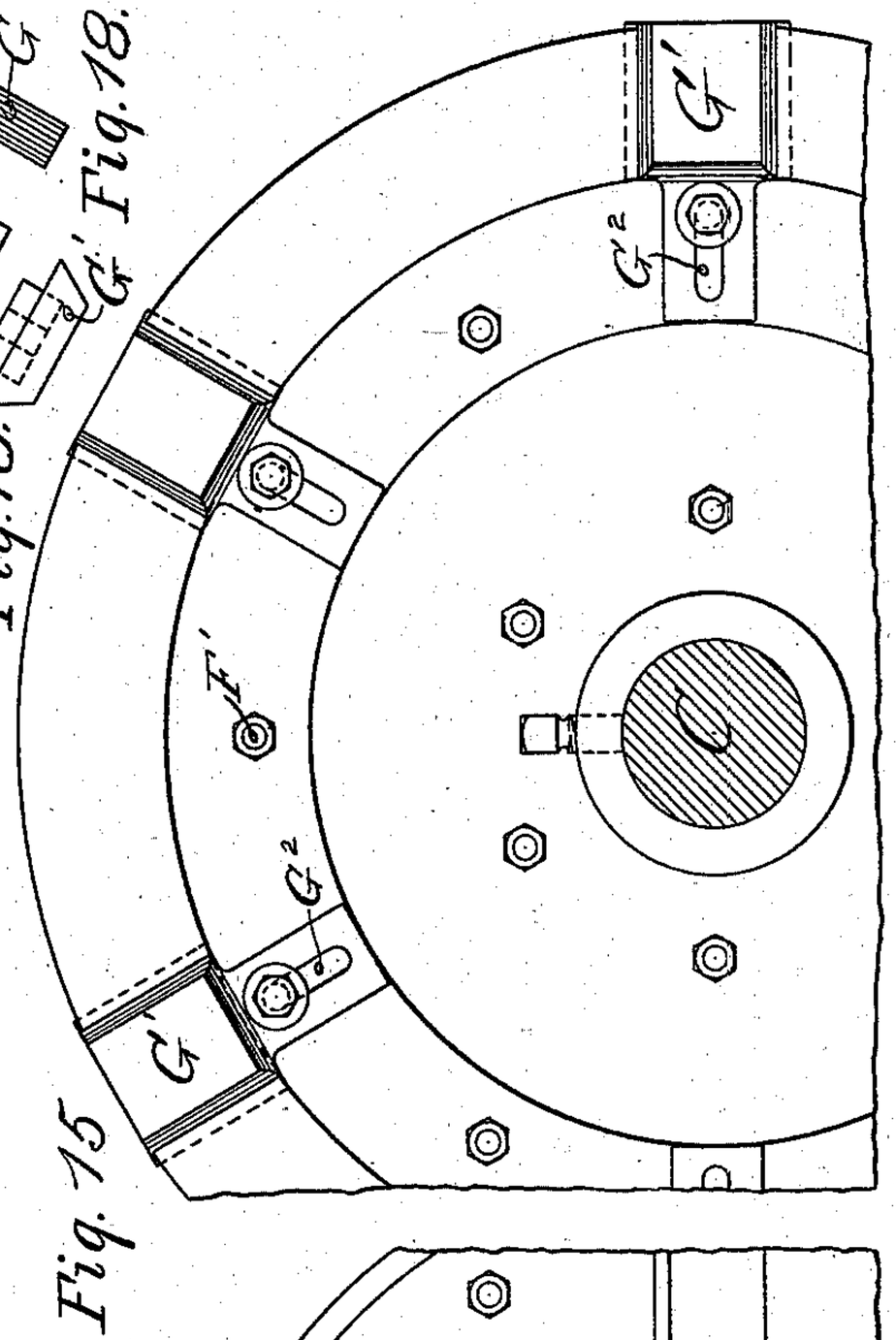

Fig. 16. Fig. 15

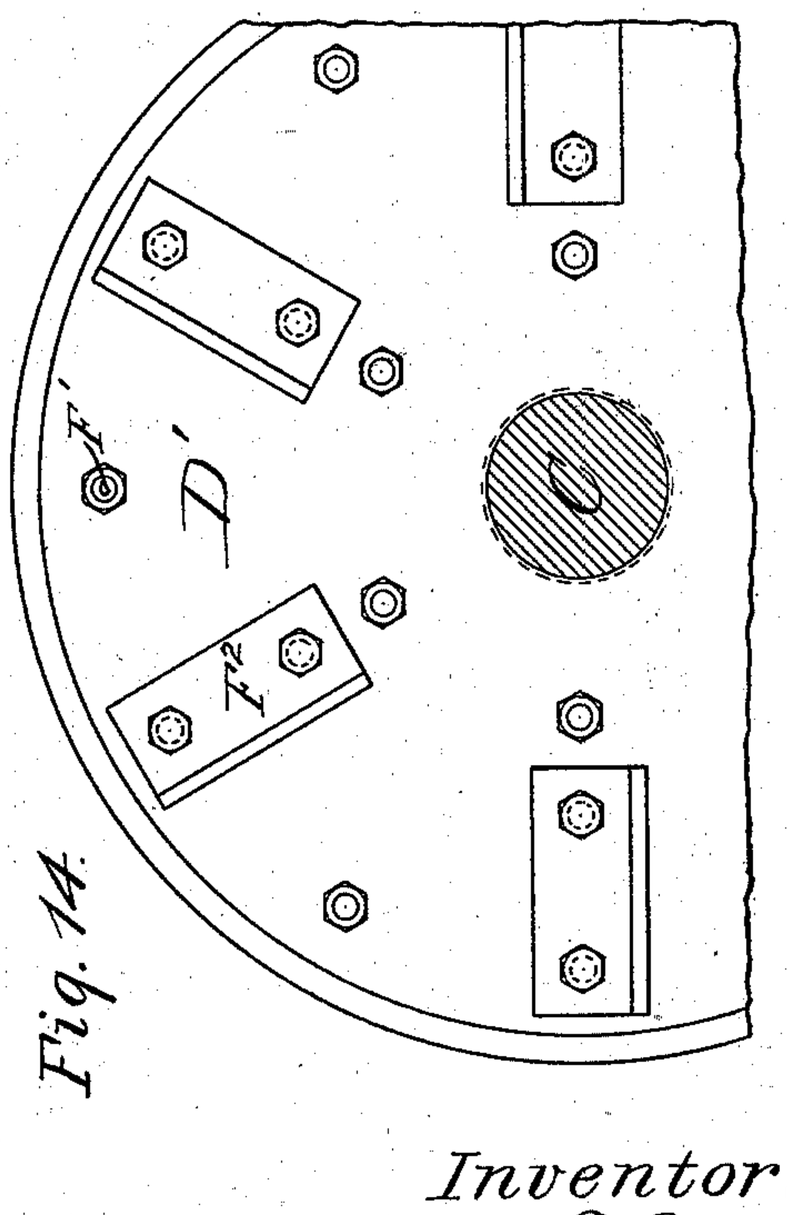

Fig. 14.

Witnesses:
Charles E. Tetley
D. C. Mann.

Inventor:
Orrin B. Peck

UNITED STATES PATENT OFFICE.

ORRIN B. PECK, OF CHICAGO, ILLINOIS.

CENTRIFUGAL SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 560,635, dated May 19, 1896.

Application filed July 1, 1895. Serial No. 554,675. (No model.)

To all whom it may concern:

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

My invention relates more particularly to improvements in centrifugal separators for ore, and has for its object various improvements in the construction of the machine, hereinafter more particularly described and claimed.

In the drawings accompanying this specification, Figure 1 is a central vertical longitudinal section through the center of the treatment vessel of my improved separator. Fig. 2 is a top plan view of the entire machine. Fig. 3 is a transverse section on the line 3 of Fig. 2. Fig. 4 is an elevation of the right-hand end of the machine, parts being omitted. Fig. 5 is an enlarged top plan view of a part of the gearing for longitudinally moving the deflector. Fig. 6 is a detail showing a partial elevation thereof. Figs. 7 and 8 are detail views, in plan and end elevation, respectively, of the friction-clutch member Q'. Fig. 9 is a central longitudinal section through the deflector. Fig. 10 is a sectional detail showing a portion of one end thereof somewhat enlarged. Fig. 11 is a detail plan view of one of the wearing-plates G'. Fig. 12 is a partial end elevation of the right-hand end of the deflector. Fig. 13 is a central longitudinal section of a modified form of deflector. Fig. 14 is a partial elevation of the left-hand end thereof. Fig. 15 is a partial elevation of the opposite end, and Figs. 16, 17, and 18 are detail views of one of the wearing-plates. All sections are taken in the direction indicated by the arrows.

Similar letters refer to like parts throughout the several views of the drawings.

A designates a base-plate upon which are secured standards A' A', supporting a treatment vessel or cylinder B, preferably of conical form and having integral with or secured to its opposite ends or heads hollow trunnions B' B', journaled in boxes in said standards. This treatment vessel is provided with a separating-surface A^3, and upon the exterior of said vessel is a belt surface or pulley B^2, by which it is rotated by a belt driven from any suitable source of power.

Within the treatment vessel is a deflector or cylinder B^3, having, preferably, the same conical taper as the former and forming therewith an intermediate channel or passage. It is supported upon a shaft C, extending through the trunnions B' B' and journaled in boxes in the standards A' A', and also in a third box *a* in a standard A^2. Upon this shaft is a pulley C', belted to a suitable counter-shaft, by which the deflector is driven at a different speed from the treatment vessel, preferably slower. The surface friction of the deflector with the body of liquid in the channel will generate annular currents over the separating-surface substantially in the path of rotation, which subserve a purpose hereinafter described.

The deflector may be composed of a series of metallic sections or drums D, their edges so contacting as to form a continuous external surface gradually varying in diameter and having at the opposite ends heads D' D^2. The head D' abuts against an annular enlargement or ring E upon the shaft C, and outside the head D^2 is a ring E', having an internal thread moving upon a thread on the shaft. By screwing this ring against the head the sections may be forced closely together. A second threaded ring or lock-nut E^2 secures E' against movement.

In the modified form of deflector shown in Fig. 13 instead of metallic drums wooden sections or rings F are used. These are held together between plates or heads D' D^2, the former of which abuts against a shoulder on the shaft and the latter may be secured thereto by a set-screw passing through its hub. In holes extending through the sections are tension-rods F', having nuts upon their threaded ends, which bear upon the heads and enable the sections to be drawn into close contact. This sectional construction permits the deflector to be more easily made and the parts to be readily renewed.

On a flat annular plate fastened to the head D' of the deflector are secured a number of projecting plates or wings F^2, extending toward the feed end of the treatment vessel, which serve in their rotation to quickly start in motion the liquid and material passing

into the separator, and at the same time produce an outward current which forces it through the channel or passage. On the opposite head D^2 is fastened a ring G, upon which are a number of wearing-plates G′, provided with an inwardly-extending portion through which is a slot G^2, and through these slots pass bolts to secure them to the ring. A shoulder between the plate and its extension abuts against an annular shoulder on said ring, the bolt and contacting-shoulders holding the plates firmly in place. In the operation of the separator the material tends to accumulate in the space beyond the end of the deflector and quite rapidly wear the portion passing through it. These removable plates take this wear and may be readily renewed whenever necessary. To allow this the head of the treatment vessel at the discharge end is provided with hand-holes H, registering with the plates and having suitable covers for closing them. Through these holes the plates may be removed, and by filing or otherwise cutting off a portion of the shoulder may be outwardly adjusted by means of the slotted orifices to compensate for wear, or may be replaced by new ones.

Into the head or feed end of the treatment vessel through the hollow trunnion extends a pipe H′, through which ore in a finely-divided state and mingled with a liquid, preferably water, is introduced during the period of separation or clear liquid during the discharge of heavier substances. At the other end is a series of discharge-orifices I, through which the separated material passes. Over these orifices is placed a removable wearing ring I′, having a series of similar orifices registering with them. This construction permits the part to be renewed when worn by the attrition of the material. The orifices are so small that only sufficient water escapes to wash material through, and the channel is thus kept full and the separating-surface submerged. Through the head of the cylinder is a second set of discharge-orifices J nearer the axis of rotation, in which are fitted outwardly-extending pipes J′, through which the excess of comparatively clear liquid, from which the suspended substances have been precipitated by centrifugal force, may pass and be delivered apart from the separated material. In instances where there is a scarcity of water this construction enables it to be used repeatedly, resulting in considerable economy, and may allow the separator to be operated when for lack of water it might not otherwise be used. About these two sets of orifices is an annular hood or trough K, divided by a central partition into two sections K′ and K^2, into which open annular channels k k^2, respectively. The section K′ receives the separated material and conducts it away to suitable receptacles through a passage L, while the section K^2 receives the clearer liquid from the pipes J′ and discharges it through a passage L′. Ribs L^2 extend inwardly from the trough to close proximity with the treatment vessel and prevent the spattering and loss of ore and water. Through the trunnion at the discharge end passes a pipe L^3, by which a liquid, preferably water, is introduced into the separator to assist in the discharge of the concentrates.

The deflector B^3 is shorter than the outer vessel and its supporting-shaft is mounted to allow its reciprocation through the bearings in standards A′ A′. The end which is journaled in the standard A^2 has a series of annular grooves, which engage a flanged bushing in the box a. To compensate for wear, this box is made in two parts. One rests upon the other, the lower portion being extended to support it and secured to it by bolts, which may be tightened to take up any looseness. It is mounted to slide in ways and has upon its lower side a depending lug M, in which is a threaded opening, and through this opening passes a short threaded shaft M′, journaled in the standard. Upon the outer end of this shaft is a worm-wheel M″, engaging a worm m upon a transverse shaft m', mounted on the base-plate. m' carries upon one extremity a bevel-gear N, meshing with a larger bevel-gear N′ upon a longitudinal shaft M^2, extending parallel to the axis of the treatment vessel. Upon this shaft are loosely mounted three gears. The first, a bevel-gear n, meshes with a similar gear upon a shaft n', which is rotated by a worm-wheel n^2 engaging a worm upon a short longitudinal shaft O. This shaft O is driven at the desired speed by a pulley O′, belted to a counter-shaft. The other gears carried by the shaft M^2 are spur-gears o o', meshing with gears upon short stub-shafts P P′, driven in opposite directions by pulleys p p', belted to counter-shafts. The gears n o o' may be made to rotate with the shaft M^2 by a clutch Q engaging projections on the gear n, and a friction-clutch Q′, placed between o o' and contacting with friction-disks on their inner surfaces. These two clutches are mounted to rotate with the shaft and slide on it by splines and carry radial pins q, mounted on rings loose on the clutches, which are engaged by forks upon the lower ends of levers q' q^2, pivoted near their centers and connected at the upper ends to shifting bars or rods extending to any desired point by pins moving in short slots. Near the upper ends of the levers are weights R R, which assist in throwing the clutches and holding them in place thereafter.

At the outer end of the shaft M′ and fast thereon is a hand-wheel R′, having a notch or notches on its inner hub into which extend projections on the hub of the worm-wheel M″, said wheel being secured in place against longitudinal movement by a set-screw passing through its opposite hub. In the position in which the parts are shown the worm-wheel and worm are in mesh and effect the travel of the box a by the power-gearing previously described. If for any reason the deflector is removed from the treatment-cylinder, when

it is again replaced the set-screw of the worm-wheel is loosened and said wheel is moved to the left out of engagement with the hand-wheel and worm, enabling the box to be readily moved by the rotation of the hand-wheel to cause the flanges in the bushing to come in the proper place to receive the annular projections on the shaft.

The operation of the device is as follows: The deflector being at the point shown in Fig. 1, the period of separation is about to begin. Ore in a finely-divided state and mingled with a liquid, preferably water, is fed into the treatment vessel, which is being rotated at a speed sufficient to develop the desired degree of centrifugal force, in sufficient quantities to fill the channel or passage between it and the deflector. This is forced through the channel by the centrifugal force generated in the body of water filling the space at the head end and by the action of the revolving wings F^2, producing a current through the vessel transverse to the path of rotation. Here centrifugal force causes the material to move toward a position around the circumference of the vessel and the heavier to lodge upon the separating-surface. The lighter remains partially or wholly suspended in the liquid and is moved along toward the discharge-orifices by the transverse current, discharged into the hood, and conveyed to the desired point. At the same time annular currents are created in the liquid contained in the channel by the friction between it and the surface of the deflector. These currents tend to cause the lighter material to move in the path of rotation of the separating-surface, starting it in motion and thus requiring a less transverse flow, and therefore a less quantity of liquid to accomplish the same result. If there were only the transverse flow, it would require a considerable velocity to move it from the initial point, to which it is carried by centrifugal force, and once started it would pass through the cylinder too quickly to be properly separated. As separation progresses and heavier material accumulates on the separating-surface the deflector is moved gradually to the right, the clutch Q being in engagement, thus carrying its exterior away from the separating-surface and widening the channel between them. As a result the distance between said deflector and the surface of the accumulating material is kept approximately constant, maintaining the velocity of flow through the channel constant, and preventing heavier substances from being carried away with the lighter. Separation being accomplished and a sufficient amount of heavier substances accumulated on the separating-surface, they are now to be discharged. The clutch Q is disengaged and the friction-clutch Q′ brought into engagement with the disk on the gear *o*. This causes the deflector to move rapidly in the opposite direction, contracting the channel and causing the heavier substances to be washed from the separating-surface by the resulting increased velocity of flow thereover. At the same time clear liquid is fed into the separator through the pipe L^3, which washes the material through the discharge-orifices into the section K′ of the trough, which conveys it to a separate receptacle from that which received the lighter. The rapid return is allowed to continue until the deflector has passed the point it occupied at the beginning of the separating period and the wings F^2 have nearly reached the head end of the treatment vessel, contracting the channel to its minimum width and completing the expulsion of the concentrates. The other side of friction-clutch Q′ is now thrown into engagement with the gear *o*′, reversing the direction of travel of the deflector and moving it rapidly back to the point at which the channel is of the proper width to begin separation, when they are disengaged and the clutch Q is again thrown in and the operation is repeated. By the use of this rapid discharge and return motion a considerable saving of time is accomplished, the necessary period being given for separation and the discharge of heavier substances and the return of the parts to their initial point most quickly effected.

Although the term "cylinder" has been applied to the treatment vessel and deflector for brevity, this form is not essential to the operation of the machine and any other might be employed by which the desired result would be obtained. It is to be understood that the word is used in this generic sense in both description and claims.

It is obvious that many changes and modifications in the details of construction of the various parts of the mechanism herein described may be made as desired by the constructor, or to best suit the varied conditions under which the machine is operated, without departing from the spirit of my invention.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a centrifugal separator, the combination of a rotatable separating-surface, a deflector or cylinder in proximity thereto, mechanism for varying the width of the channel or passage between them, a shaft geared thereto, wheels upon said shaft which may turn loosely on or be made to rotate therewith, means for rotating two of said wheels in the same direction at different speeds, to produce different rates of movement during the return of the deflector from the position after discharge and during the separating period and a third in the opposite direction, substantially as described.

2. In a centrifugal separator, the combination of a rotatable treatment vessel, discharge-passages for the separated lighter and heavier substances therefrom, and passages nearer to the axis of rotation for the discharge of comparatively clear liquid from the vessel apart from the material, substantially as described.

3. In a centrifugal separator, the combina-

tion of a rotatable treatment vessel, discharge-passages for the separated lighter and heavier substances therefrom in the periphery of the vessel, and passages through the head thereof for the discharge of comparatively clear liquid apart from the material, substantially as described.

4. In a centrifugal separator, the combination of a rotatable treatment vessel, discharge-passages for the separated lighter and heavier substances therefrom, passages nearer the axis of rotation for the discharge of comparatively clear liquid, and a double trough or hood surrounding the discharge-passages and receiving the material and liquid in separate sections, substantially as described.

5. In a centrifugal separator, the combination of a rotatable treatment vessel, a deflector or cylinder therein, and a series of separate removable wearing-plates attached to the head of said deflector near the discharge end of the treatment vessel, substantially as described.

6. In a centrifugal separator, the combination of a rotatable treatment vessel, a deflector or cylinder therein, and a series of separate adjustable, removable wearing-plates on said deflector near the discharge end of the treatment vessel, substantially as described.

7. In a centrifugal separator, the combination of a rotatable treatment vessel, a deflector or cylinder therein, removable wearing-plates on said deflector near the discharge end of the treatment vessel, and openings in said end of the vessel to allow the removal of the plates, substantially as described.

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