(No Model.) 4 Sheets—Sheet 1.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

No. 560,633. Patented May 19, 1896.

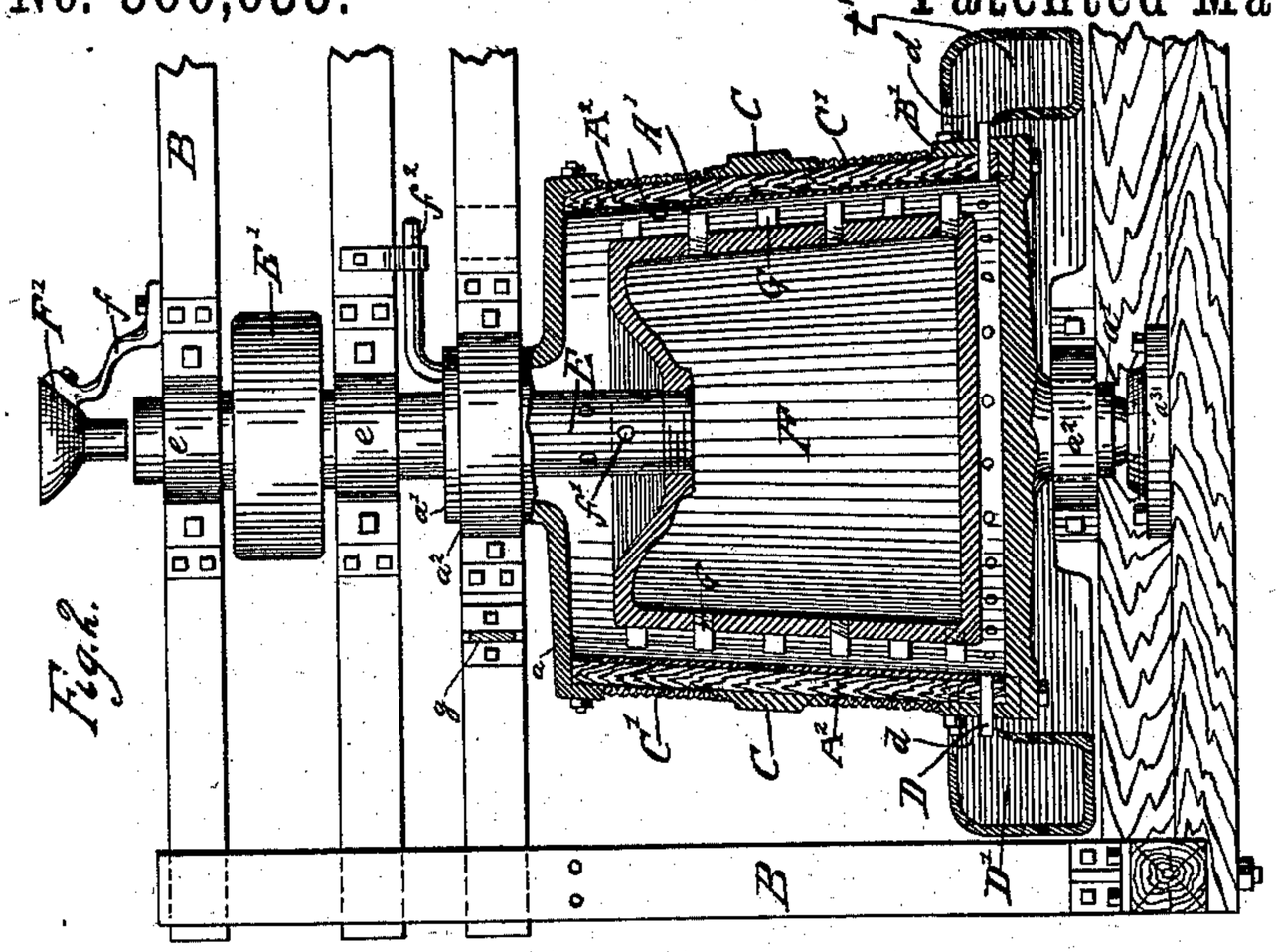

Fig. 2.

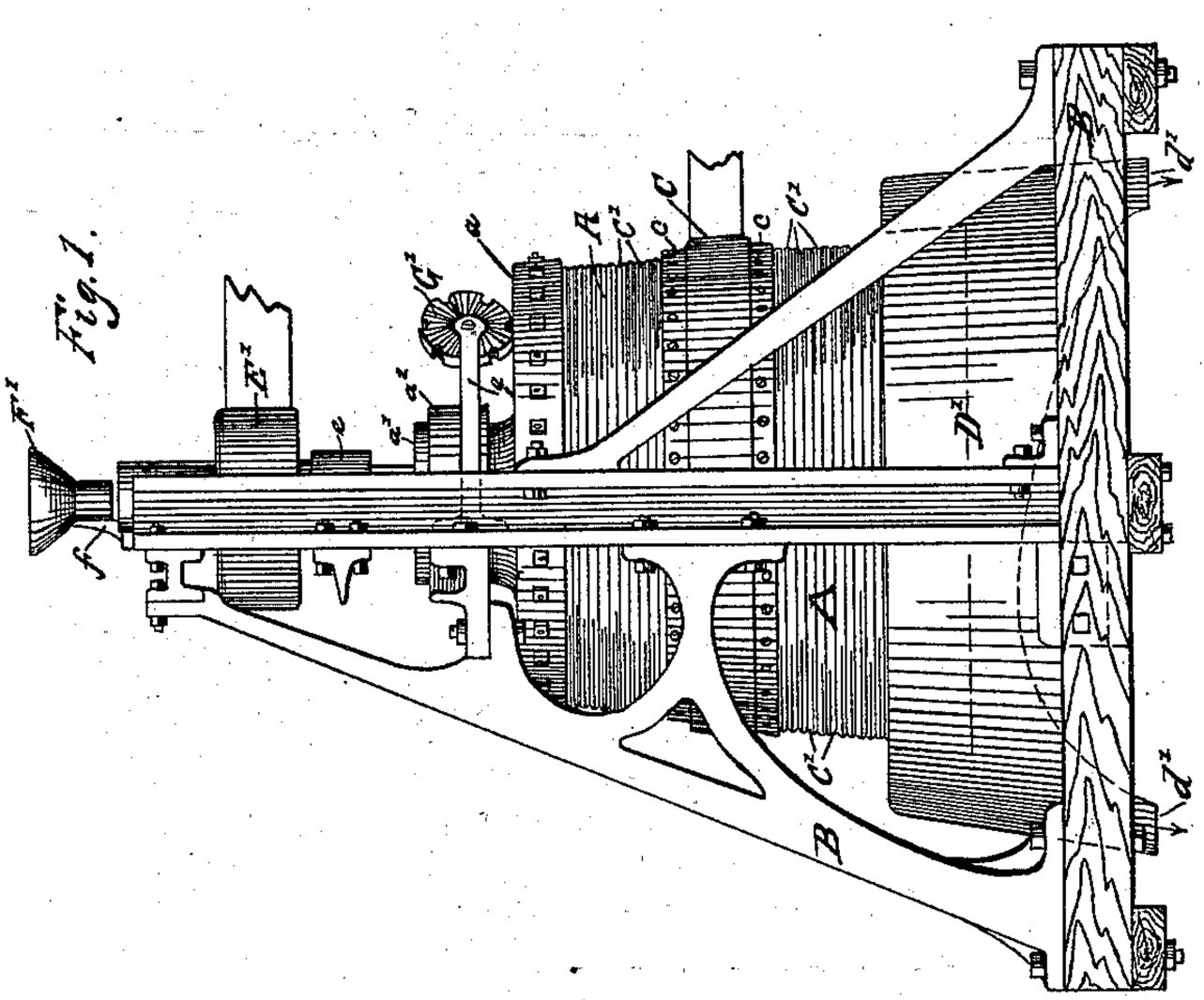

Fig. 1.

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Fig. 5.

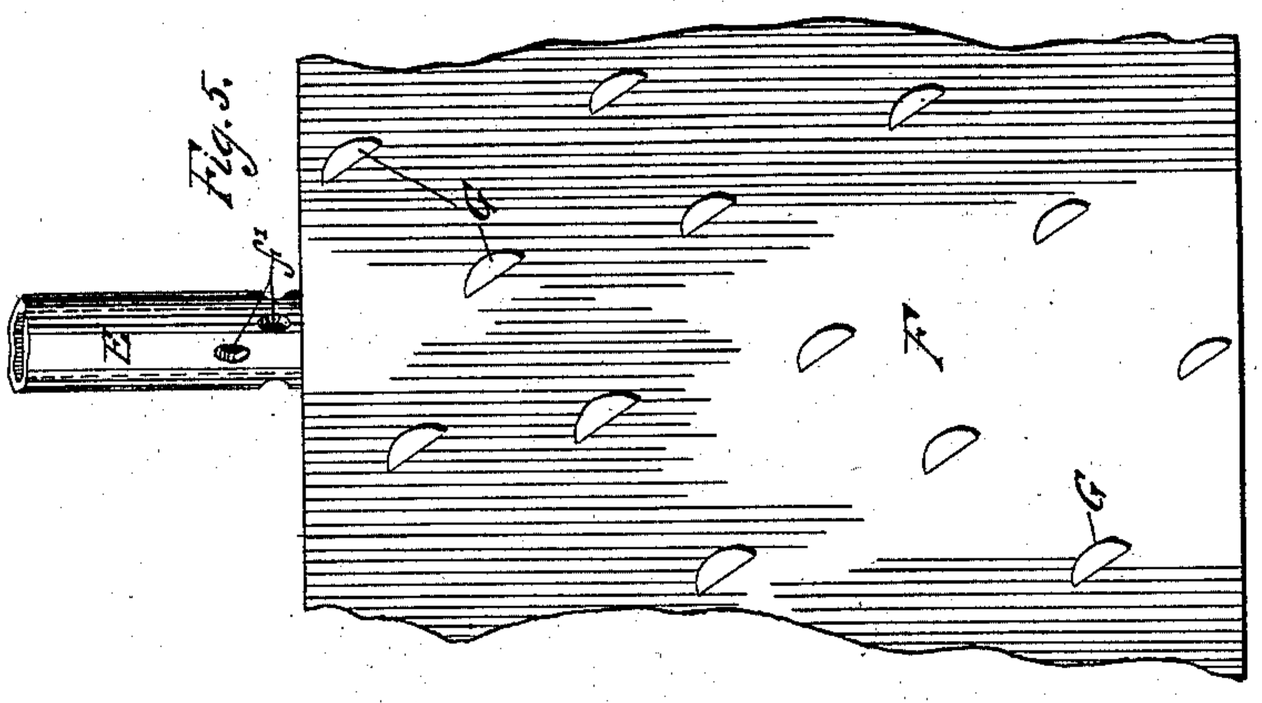


Fig. 4.

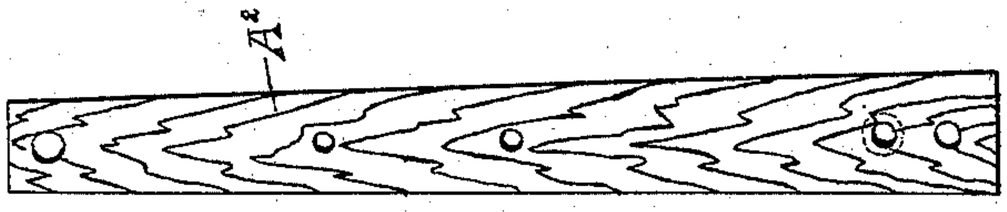
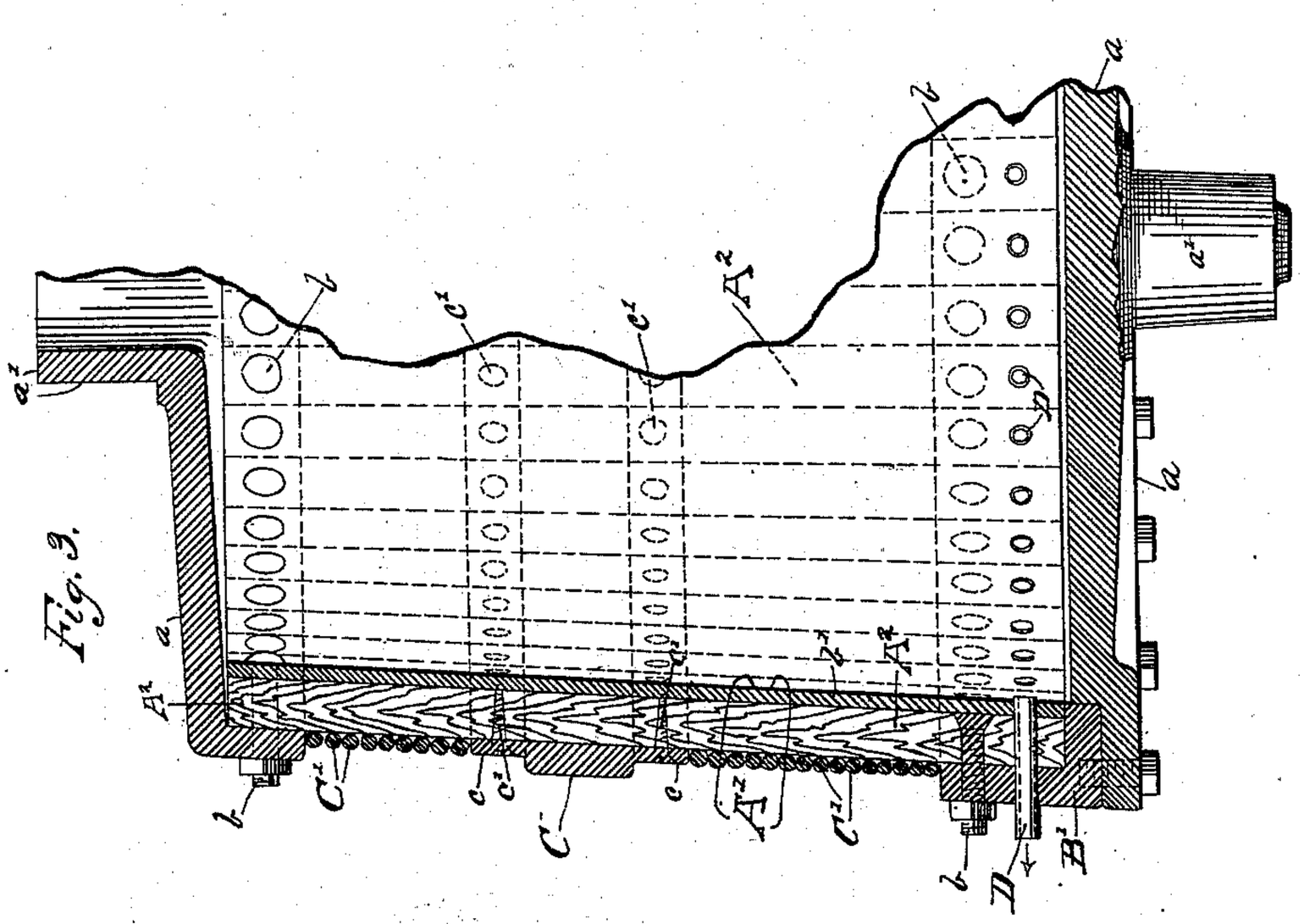


Fig. 3.



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CENTRIFUGAL SEPARATOR.

No. 560,633.

Patented May 19, 1896.

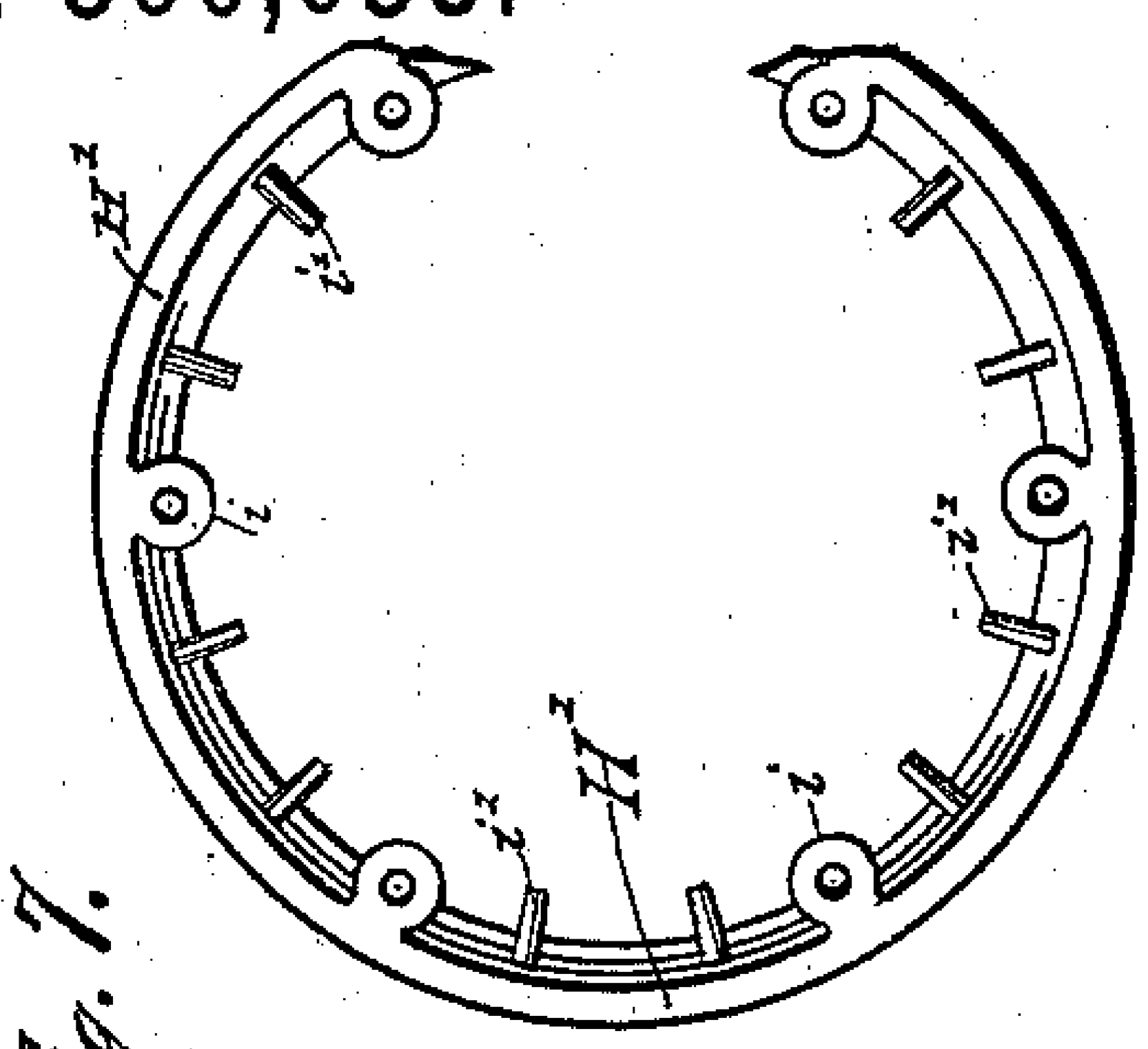

Fig. 7.

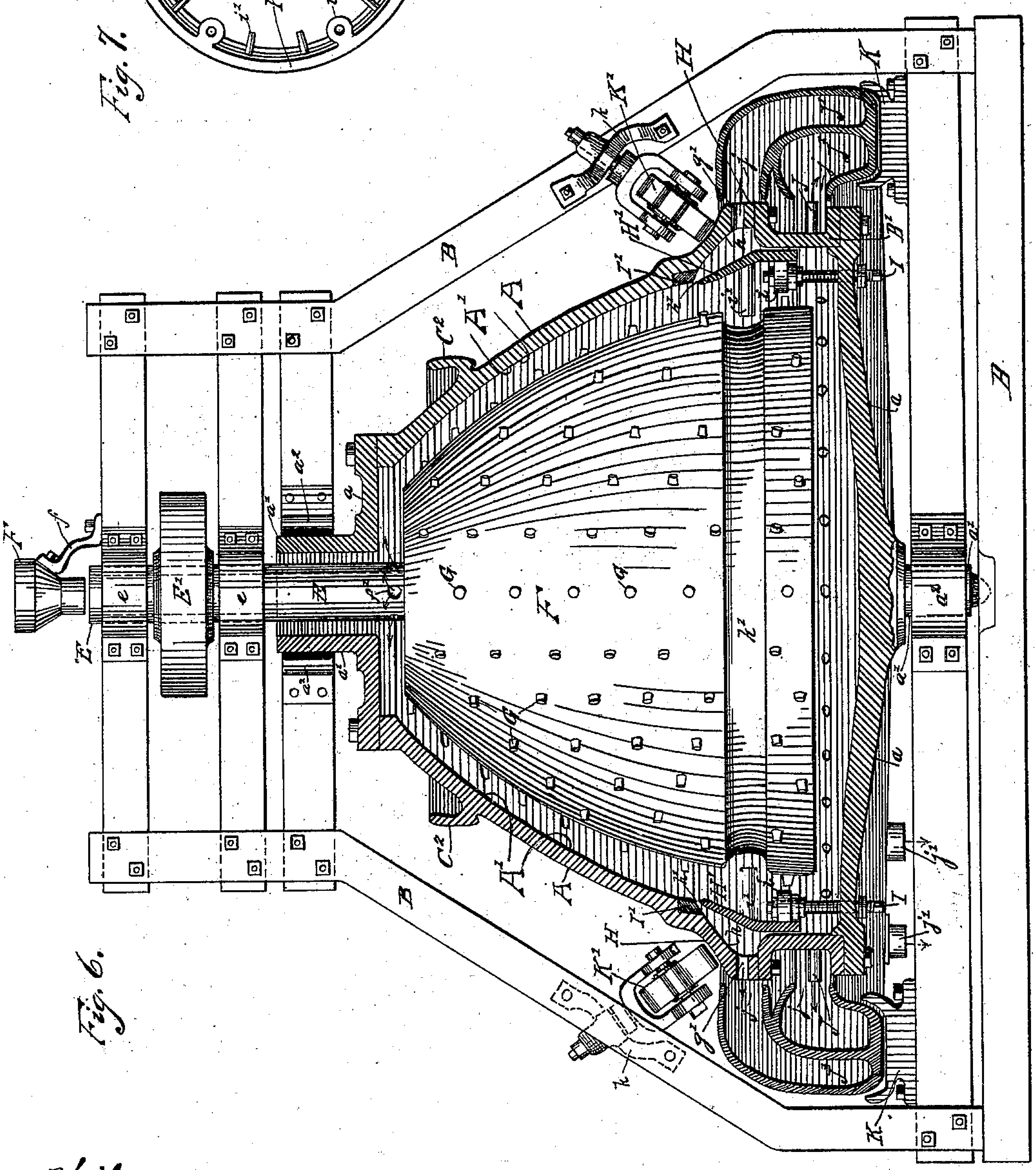

Fig. 6.

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(No Model.) 4 Sheets—Sheet 4.

O. B. PECK.

CENTRIFUGAL SEPARATOR.

No. 560,633. Patented May 19, 1896.

Fig. 8.

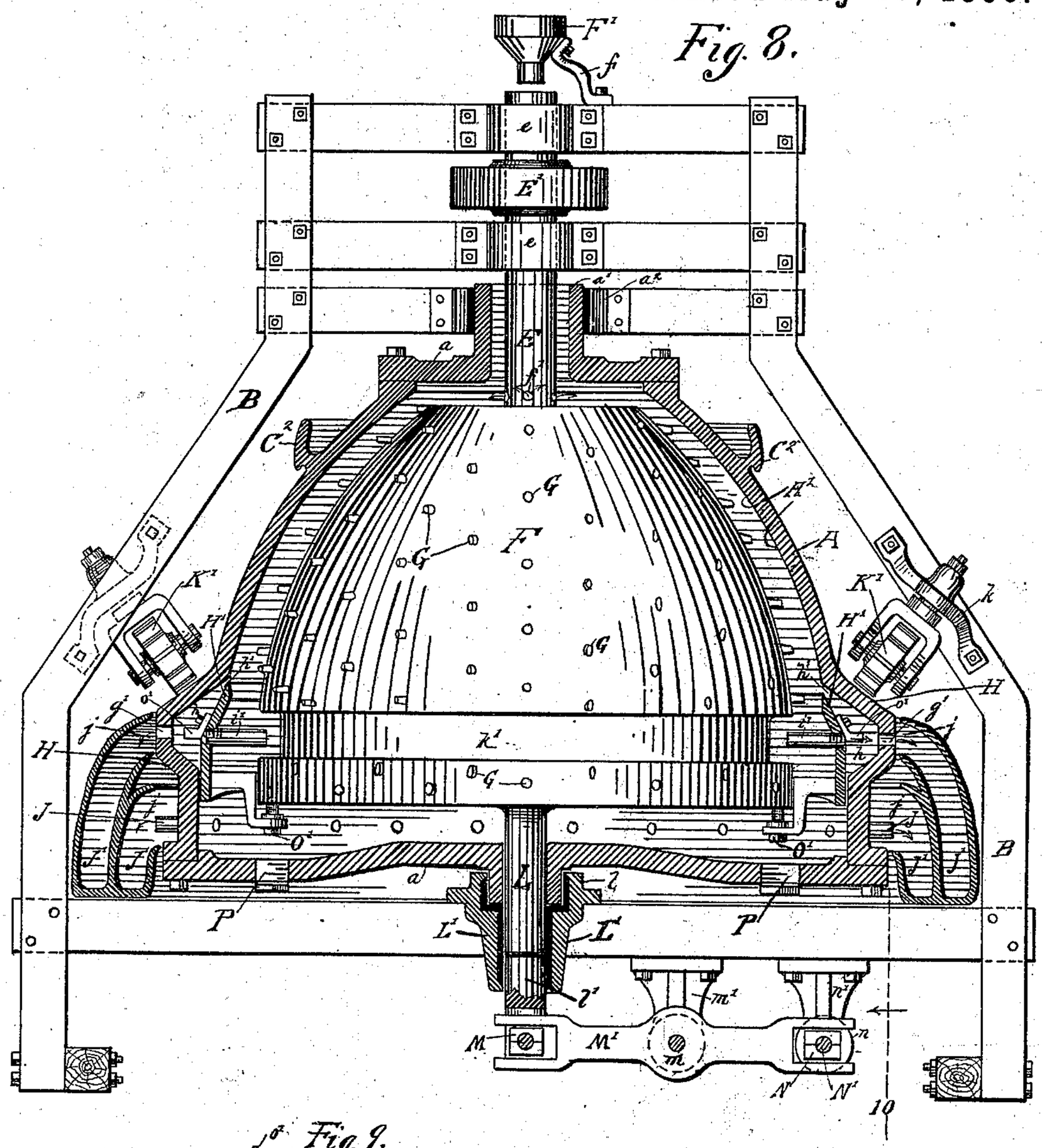


Fig. 9.

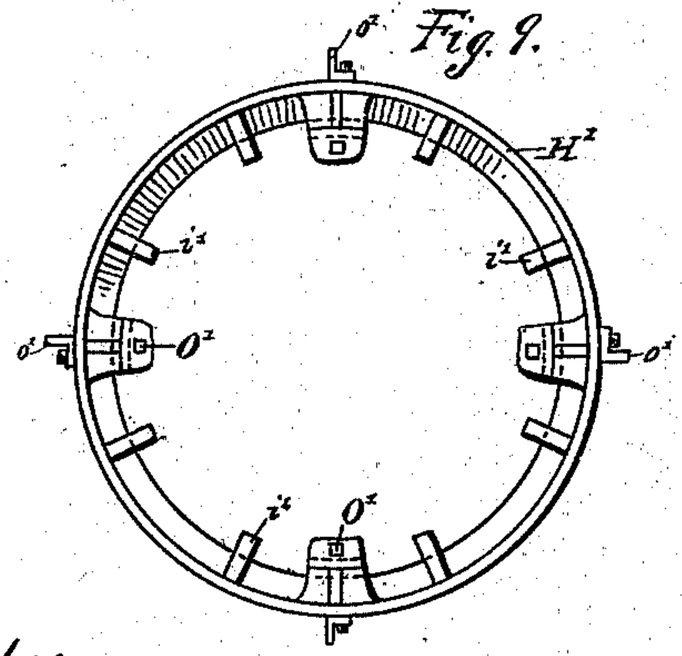
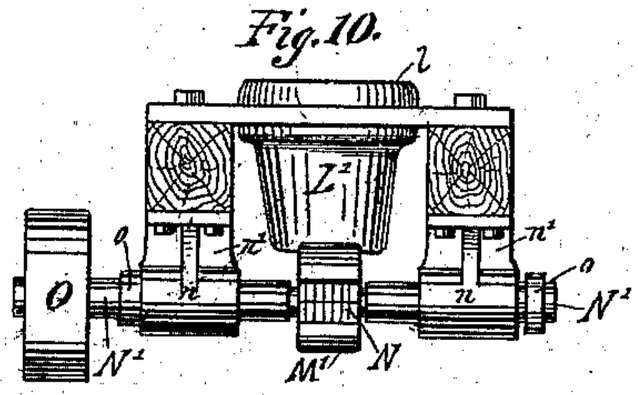


Fig. 10.



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UNITED STATES PATENT OFFICE.

ORRIN B. PECK, OF CHICAGO, ILLINOIS.

CENTRIFUGAL SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 560,633, dated May 19, 1896.

Application filed November 6, 1894. Serial No. 528,117. (No model.)

To all whom it may concern:

Be it known that I, ORRIN B. PECK, a citizen of the United States, residing in 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.

The principal objects of my invention are to provide a centrifugal separator wherein the force of gravity assists in carrying material under treatment over the separating-surface toward the point of discharge to effect a continuous separation of heavier and lighter substances and a separate and continuous discharge thereof, to provide a deflector within the treatment-cylinder held in a central position largely by the force of the water contained within said cylinder, and also to improve various points in construction. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a vertical side elevation of one of my improved separators. Fig. 2 is a central vertical section in a plane at right angles to Fig. 1. Fig. 3 is an enlarged transverse vertical section of a portion of the treatment-cylinder. Fig. 4 is a detail of one of the staves of the treatment-cylinder detached. Fig. 5 is a detail elevation of an enlarged portion of the deflector, showing the preferred oblique position of the agitating or plowing studs. Fig. 6 is a central vertical section of another form of separator embodying my improvements. Fig. 7 is a detail bottom plan view of the dividing-ring partly broken away. Fig. 8 is a central vertical section of still another form of my invention. Fig. 9 is a detail bottom plan view of the dividing-ring somewhat modified from that shown in Fig. 7. Fig. 10 is a detail sectional view of Fig. 8 on line 10, looking in the direction of the arrow.

The treatment vessel or cylinder A, having a separating-surface A′, is preferably provided with heads or ends *a*, having trunnions *a*′, the upper one of which is hollow and is journaled in suitable boxes a^2 on the supporting-frame B. The lower trunnion is stepped in a bearing a^3. The treatment vessel or cylinder, which for brevity will be called a "treatment-cylinder" throughout the specification, is shown as enlarging toward its lower or discharge end, but may be made straight, if desired. The treatment-cylinder, when its form will permit, may be constructed of staves or sections of wood A^2, as particularly shown in Figs. 2, 3, and 4, secured at their ends to flanges on the heads of the cylinder by means of bolts *b*, or they may be secured at one or both ends, preferably at least at the larger, to a supplemental ring B′, which is detachably secured to the head of the cylinder to admit of its easy removal and the insertion or withdrawal of the deflector. If it were not for the supplemental ring it would be necessary to remove the fastening from each stave at one end, which would be inconvenient and might permit the staves to move relatively, thereby spoiling the symmetrical circular shape of the end of the treatment-cylinder. The interior wall of the cylinder when made of wood may be covered with a lining *b*′ of rubber or like material to assist in making it water-tight and to afford a separating-surface which may be replaced when worn. An encircling metal ring forms a belt-surface C at the central portion of the cylinder, which has at each side a thinner rim *c*, provided with holes through which screws *c*′ pass to assist in holding the staves of the cylinder together and also to retain the ring in place. The cylinder is further reinforced by a wrapping of wire C′. Near its lower end the cylinder is provided with a row of discharge-orifices carrying tubes D, and surrounding these tubes and having an annular channel *d* through its inner wall is a trough D′ to catch the material as it is thrown from the treatment-cylinder, provided with discharge-passages *d*′.

Within the treatment-cylinder, supported on a preferably hollow shaft E, extending through the upper trunnion *a*′, journaled in the boxes *e* and rotated through a pulley E′, is a deflector F, which is made of light material or is hollow, as shown in Fig. 2, so that it is lighter than an equal bulk of water, thereby enabling it to be maintained in a central position in the treatment-cylinder by the pressure of water surrounding the deflector, and which, acted upon by centripetal force, presses the deflector throughout its circumference toward the axis of rotation, thus exerting a strong uniform force to cause it to

maintain a central position. This construction is especially advantageous when the deflector is supported at one end only, when it is not mounted very securely, or is journaled in bearings a considerable distance apart. The vertical position of the shaft E and deflector is preferably maintained by the hubs of the pulley E′ contacting with the ends of the boxes *e*.

Just above the upper end of the hollow shaft E is located a funnel F′, supported by a bracket *f*. This funnel serves to introduce material into the hollow shaft, from which it passes out of orifices *f′* onto the upper portion of the separating-surface. On the surface of the deflector are placed projections or studs G to effect agitation of material over the separating-surface. The outer or service ends of these studs may be made to serve as plows as well as agitators to plow or deflect material on which they operate toward the discharge end of the treatment-cylinder by flattening them on one or both sides and setting them in the deflector with the flattened side at an angle in an oblique position to the path of revolution, as shown in Fig. 5.

To vibrate the treatment-cylinder and separating-surface to assist in separation, there is provided an irregular roll or cam G′, supported on an arm *g* and contacting with the upper head of the treatment-cylinder, producing shocks thereto in its rotation.

In the form of separator shown in Figs. 6 and 7 the treatment-cylinder and other parts are made of metal and somewhat different in form. The walls of the treatment-cylinder are curved, the angle with the axis of rotation decreasing toward the discharge end for purposes hereinafter explained. The treatment-cylinder is provided with a vertical ring shaped to afford a belt-surface C^2.

This machine is so arranged that the process of separation can be carried on continuously—that is, the introduction of material to the treatment-cylinder and the various stages of separation of heavier from lighter substances and their separate discharge are effected simultaneously and continuously during the operation of the separator. To accomplish this, the lower portion of the treatment-cylinder, preferably throughout its entire circumference, is provided with an extended or enlarged portion H, forming an interior recess or channel *h*, from which discharge-orifices G′ radiate through the wall of the cylinder. Within the treatment-cylinder and over the channel *h* is an adjustable annular plate or ring H′, made of comparatively light metal, with its upper edge thinned to adapt it to divide or cut the layer of particles of material on the separating-surface, dividing the stratum or layer of heavier substances from beneath the lighter, and also protecting the discharge-orifices for heavier particles from the ingress of the lighter. It may therefore be termed a "divider" or a "protector." The edge of the divider approaches closely to the shoulder caused by the enlargement H and leaves only a small passage *h′* between them. This passage may be varied in size by the vertical adjustment of the divider, which may be effected by threaded rods I engaging at their upper ends lugs *i* on the ring and near their opposite ends the head of the treatment-cylinder.

To supply comparatively clean water to the recess *h* for discharge with the particles of heavier material deflected thereunder and to prevent the water within the treatment-cylinder from forcing a channel through and disturbing that portion of the material entering the passage *h′*, there are provided tubes *i′*, mounted in orifices in the divider and extending in sufficiently toward the axis of the cylinder to pass through any layer of material that may be formed, and preferably somewhat farther to insure a minimum amount of lighter material being conducted with the water to the chamber *h* and again mingled with the heavier, which are deflected under the divider and discharged therefrom. Where the cutting edge of the divider closely approaches the separating-surface the shoulder is preferably provided with a removable ring I′, which can be replaced as desired when worn.

Around the lower portion of the treatment-cylinder, below the separating-surface and divider-ring, are orifices, preferably carrying short tubes J, for the discharge of the lighter portions of material. An annular trough J′, supported on the frame B, encircles the lower end of the cylinder, having two compartments and an annular channel *j* opening into each in alinement with the discharge-orifices *g′* and tubes J, whereby the heavier and lighter substances are caught separately and discharged from the compartments through spouts *j′*. It is desirable to impart a tremor or vibration to the separating-surface to assist in separation, and especially to cause the heavier substances that accumulate on the separating-surface and such of the lighter portion as form a layer upon the heavier to creep or gradually travel along toward the discharge-point. To accomplish this, cam-rolls K′, rotatably mounted on a bracket *k*, operate in contact with the shoulder caused by the enlargement H of the treatment-cylinder. The irregular shape of these rolls imparts a series of shocks to the cylinder as it rotates, and thus vibrates the separating-surface.

The deflector or agitating-cylinder F is provided with an annular recess *k′* to admit of the tubes *i′* being extended nearer to the axis of rotation, and like the form first illustrated is supported on the hollow shaft E, mounted in journal-boxes *e* and rotated by the pulley E′.

In Figs. 8, 9, and 10 is illustrated still another form of my invention. The general shape of the treatment-cylinder, deflector, and most of the other parts are shown as similar

to those illustrated in Figs. 6 and 7; but the treatment-cylinder in this instance is preferably provided with a hollow trunnion at its lower end and the deflector with an extended shaft L, which passes through said trunnion and is journaled in a box L′, the upper portion *l* of which may also serve as a step for the trunnion. The journal-box L′ is extended down to receive the plunger *l′*, serving as a guide to the same. On the upper end of this plunger rests the deflector-shaft L, and at its opposite end it is connected by means of a sliding box M to one end of a lever M′, pivotally fulcrumed at *m* to the supporting-brackets *m′*, and connected at its other end by a sliding box N to the crank portion of a crank-shaft N′. This crank-shaft is supported in journal-boxes *n* on brackets *n′*, depending from the lower part of the frame of the separator, as particularly shown in Fig. 10, is rotated by a belt upon the pulley O, and is held from longitudinal movement in its boxes by collars *o*. By the rotation of the crank-shaft N′ a rocking motion will be imparted to the lever M′, reciprocating the plunger *l′*, and as this supports the shaft of the deflector the latter with the agitators will be moved in a direction transverse to its path of rotation, causing practically the whole of the separating-surface to come under the influence of said agitators. The upper portion of the deflector-shaft is journaled, and there is sufficient space between the pulley E′, boxes *e*, and other parts of the separator to admit the reciprocation of the deflector. In this form of separator the dividing-ring is made slightly different in form and is adjustably secured to the lower part of the deflector by threaded studs O′ and is revolved by the deflector in its rotation instead of by the treatment-cylinder, as previously described. The divider, in addition to the tubes *i′* and other parts attached to it, preferably carries several projections or plows *o′*, extending into the channel *h* and serving to move or plow the material passing under the divider over the discharge-orifices *g′* to facilitate its discharge. Without these plows material piles up within the channel between the orifices, and therefore tends to clog. To admit of access to the studs O′ for the adjustment of the dividing-ring, there are screw-threaded holes through the bottom of the treatment-cylinder opposite the studs, provided with screw-threaded plugs P.

The operation of the separators, when constructed as first described, is in successive alternations of separating and accumulating a desired quantity of heavier material on the separating-surface while discharging the lighter portions and then discharging the accumulated heavier, diverting the two to different places of deposit, employing the force of gravity acting in the direction of travel of the material through the treatment-cylinder toward the point of discharge to assist the other forces employed for effecting such separation and discharge of the respective substances. The treatment-cylinder and deflector are rotated at a relatively greater or less speed, as will suit the peculiar conditions existing. The material to be separated in a finely-divided state and mingled with a considerable quantity of water is introduced by the hollow shaft E and orifices *f′* into the space between the top of the deflector and the treatment-cylinder and deposited on the upper portion of the separating-surface, from whence it passes down toward its lower end. The amount of water introduced is sufficient to keep the channel or passage between the deflector and the inner wall of the cylinder well filled or the separating-surface submerged. During the separating period the differential speed of the separating-surface and the deflector should be sufficiently great that the force of the water flowing through the channel, the agitation caused by the projections and otherwise, and the force of gravity will carry the lighter portions of the material downward over the separating-surface to the discharge-orifices; but said combined forces are sufficiently weak to permit the heavier substances, actuated by centrifugal force, to lodge and accumulate on the separating-surface until a desired quantity has gathered, when the introduction of material to the treatment-cylinder is preferably discontinued, water alone being introduced during the unloading period, and the differential speed of the cylinder and deflector is now increased, preferably by lessening the speed of the former, thereby lessening the centrifugal force developed to maintain the layer of heavier substances on the separating-surface, at the same time increasing the agitation to which such material is subjected sufficiently to enable these forces, assisted by gravitation, to move it downward to the discharge-orifices, through which it passes into the surrounding trough. After the heavier has been discharged the initial speed may be restored and the operation repeated. As the heavier and lighter portions of the material flow from the trough D′ they will be received in separate receptacles. If desired, additional water may be introduced to the treatment-cylinder by means of a pipe f^2, extended into the hollow trunnion *a′*.

In the operation of the separator illustrated in Fig. 6 of the drawings the process of separation and discharge of the heavier and lighter material is continuous. The material is introduced into the treatment-cylinder and separated in the manner just described, and the lighter substances will travel down the separating-surface, passing over the dividing-ring to their discharge-orifices, while the heavier will accumulate in a layer nearest the separating-surface under the lighter. The outward slant of the wall of the treatment-cylinder as it approaches the discharge end is less than in the previous instance, retarding the progress of material and making

the accumulation on the separating-surface, which tends in the preceding form to pile up at the feed end, nearly uniform throughout. The layer of heavier substances will be driven by centrifugal force, assisted by the force of gravity and by the vibration of the cylinder, gradually along the separating-surface toward the discharge end of the cylinder, at the same time carrying along any lighter substances that may be lodged thereon, and as the layer reaches the divider the heavier will be divided from beneath the lighter and diverted through the narrow passage *h'* into the channel under the dividing-ring, from whence it will be discharged through the orifices into the appropriate compartment in the surrounding trough, while the lighter substances pass to the orifices nearer the end of the cylinder and are discharged and caught in the other compartments.

The operation of the form illustrated in Figs. 8, 9, and 10 of the drawings is very similar to that just described. The dividing-ring, however, travels with the deflector, and with its plows *o'* aids the discharge of the heavier substances from the channel *h*. During the operation the crank-shaft is revolved, imparting a slight reciprocation to the deflector and the divider-ring, which increases the field of action of the agitators and assists the separation and discharge of material.

While there are illustrated separators having treatment-cylinders provided with shafts or trunnions on which they are journaled, it is not necessary to make them in this way, as the cylinder may be provided with bearings encircling its body, if desired. The studs carried by the deflector should be extended far enough therefrom to produce sufficient agitation.

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

1. In a centrifugal separator, the combination of a rotatable separating-surface, a deflector therein of less specific gravity than a volume of water of equal size, whereby the same is held in position by the water within the separator, substantially as described.

2. In a centrifugal separator, the combination of a rotatable treatment-cylinder composed of staves or sections secured at least at one end to a ring, which is detachably secured to the head of the cylinder, substantially as described.

3. In a centrifugal separator, the combination of a rotatable treatment-cylinder composed of staves or sections secured at least at one end to a ring, which is detachably secured to the head of the cylinder, and an encircling ring mounted on said cylinder affording a belt-surface therefor, substantially as described.

4. In a centrifugal separator, the combination of a rotatable separating-surface provided with one or more passages for the discharge of heavier substances, a plate protecting such passages from the ingress of the lighter substances, and agitators operating under said plate, substantially as described.

5. In a centrifugal separator, the combination of a rotatable separating-surface for separating material into strata of heavier and lighter substances, and an independently-rotatable divider for separating the heavier stratum from beneath the lighter, substantially as described.

6. In a centrifugal separator, the combination of a rotatable separating-surface for separating material into strata of heavier and lighter substances, a divider for separating the heavier stratum from beneath the lighter, discharge-passages beneath the same and agitators carried by the divider operating in proximity in said passages, substantially as described.

7. In a centrifugal separator, the combination of a rotatable separating-surface upon which material is separated into strata of heavier and lighter substances, a divider for separating the heavier stratum from beneath the lighter, and a differentially-rotatable deflector therein carrying agitators, substantially as described.

8. In a centrifugal separator, the combination of a rotatable separating-surface upon which material is separated into strata of heavier and lighter substances, a conduit depositing material for separating near the upper portion of the separating-surface, a divider for separating the heavier strata from beneath the lighter near its lower portion, discharge-orifices in proximity thereto, and a deflector to guide material over the separating-surface, substantially as described.

9. In a centrifugal separator, the combination of a rotatable separating-surface upon which material is separated into strata of heavier and lighter substances, a conduit depositing material for separation near the upper portion of the separating-surface, a divider for separating the heavier stratum from beneath the lighter near its lower portion, discharge-orifices in proximity thereto, and a longitudinally-reciprocating deflector acting over the separating-surface, for agitating material, substantially as described.

10. In a centrifugal separator, the combination of a rotatable separating-surface, a conduit depositing the material for separation near the upper portion of said surface, one or more orifices for discharging the same near the lower portion thereof, and a longitudinally-reciprocating agitator acting over the separating-surface, substantially as described.

11. In a centrifugal separator, the combination of a rotatable separating-surface upon which material is separated into strata of heavier and lighter substances, a divider for separating the heavier stratum from beneath the lighter, and a longitudinally-reciprocating agitator acting over the separating-surface, substantially as described.

12. In a centrifugal separator, the combination of a rotatable separating-surface upon which material is separated into strata of heavier and lighter substances, a conduit depositing material for separation near the upper portion of the separating-surface, a divider for separating the heavier stratum from beneath the lighter near its lower portion, discharge-orifices in proximity thereto, and a longitudinally-reciprocating agitator acting over the separating-surface, substantially as described.

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