No. 668,744. Patented Feb. 26, 1901.

P. H. ADAMS.

CENTRIFUGAL SEPARATOR.

(Application filed May 27, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

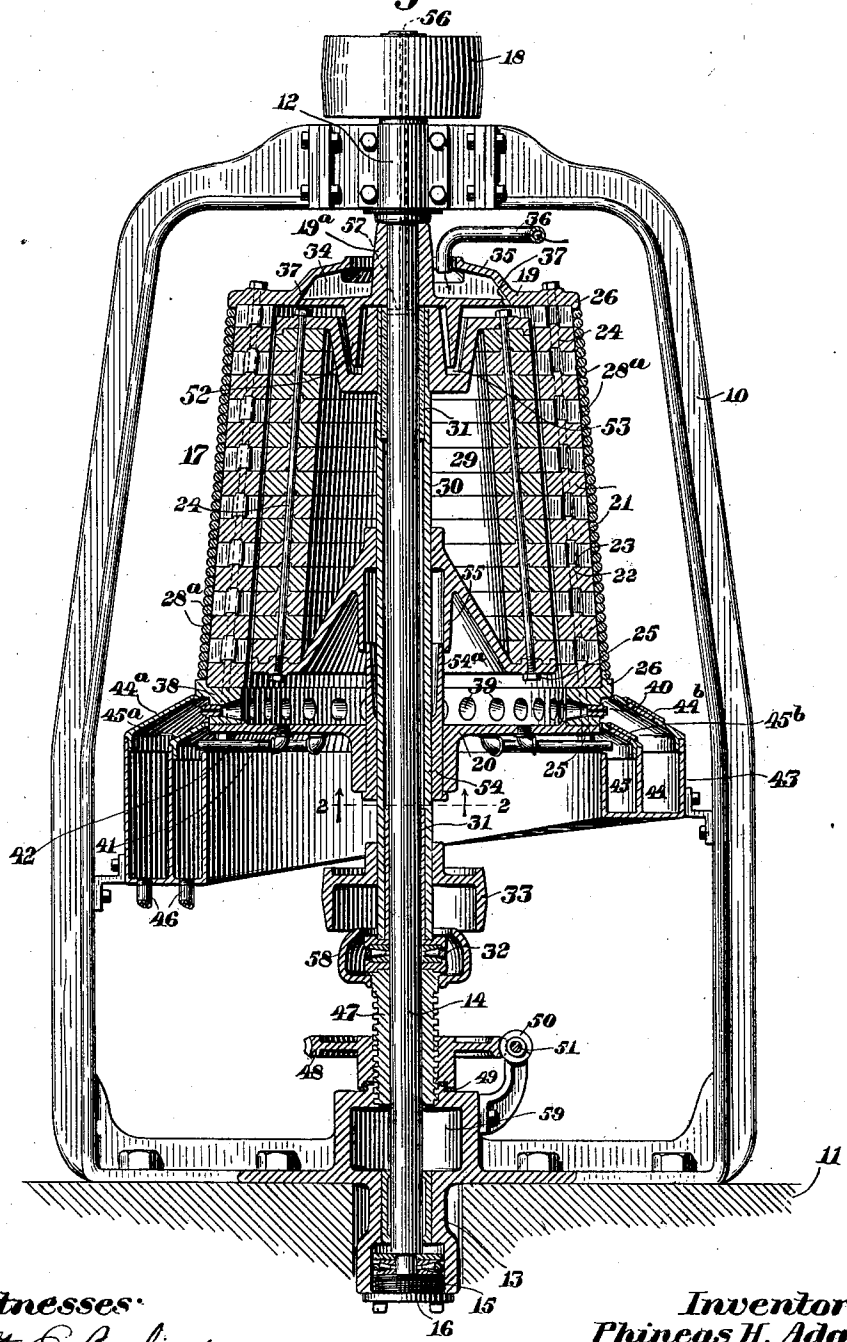

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Fig. 2.

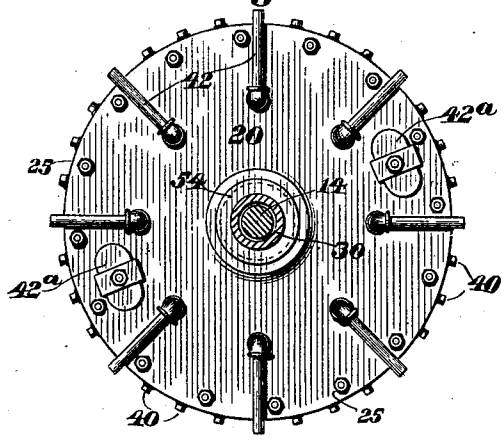


Fig. 3.

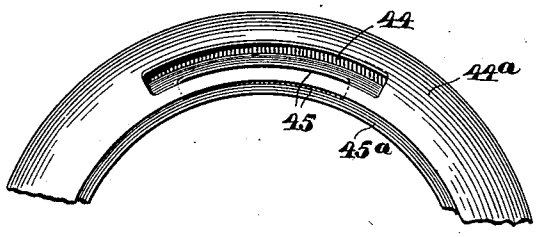
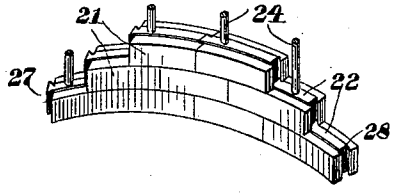


Fig. 4.



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UNITED STATES PATENT OFFICE.

PHINEAS H. ADAMS, OF CHICAGO, ILLINOIS, ASSIGNOR TO EDMOND C. PECK, OF SAME PLACE.

CENTRIFUGAL SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 668,744, dated February 26, 1901.

Application filed May 27, 1899. Serial No. 718,594. (No model.)

To all whom it may concern:

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

My invention relates more particularly to improvements in the art of centrifugal separation or concentration of materials while in a finely-divided state and in the presence of or mixed with water; and it consists in the various details of construction of a machine for use in the art, as hereinafter described and claimed.

In the drawings, Figure 1 is a central vertical longitudinal section of my improved separator. Fig. 2 is a horizontal transverse section on the line 2 2 of Fig. 1 looking in the direction of the arrows. Fig. 3 is a detail of the trough, showing the openings in the covers; and Fig. 4 is a detail in perspective showing the construction of the walls of the treatment vessel and deflector.

Similar numerals designate like parts throughout the several figures of the drawings.

10 designates a frame of any desired material and construction suitably supported upon a base or foundation, as indicated at 11. In the upper portion of the frame is situated a bearing 12, and in the lower portion is a step-bearing 13, illustrated as projecting through an opening in the base. In these bearings is mounted a vertical shaft 14, supported at its lower end in the step by a suitable antifriction device 15, which is in turn supported by a plug 16, threaded into the lower portion of the step, permitting a vertical adjustment for the purpose of taking up the wear. This shaft 14 carries a rotatable treatment vessel or cylinder 17, preferably of conical form. Upon the upper end of the shaft is secured a driving-pulley 18, by means of which the treatment vessel is rotated. The treatment vessel consists of two heads, the upper, 19, secured to the shaft 14 by an upwardly-extended hub 19^a and the lower, 20, mounted as will be hereinafter described, and the intermediate cylindrical or frusto-conical portion. For convenience in constructing the cylinder, particularly if large and difficult to cast or otherwise form of metal, this intermediate portion is preferably built up of a number of horizontal rings 21 21, resting one upon the other between the heads, each of the rings being provided with a substantially central annular projection or tongue 22 upon its upper side, extending into a corresponding groove 23 in the lower side of the ring above it. This interlocking construction is employed to insure the cylinders being water-tight and to assist in retaining the rings in place. Through the heads of the cylinder and through holes in the rings forming the walls extend bolts 24, having upon one end nuts 25, which when tightened draw the heads toward each other and hold the parts of the cylinder securely together. As in the preferred conical form, the rings are of gradually-increasing diameter from the top of the cylinder to the bottom. The bolts 24 are inclined to the same amount to enable them to pass through the center of the body of the rings, and thus uniformly distribute the pressure. Both of the heads are provided at their outer edge with annular flanges 26 26, serving to retain the rings adjacent to the heads in position. The wall of the cylinder may be, and preferably is in the construction described, composed of wood. The wooden rings are conveniently formed in separate sections or sectors of suitable length, which may be connected to one another by dovetailed tongues and grooves 27 28, respectively, in the adjacent ends, as is illustrated in Fig. 4. The bolts 24 preferably pass through each sector and at some point intermediate of its ends. This position holds both ends of the sectors firmly in place against that on each side, resisting the strong tendency to separate under the action of centrifugal force. With the conical vessel these bolts not only resist the separation of the sections, but also draw them positively together by a component of the stress acting at right angles to the axis. To strengthen the cylinder and further resist the centrifugal strain, its exterior may be provided with a winding of wire, as shown at 28^a.

Within the treatment vessel is a deflector or cylinder 29, which is mounted upon a hol-

low shaft 30, surrounding the cylinder-shaft and having a bearing upon it, it being illustrated in the drawings as contacting therewith at points 31 31, where sleeves of Babbitt or other antifriction metal are interposed. The hollow shaft extends from the upper head of the cylinder through the lower head and at the bottom is independently stepped upon an antifriction-bearing 32, similar to that employed for supporting the lower end of the central shaft. It is rotated by a pulley 33 at a different speed from the treatment vessel, preferably slower. The construction of the wall of the deflector may be the same as that of the cylinder, except that the winding of wire is preferably omitted.

Upon the upper head of the cylinder is a receptacle 34, formed by an upwardly and inwardly projecting wall or flange 35, which may be secured to, but is preferably cast integrally with, said head. Into the annular opening between the wall of the receptacle and the hub of the head extends a feed-pipe 36, through which the ore or other material in a finely-divided state and mingled with water to form what is termed "pulp" is fed. From the lower and outer portion of the receptacle a number of orifices 37 open through the head and permit the mixture to pass into the treatment vessel. This arrangement insures a uniform feed of the pulp about the entire periphery of the treatment vessel, even if it is delivered to the receptacle at but a single point. The opposite head of the cylinder is preferably formed in two parts, a lower portion or head proper and an upper portion or ring 38, carrying the lower retaining-flange 26, previously described, and provided at its central portion with an annular series of discharge-orifices 39, through which the separated material passes. They may be of conical or inwardly-flaring form at their inner end to facilitate the passage of material and to prevent clogging. In the outer portion of the orifices are preferably placed removable nipples 40, which are externally threaded and have squared heads to permit their ready removal and replacement. This allows the renewal of the parts when worn by the attrition of the discharged material. The openings in the nipples are so small that only sufficient water escapes to wash material through, and the channel is thus kept full and the interior surface of the cylinder submerged. Through the head 20 of the cylinder is a second set of discharge-orifices 41 nearer the axis of rotation, having fitted in them outwardly-extending pipes 42, through which the excess of comparatively clear water from which the suspended material has been precipitated by centrifugal force may pass and be delivered apart therefrom. Hand-holes 42^a, suitably closed, may be provided in the head 20 to permit access to the lower portion of the cylinder.

About the two sets of discharge-orifices is a double annular trough 43, suitably supported upon the frame 10 or otherwise and divided into two sections 44 and 45, into which are discharged, respectively, the separated material and clear water. Pipes or conduits 46 46 conduct away the contents of the trough. The tops of the trough-sections 44 45 are provided with annular covers 44^a and 45^a, respectively, which rest at their outer edges upon the top of the outer wall of the sections, the inner edges extending into close proximity to the exterior of the cylinder. To permit ready access to the discharge-nipples for changing or cleaning them, the cover 44^a is provided with a sector-shaped removal panel or section 44^b and the cover 45^a with a similar section 45^b, registering with section 44^b, through which the ends of the pipe 42 may be reached.

The deflector 29 is shorter than the cylinder 17, and the step 32 of its shaft is mounted to permit the reciprocation of the latter upon the central shaft 14, it being mounted upon a sleeve 47, surrounding the central shaft. This sleeve is provided with a thread upon its outer cylindrical surface engaging a thread upon the interior of the hub of a worm-wheel 48, which rests rotatably upon the lower portion of the frame 10. A flanged wearing-ring 49, of antifriction metal, may be interposed between the worm-wheel and the frame, serving to reduce the friction, take the wear, and retain the wheel in place. A worm 50, mounted upon a suitably supported and driven shaft 51, engages the worm-wheel and by its rotation in one direction or the other serves to raise or lower the sleeve 47 by the action of the screw-thread, and thus in turn raise or lower the deflector, moving it from one end of the cylinder to the other.

To prevent the material within the cylinder from reaching the upper bearing of the deflector upon the central shaft, the head at that end is provided with a downwardly-extending annular flange 52 near its inner portion, which projects into an annular groove 53 in the head of the deflector. The flange and groove are of such a dimension or depth that the former will remain within the latter during the entire movement of the deflector, being thus always interposed between the feed-openings and the bearing. The outer wall of the groove 53 is outwardly inclined, so that if any material should fall within it it would be at once thrown out by centrifugal force.

The hub of the lower cylinder-head is mounted to rotate upon the deflector-shaft 30, having a bearing thereon, and to protect this bearing against the introduction of material a sleeve 54 is preferably interposed between the hub and the shaft, being secured to the former. Upon this sleeve is an upwardly-extending annular flange 54^a, which is encircled by a similar flange 55, depending from the lower head of the deflector. As in the device at the upper end, the flanges are of such dimension that they always overlap

and shield the bearing. To give room for these lower flanges, the head of the deflector at this end is upwardly and inwardly inclined.

Lubrication of the bearings may be effected by a central channel 56, extending through the shaft 14 to a point at which transverse channels 57 lead to the exterior of the shaft. The oil flowing out of these latter channels passes the entire length of the shaft, lubricating the bearings at 31 31, the antifriction-bearing 32, and finally the antifriction-bearing 15. About the bearing 32 is a shield or flange 58, mounted upon the sleeve 47, serving to retain the oil. To permit the driving-pulley 33 of the deflector to go in the comparatively narrow space between the lower end of the vessel and the bearing 32, the outer or face portion of the pulley is supported at its upper edge instead of at the center, leaving a recess into which the shield 58 may pass when the deflector and its pulley are lowered. The movement of the sleeve 47 downward is provided for by leaving a space 59 about the central shaft in the lower part of the frame 10. This closed space also serves as a reservoir for the excess of the lubricant.

In operation the deflector being at the point shown in Fig. 1 the period of separation is about to begin. Ore finely pulverized and mingled with water to form a pulp is fed through the pipe 36 into the receptacle 34 and passes into the vessel, which is being rotated at a speed sufficient to develop the desired degree of centrifugal force. The mixture is supplied in sufficient quantities to fill the channel or passage between the inner or separating surface and the deflector and is forced therethrough by the centrifugal force acting in the body of water between the head of the cylinder and deflector at the feed end and along the inclined surface and also to some extent by gravity, producing a current downward through the vessel. Here centrifugal force causes the material to move toward a position around the circumference of the vessel and the heavier to lodge on the separating-surface. The differential rotation of the deflector causes an agitation in the mixture within the channel, permitting the precipitation of the heavier portion, while it causes the lighter to be partially or wholly suspended in the liquid and moved along toward the discharge-orifices by the downward flow. As separation progresses and heavier material accumulates on the separating-surface the worm and worm-wheel are rotated to gradually lower the deflector, thus carrying its exterior away from the separating-surface and widening the channel between them. The distance between said deflector and the surface of the accumulating material is thus kept approximately constant, maintaining the flow through the channel constant and of such intensity as to carry along only the lighter substances. These will be delivered into the outer section of the trough and be carried away for further treatment or permitted to go to waste. When the desired amount of heavier substances or "concentrates" has accumulated on the separating-surface, they are discharged by reversing the direction of rotation of the worm, thus causing the deflector to move upward, contacting the channel and causing the deposit to be washed from the separating-surface by the resultant increased velocity of flow. If desired, the speed of rotation of the treatment vessel may be simultaneously decreased to cause the material to be held less firmly to the separating-surface and the speed of rotation of the deflector increased to produce greater agitation. During the period of discharge of the concentrates the feed of material to the treatment vessel is preferably stopped and water introduced to assist in the removal. At this time the discharge-pipe of the outer trough will be so connected or directed as to convey the concentrates to a suitable receptacle. During the entire operation comparatively clear water is discharged through the pipes 42 into the inner section of the trough and is conducted away for further treatment, to be used again or go to waste.

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

1. In a centrifugal separator, the combination of a treatment vessel supported upon a rotatable shaft, a longitudinally-movable deflector within said vessel mounted upon a hollow shaft surrounding that of the vessel and having a bearing upon the same, and another bearing for the deflector-shaft independent of the vessel, substantially as described.

2. In a centrifugal separator, the combination of a treatment vessel supported upon a rotatable shaft, an independently-rotatable and longitudinally-movable deflector within said vessel mounted upon a hollow shaft surrounding that of the vessel and having a bearing upon the same, and another bearing for the deflector-shaft independent of the vessel, substantially as described.

3. In a centrifugal separator, the combination of a treatment vessel, a shaft for rotating the same, and an independently-rotatable deflector within said vessel mounted upon a hollow shaft surrounding that of the vessel and having a bearing upon the same, the treatment vessel being secured to the inner shaft at one end and having a bearing upon the exterior of the hollow shaft at the other, substantially as described.

4. In a centrifugal separator, the combination of a rotatable treatment vessel supported upon a vertical shaft, a step for said shaft, and a longitudinally-movable deflector within said vessel mounted upon a hollow shaft surrounding that of the vessel and stepped independently thereof, substantially as described.

5. In a centrifugal separator, the combination of a rotatable treatment vessel supported upon a vertical shaft, a step for said shaft, a deflector within said vessel mounted upon a

hollow shaft surrounding that of the vessel and stepped independently thereof, and a movable means for supporting the latter step, substantially as described.

6. In a centrifugal separator, the combination of a rotatable treatment vessel supported upon a vertical shaft, a step for said shaft, a deflector within said vessel mounted upon a hollow shaft surrounding that of the vessel and stepped independently thereof, a sleeve surrounding the vessel-shaft for supporting the latter step, and means for moving said sleeve, substantially as described.

7. In a centrifugal separator, the combination of a rotatable treatment vessel supported upon a vertical shaft, a step for said shaft, a deflector within said vessel mounted upon a hollow shaft surrounding that of the vessel and stepped independently thereof, means for supporting the latter step, and means for reciprocating said support, substantially as described.

8. In a centrifugal separator, the combination of a rotatable treatment vessel, a deflector therein, an annular flange upon one head of the vessel extending into an annular groove in the head of the deflector, and feed-orifices through said head of the vessel outside the flange, substantially as described.

9. In a centrifugal separator, the combination of a rotatable treatment vessel, a longitudinally-movable deflector therein, and an annular flange upon the head of the vessel at the feed end and extending into an annular groove in the head of the deflector, said flange and groove being of such dimensions that the former will remain within the latter during the entire movement of the deflector, substantially as described.

10. In a centrifugal separator, the combination of a rotatable treatment vessel, a deflector therein, and an annular flange upon the head of the deflector encircling an annular flange upon the head of the vessel at the discharge end, substantially as described.

11. In a centrifugal separator, the combination of a rotatable treatment vessel provided with heads, a longitudinally-movable deflector therein also provided with heads, and an annular flange upon the head of the deflector encircling an annular flange from the head of the vessel at the discharge end, said flanges being of such dimension that they will remain overlapped during the entire movement of the deflector, substantially as described.

12. A cylinder, consisting of two heads mounted upon a shaft, rings of gradually-increasing diameter between said heads each composed of sectors and forming the wall of the cylinder, and inclined bolts passing through the rings between the heads and serving to clamp the parts together, substantially as described.

13. A cylinder, consisting of two heads mounted upon a shaft, wooden rings of gradually-increasing diameter between said heads each composed of sectors and forming the wall of the cylinder, and inclined bolts passing through the rings between the heads and serving to clamp the parts together, substantially as described.

14. A cylinder, consisting of two heads mounted upon a shaft, rings of gradually-increasing diameter between said heads each composed of sectors and forming the wall of the cylinder, tongues upon the sectors extending into grooves in the adjacent sectors, and inclined bolts passing through the rings between the heads and serving to clamp the parts together, substantially as described.

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