No. 689,570. Patented Dec. 24, 1901.

J. J. BERRIGAN.

PROCESS OF CENTRIFUGAL EXTRACTION.

(Application filed June 15, 1901.)

(No Model.) 2 Sheets—Sheet 1.

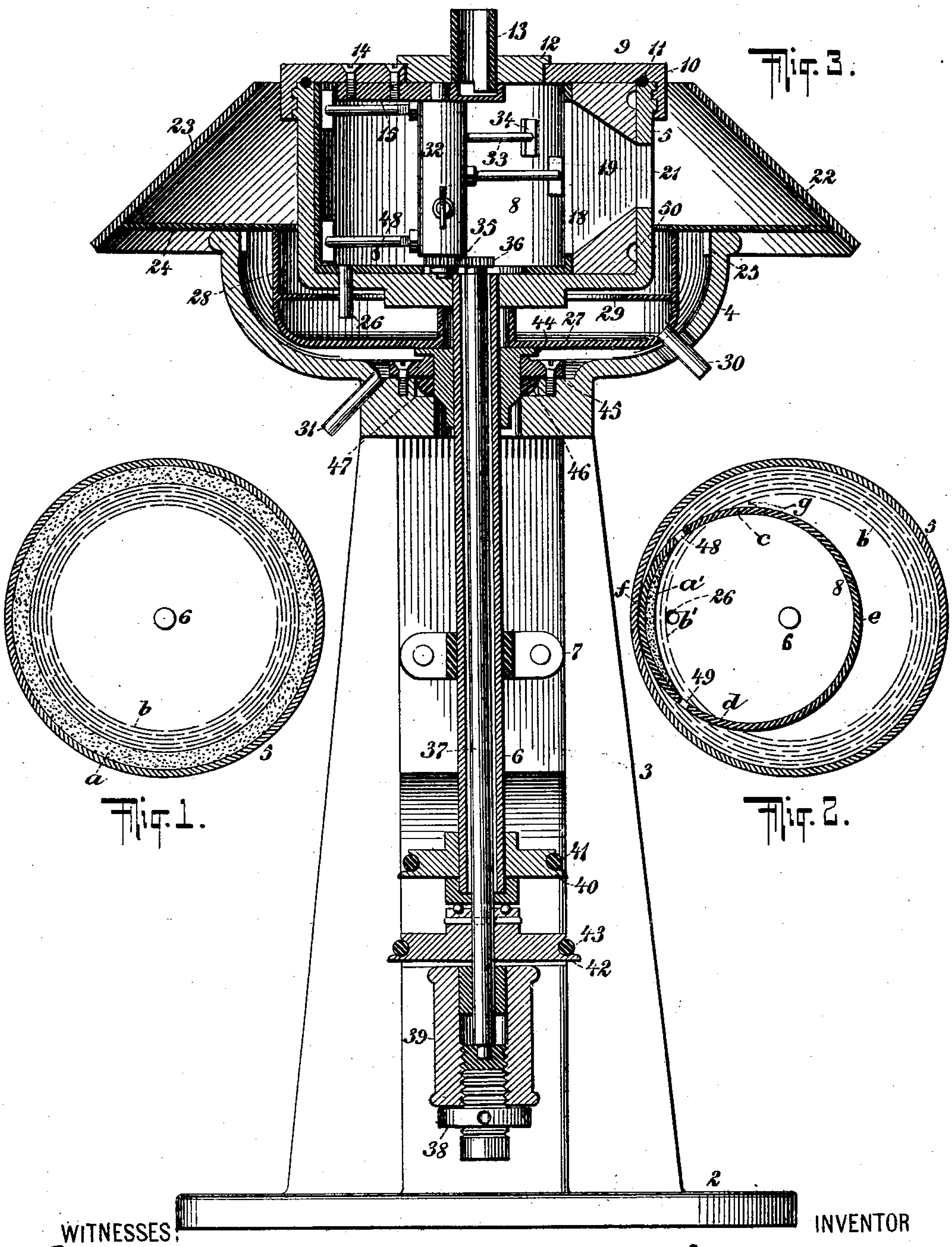

Fig. 3.

Fig. 1.

Fig. 2.

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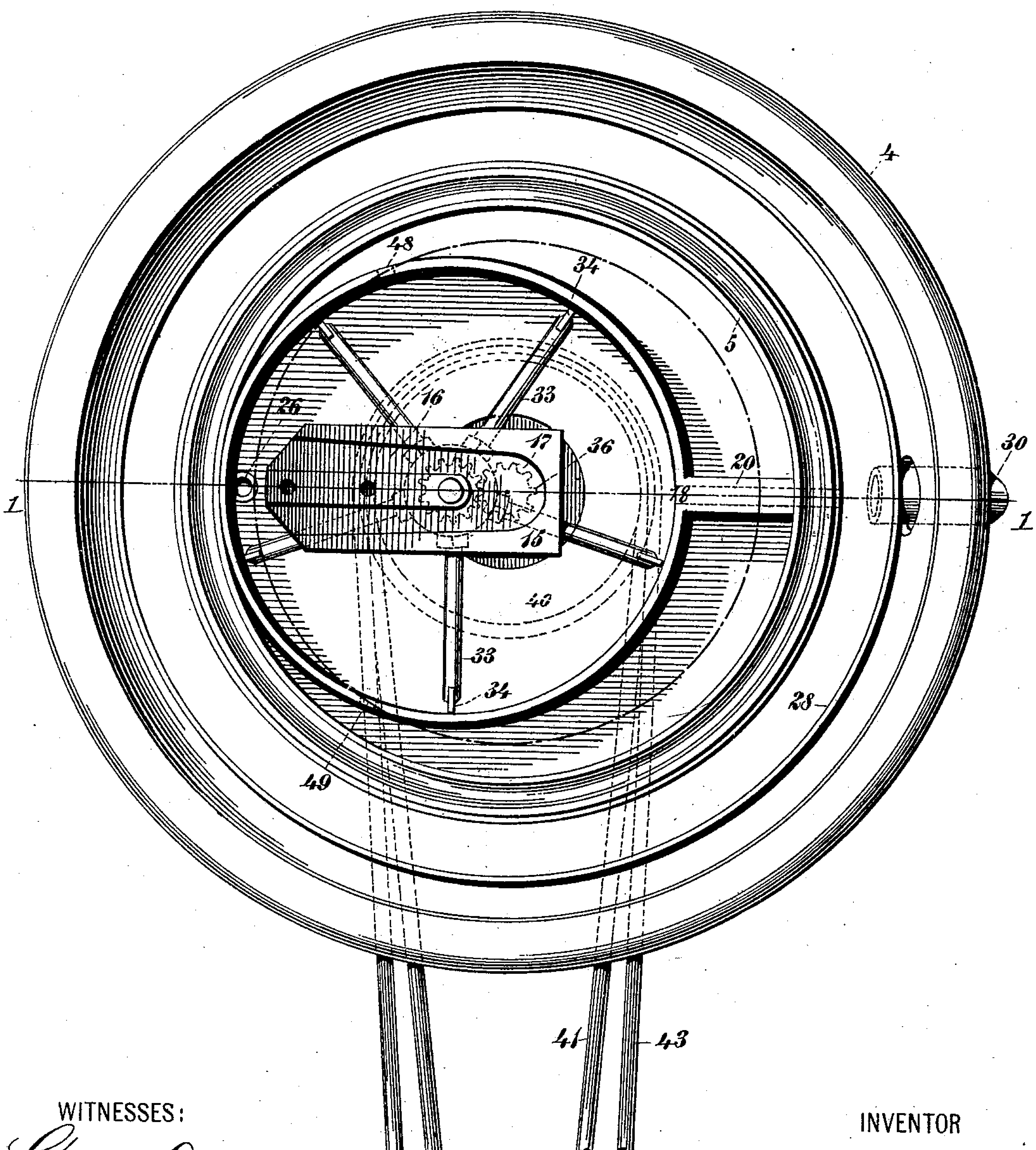
Fig. 4.



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PROCESS OF CENTRIFUGAL EXTRACTION.

SPECIFICATION forming part of Letters Patent No. 689,570, dated December 24, 1901.

Application filed June 15, 1901. Serial No. 64,660. (No model.)

To all whom it may concern:

Be it known that I, JOHN JOSEPH BERRIGAN, of East Orange, Essex county, New Jersey, have invented a new and useful Improvement in Processes of Centrifugal Extraction, of which the following is a specification.

My invention relates to the art of separating the solid constituent from a fluid mass of combined solid and liquid constituents, which consists in first depositing the solid from the mass introduced into a rotating vessel upon a definite area of the internal periphery of said vessel by the action of centrifugal force due to said rotation and permitting the liquid to escape; second, removing said solid from said place of deposit and conveying it over a portion of said internal periphery rendered substantially dry by said centrifugal force, whereby said solid is further freed from moisture, and, third, causing said solid to be ejected in substantially dry condition by the action of said centrifugal force.

In the accompanying drawings, Figures 1 and 2 are diagrams intended to illustrate my aforesaid process. Fig. 3 is a vertical section of a machine in which my said process may be carried into effect, made on the line 1 1 of Fig. 4. Fig. 4 is a plan view.

Similar characters of reference indicate like parts.

The standard 3 of the machine is preferably cast in one piece with the cup 4. In said cup is a drum 5, supported on the hollow shaft 6, which shaft is rotated by any suitable means and passes through the gland 44 in the upper portion of said standard. In the drum 5 is eccentrically placed the receptacle 8, closed above by the cover 9, having a flange 10 internally threaded to engage with the drum periphery. In the cover 9 is a flanged plug 12, which supports the inlet-conduit 13. Below the conduit 13 and secured on the under side of the cover by the screws 14 is a plate 15, in which are formed channels 16, Fig. 4. In the wall of receptacle 8 is an opening 18, which communicates through the tapering conduit 19, formed on the plate 20, with the opening 21 in the wall of the drum. The openings 18 and 21 and conduit 19 together form an outlet for the escape of the separated solid material in the manner hereinafter to be described.

Within the cup 4 is a pan 27, having a horizontal partition 29, which is open at its middle portion. Entering the pan 27 is a short pipe 26, which communicates with the receptacle 8. Through this pipe the separated liquid escapes into the pan and thence out of the machine through the short pipe 30. The short pipe 31 in the cup 4 is a drain-pipe for said cup.

32 is a cylinder pivoted in the receptacle 8 and plate 15 and provided with arms 33, which carry at their ends scraper-blades 34.

37 is a solid shaft disposed within the shaft 6 and rotated by any suitable means. Motion from this shaft is imparted to the cylinder 32 by means of the gears 35 and 36. When the cylinder 32 is rotated, the scraper-blades 34 engage with the solid material deposited on the inner periphery of receptacle 8 and carry it to the outlet 18 in the manner hereinafter described.

In the wall of receptacle 8 are openings 48 and 49, which establish liquid communication between the interior of said receptacle and that of drum 5.

Having now described the construction of one specific apparatus in which I may carry my process into effect, I will now explain the principle on which that process depends and the various steps by which it is performed, referring for convenience to the illustrative diagrams, Figs. 1 and 2.

Fig. 1 shows in plan a circular vessel—such as the drum 5, for example—rotating on a central axis 6 and without internal partitions or chambers. If a liquid is placed in such a rotating drum, it will form, through the action of centrifugal force, a ring in contact with the inner periphery of the drum. If a combined liquid and solid be introduced, then the solid (if heavier than the liquid) will form a ring, as *a*, against the periphery, while the liquid will form a ring *b* within the ring *a*. If the liquid is heavier than the solid, then the liquid will form the outer ring *a* and the solid the ring *b*.

In Fig. 2 I have placed the receptacle 8 eccentrically within the drum 5. Assume liquid only, as water, to be introduced into receptacle 8. Then that liquid will flow through the openings at 48 and 49 from the receptacle into the drum, and, as before, by the action of centrifugal force when the drum is rotated will form a ring which will extend around the inner periphery of the drum and be intersected at relatively opposite points, as *c d*, by the periphery of receptacle 8, or the position of the receptacle 8 in the drum 5 may be thus defined as follows: That said receptacle is so placed in said drum that a portion of said receptacle extends into the layer of material formed around and within the drum periphery by the action of centrifugal force. Now if the drum in Fig. 2 be considered for the moment at rest then the liquid will of course meet every part of the immersed periphery of the receptacle 8; but when the drum is in rotation and the liquid ring is formed the liquid in the receptacle 8 is withdrawn from all that portion of the inner periphery thereof which is included in the arc *c e d* between *c* and *d*, which lies nearest the axis of rotation, and concentrated in that portion of the periphery which is included in the arc *c f d* between *c* and *d*, which lies farthest from the axis of rotation. The arc *c e d* therefore shows the extent of inner surface of the receptacle 8, which by reason of the withdrawal of liquid therefrom becomes a substantially dry surface. Obviously its length measured circumferentially around the receptacle 8 will depend upon the location of the points *c d*, where the ring of liquid intersects the periphery of said receptacle, or, in other words, upon the thickness of the ring measured radially to the axis of rotation. Obviously, again, the thickness of the ring will be dependent upon the distance of the liquid-outlet similarly measured from said axis. Thus if said outlet be located at 26 in Fig. 1 the thickness of the ring will be determined by the distance of the hole from the axis of rotation and will be equal, or substantially so, to the distance of the hole from the inner perimeter of the drum. If the opening at 26 were moved nearer to the perimeter of the drum 5, the ring would be thinner, the arc *c f d* smaller, and the dry surface *c e d* larger. If the opening at 26 were moved nearer to the center of drum 5, the ring would be thicker, the arc *c f d* larger, and the dry surface *c e d* smaller. With this explanation any one skilled in the art can regulate the perimetrical length of the dry surface in the receptacle 8 as he may deem best. So, also, he may accomplish a like result by increasing or diminishing the diameter of the receptacle 8 or by changing the shape or configuration of said receptacle. So far I have considered for the sake of simplicity in explanation a liquid only as introduced into the receptacle 8 of Fig. 2 and forming a ring around the periphery thereof in the manner described. Now assume that after the apparatus has been started with liquid only a fluid mass of combined solid and liquid is introduced into receptacle 8 and preferably directed so that it meets the inner periphery of said receptacle at *f*, the point of tangency between said receptacle and drum 5. The solid constituent will at once be thrown against the inner periphery of receptacle 8, as shown at *a'*, but not against the inner periphery of drum 5 exterior to said receptacle, because it is retained in the latter, the wall thereof forming an efficient barrier. The liquid in the introduced mass may mingle through the openings 48 and 49 with the liquid in the drum 5 first introduced. Therefore the ring of material formed by the action of centrifugal force is not a continuous ring *a* of solid with an internal continuous ring *b* of liquid, as in Fig. 1, but is a ring made up of a part wholly liquid—namely, that part outside of the receptacle 8—and a part which is formed of solid material *a'* and liquid *b'*—namely, that part inside the receptacle 8. This state of affairs being clearly apprehended, I come to the mode of dealing with the two materials, solid and liquid, thus segregated. In earlier machines the organization has been such as to produce the double continuous ring *a b* of Fig. 1. The solid material, in my judgment, cannot be got out of an apparatus thus organized without bringing with it an amount of liquid which by ordinary processes and with the materials for which centrifugal treatment is desirable cannot be expelled except at prohibitory cost. Consider now the new conditions. From the receptacle 8 of Fig. 1 the liquid thrown against the periphery escapes by the opening 26, leaving the solids still adherent. Now conceive a means of carrying that solid from the place of its deposit (*c f d*, Fig. 2) away from the liquid layer to the dry surface (*c e d*, Fig. 2) and then transporting it over that surface before allowing it to escape. The solid is now being revolved not in liquid, but in the presence of the atmosphere, and thus it is rapidly deprived of moisture.

I have already pointed out how the absolute length of the dry surface may be varied. It is also possible in the construction illustrated in Fig. 2 to vary the effective length by suitably placing the orifice at which the dry solid escapes. Thus if the solid is carried over the dry space in the direction *d e c* and the outlet be placed, say, at *g* very near to *c* the solid material will be carried over the entire length of the dry surface before it is permitted to escape. If the opening be placed at *e*, midway between *d* and *c*, then the material will be carried over half that surface, and so on. Thus the person skilled in the art may establish for himself the desired effective length of dry surface.

Having now generally described the operation of the apparatus, I will explain that of the specific machine illustrated in Figs. 3 and 4. Motion being imparted to the pulleys 40 and 42 and the drum set in rotation, I first introduce a sufficient amount of liquid to produce the liquid ring. Then through the inlet-conduit 13 the combined solid and fluid material is introduced. As it descends upon the plate 15 it is carried by the action of centrifugal force through the channels 16 and is projected against that part of the inner periphery of the receptacle 8 which is farthest from the axis of rotation of the drum 5, and, as has already been described, there will thus be formed a layer of solid immediately adjacent to said periphery at the part aforesaid and a layer of liquid inside the solid layer. The liquid layer will escape through the pipe 26, pass to the pan 27, and out at the pipe 30 into any suitable receptacle. The solid layer as fast as it is formed is removed from the inner periphery of receptacle 8 by the revolving blades 34 and is carried over to the dry surface within the receptacle 8 in the manner already described. This dry surface in the machine here shown extends from either the opening 48 or the opening 49 to the escape-opening 18, depending upon the direction of rotation. In this particular machine I place the plate 20, containing the tapered outlet-conduit, in line 1 1 of Fig. 4, and therefore in the line which passes through the axis of rotation and the point of tangency of the periphery of receptacle 8 and the periphery of drum 5 for the sake of the better balance obtained. I therefore use only one-half of the effective dry surface, which I find by actual experiment with this machine to be practically sufficient. The solid material is therefore carried by the blade 34 over the dry surface within receptacle 8, and then by the action of centrifugal force it is ejected through the conduit 19 and opening 21 in the side of the drum.

I claim—

The improvement in the art of separating the solid constituent from a fluid mass of combined solid and liquid constituents which consists in, first, depositing the solid from the mass introduced into a rotating vessel upon a definite area of the internal periphery of said vessel by the action of centrifugal force due to said rotation and permitting the liquid to escape; second, removing said solid from said place of deposit and conveying it over a portion of said internal periphery rendered substantially dry by said centrifugal force whereby said solid is further freed from moisture, and, third, causing said solid to be ejected in substantially dry condition by the action of said centrifugal force.

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