

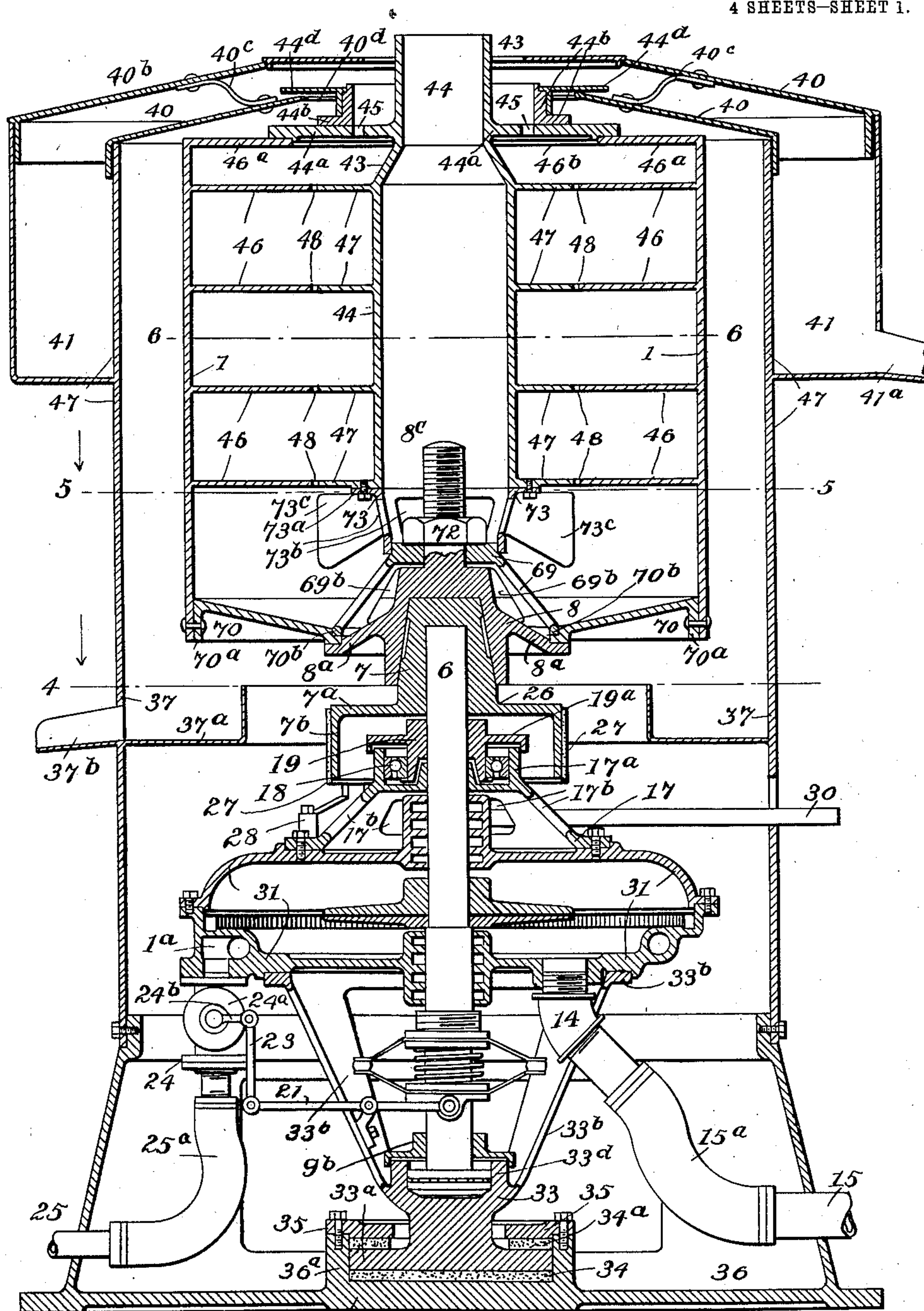
G. E. SANFORD, E. W. KOPKE & H. E. PROCUNIER.  
CENTRIFUGAL SEPARATOR.

APPLICATION FILED DEC. 24, 1909.

Patented May 23, 1911.

992,809.

4 SHEETS—SHEET 1.



Witnesses:

Fig. 1.

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per Chas. H. Burton

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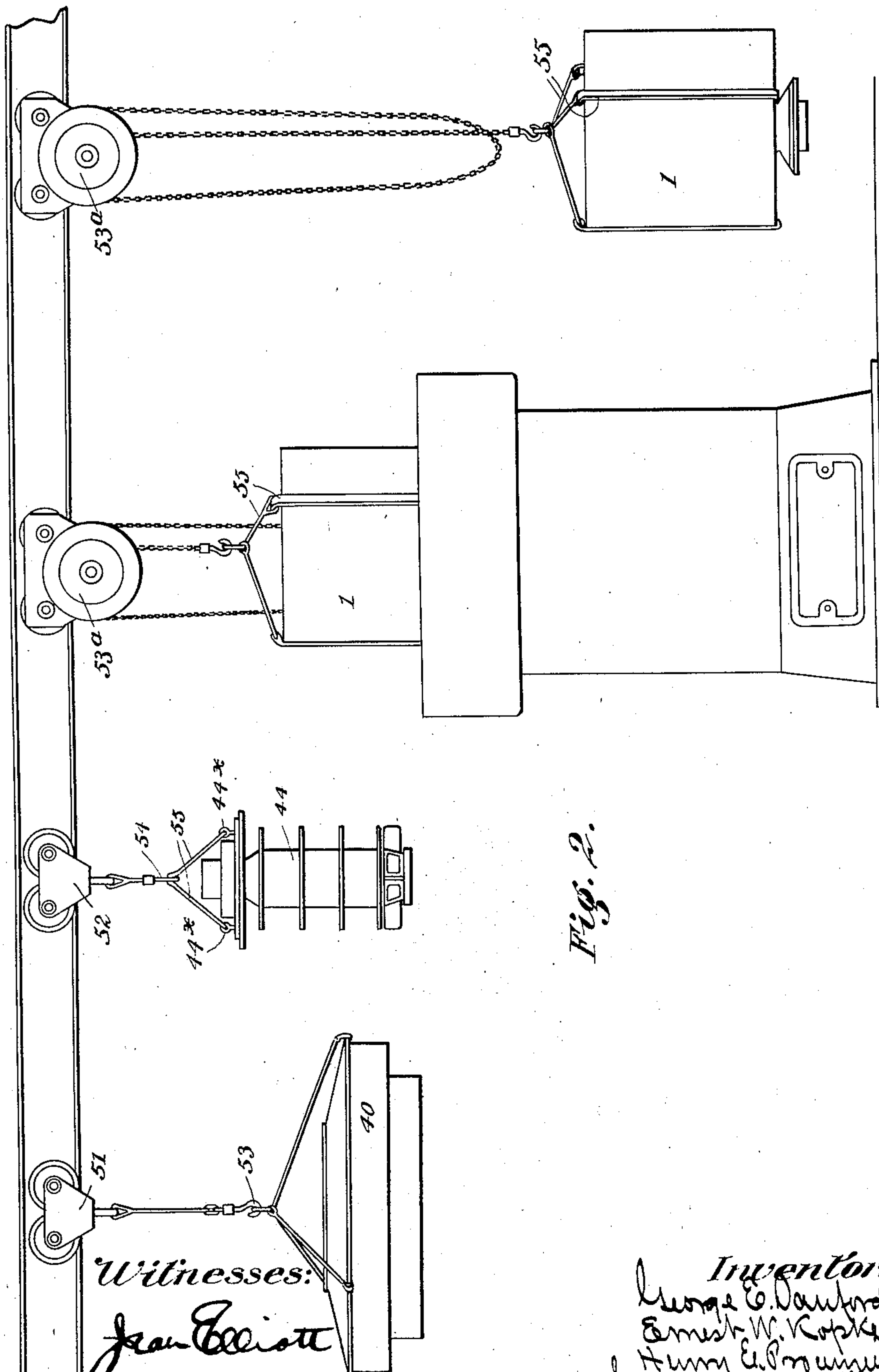
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4 SHEETS—SHEET 2.



Witnesses:

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4 SHEETS—SHEET 3.

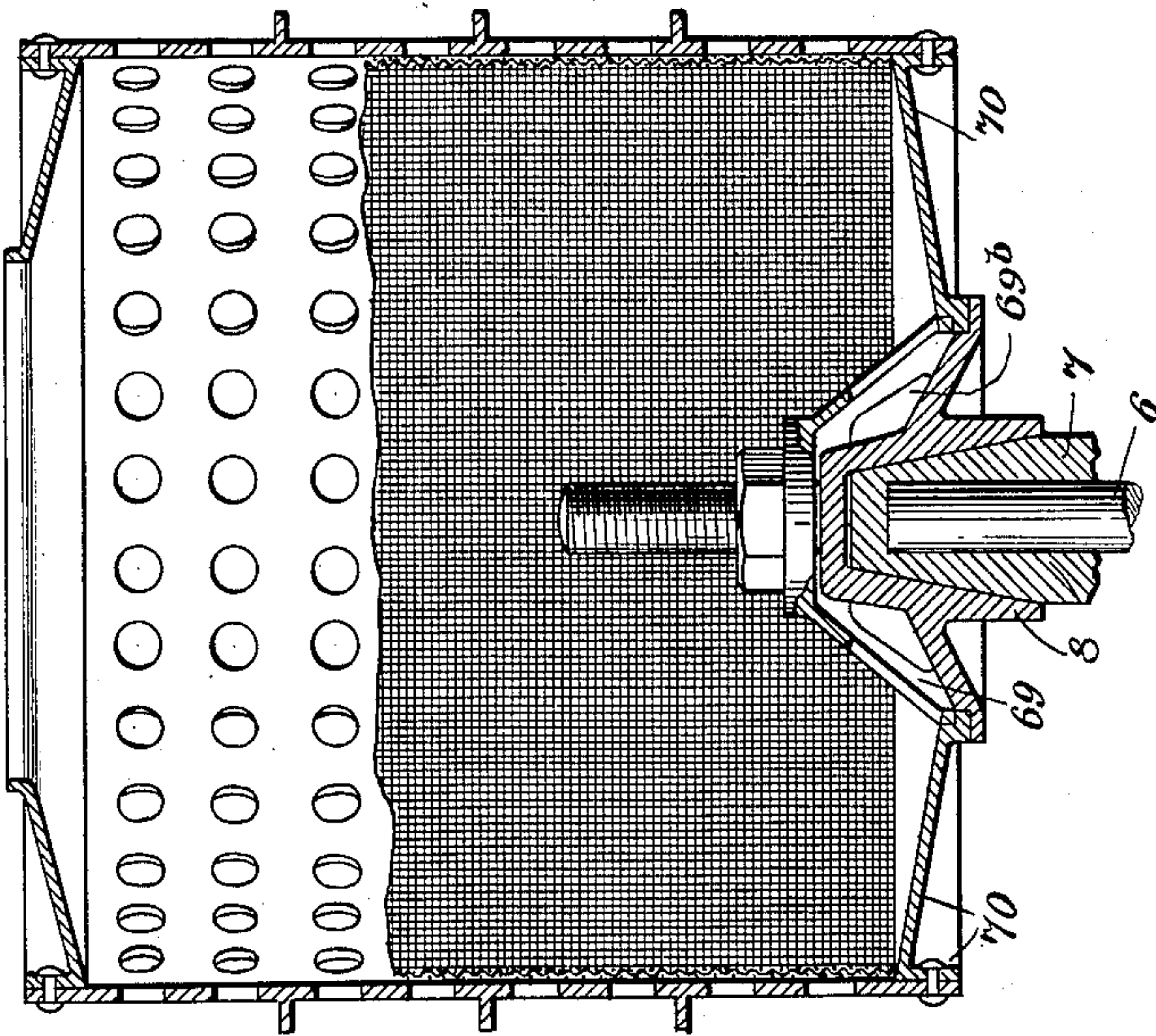


Fig. 3.

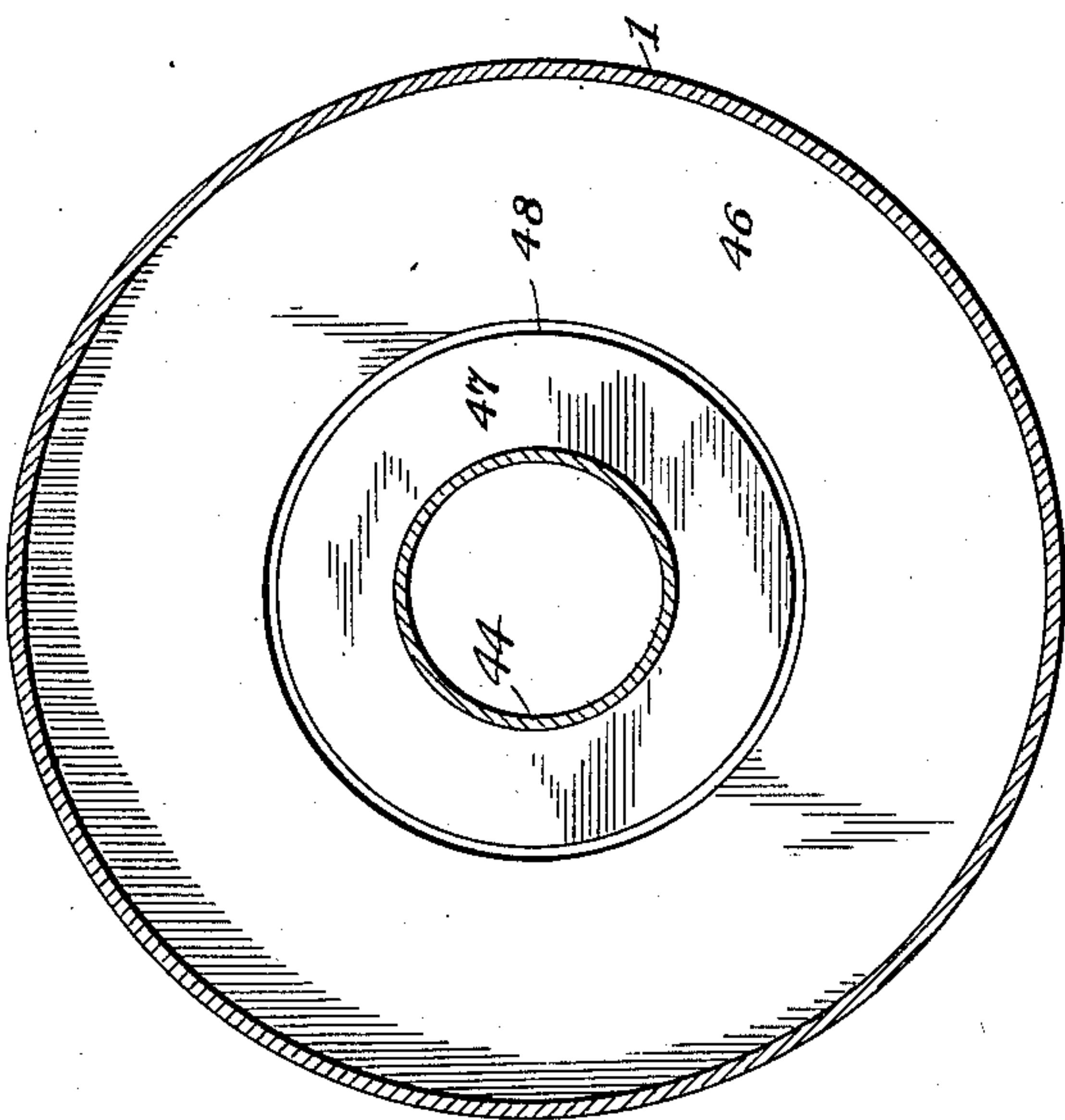


Fig. 6.

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4 SHEETS—SHEET 4.

992,809.

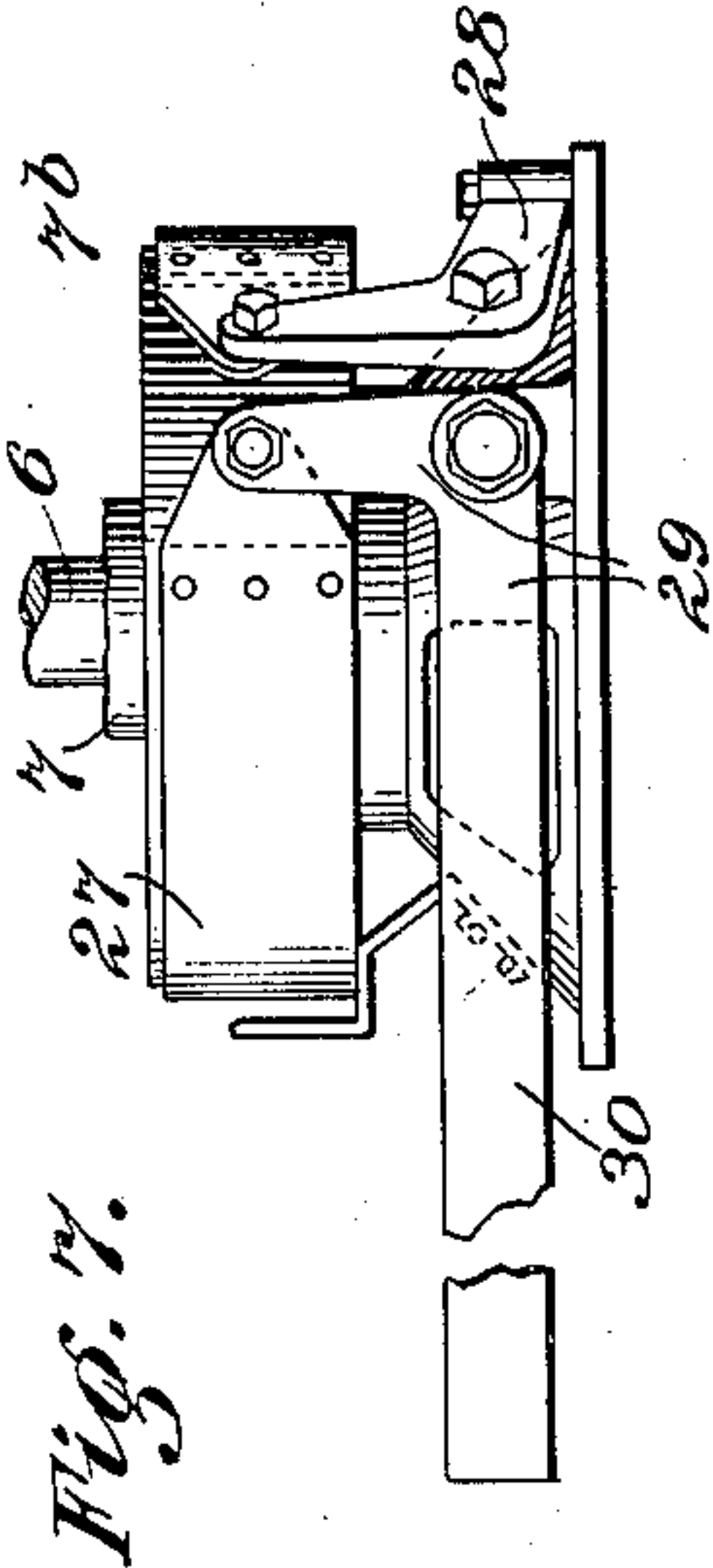


Fig. 1.

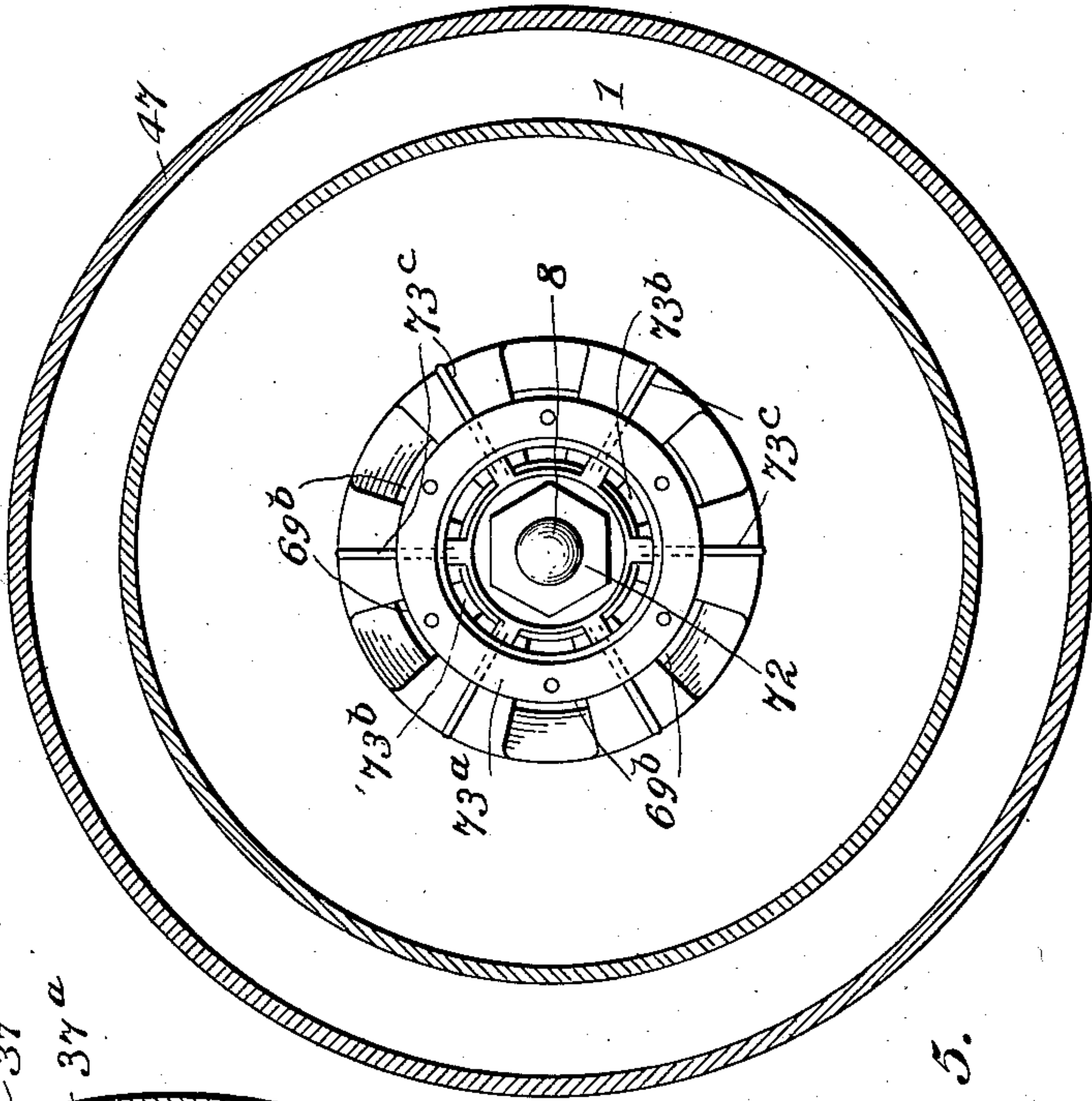


Fig. 5.

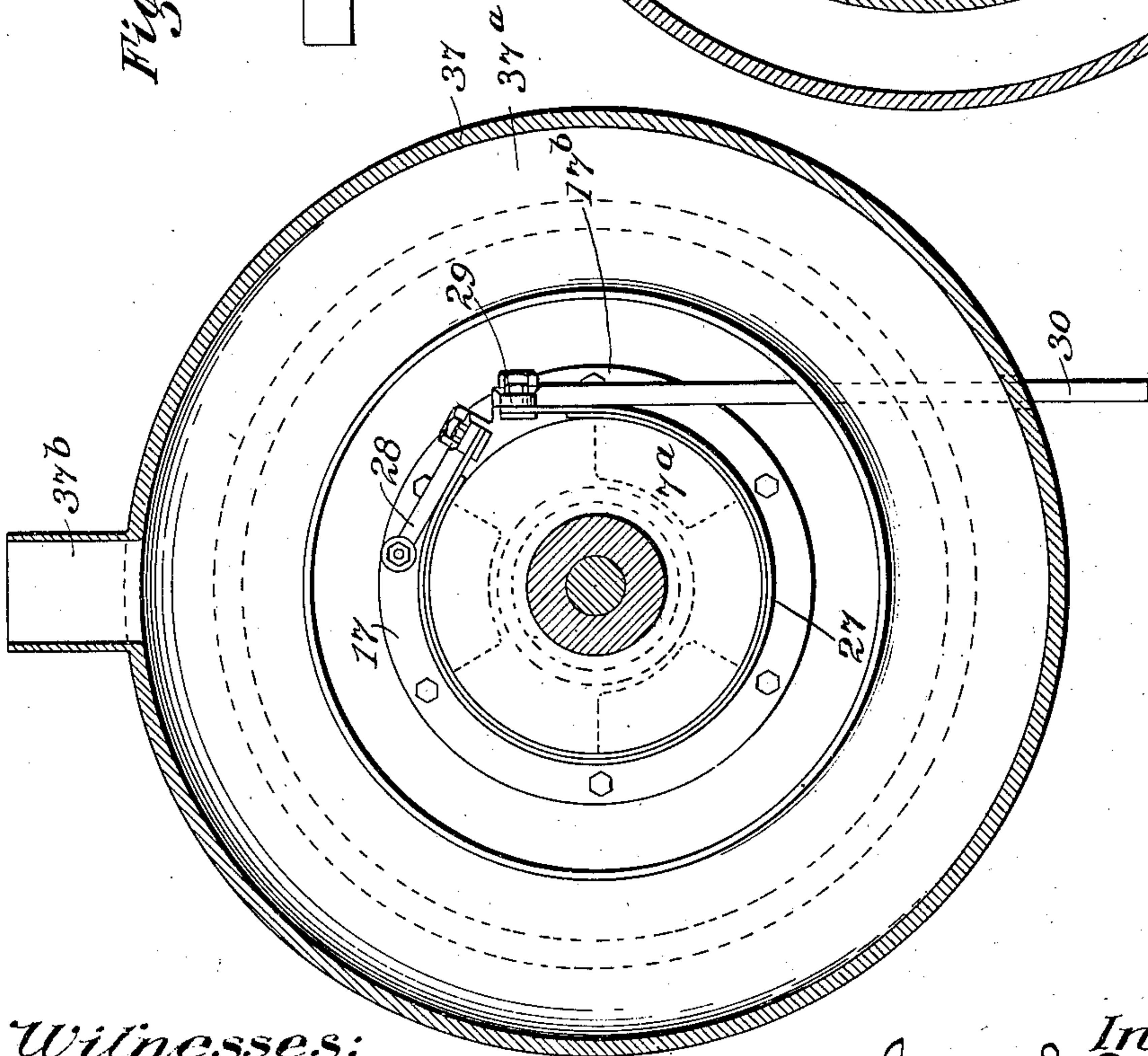


Fig. 4.

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# UNITED STATES PATENT OFFICE.

GEORGE E. SANFORD, ERNST W. KOPKE, AND HENRY E. PROCUNIER, OF CHICAGO, ILLINOIS, ASSIGNORS TO INTERNATIONAL CLARIFYING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW JERSEY.

## CENTRIFUGAL SEPARATOR.

992,809.

Specification of Letters Patent.

Patented May 23, 1911.

Application filed December 24, 1909. Serial No. 534,806.

*To all whom it may concern:*

Be it known that we, GEORGE E. SANFORD, ERNST W. KOPKE, and HENRY E. PROCUNIER, citizens 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, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved structure for separating by centrifugal action, substances of different densities, whether all are liquid or part liquid and part solid.

It consists in the element and features of construction and their combinations, shown and described as indicated in the claims.

In the drawings: Figure 1 is a vertical axial section of a structure embodying this invention. Fig. 2 is a side elevation of the same, together with the means for separating the several parts for discharging the contents and cleansing. Fig. 3 is an axial section of a bowl which is designed to be substituted for the separator bowl shown in Fig. 1, for continuing the process of separation as a process of drying when the material operated with is a moist granular or disintegrated substance, as in sugar making. Fig. 4 is a horizontal section at the line 4—4 on Fig. 1. Fig. 5 is a horizontal section at the line 5—5 on Fig. 1. Fig. 6 is a horizontal section at the line 6—6 on Fig. 1. Fig. 7 is a detail side elevation showing the brake connections and operating device.

The specific purpose for which the structure shown in the drawings is designed, is that of clarifying liquids for discharging the solid impurities therefrom, and also for drying moist granular or pulverized solids, and is intended for operating upon such materials as sugar-bearing liquor, and one feature of the invention consists in providing for rotating the rotary element in which the centrifugal separation is effected, with a steam turbine motor having its axis vertical for carrying and rotating such bowl, the entire structure being substantially a unitary one, though the different elements are separable and are designed to be separated in the process of operating the device for its entire purpose of separating the material

treated and discharging the impurities separately from the clarified liquor.

The apparatus comprises a hollow fixed base, 36, having at the center an upstanding hollow boss, 36<sup>a</sup>, whose upwardly opened cavity affords a seat and whose bottom forms a step bearing or support for the base, 33<sup>a</sup>, of the standard, 33, of the turbine casing, said standard comprising arms diverging upwardly from the base, and joined at their upper ends by an annular flange, or rim, 33<sup>b</sup>, on which the turbine casing, 31, is lodged with its axis coincident with that of said base standard. The bottom portion of the cavity of the boss, 36<sup>a</sup>, is occupied by a yielding cushion, 34, preferably of rubber, upon which the flat bottom of the base, 33<sup>a</sup>, rests; and above said bottom there is lodged thereon an annular cushion, 34<sup>a</sup>, said cushion being retained by an annular flange part, 35, which is bolted to the top of the annular boss, so that the flange-like base, 33<sup>a</sup>, of the turbine casing standard, 33, is held between the two cushions, 34, and 34<sup>a</sup>, and the standard and turbine casing and all the structure resting thereon, as hereinafter described, is thereby adapted to slight yielding in all directions away from strict vertical position.

The turbine casing, 31, has a steam inlet opening, 1<sup>a</sup>, to which is connected a fitting, 24, having a valve, 24<sup>a</sup>, and an exhaust or outlet opening to which there is connected a fitting, 14, the fittings, 24, and 14, being connected by flexible tubes, 25<sup>a</sup>, and 15<sup>a</sup>, respectively, with the fixed steam supply exhaust pipes, 25, and 15. The purpose of this flexible connection is to accommodate the rocking or vibrating action of the entire structure which tends to result from rapid rotary motion of even the most perfectly balanced body when stepped at the lower end, and revolving about a vertical axis. The turbine shaft, 6, is stepped at its lower end by means of a suitable anti-friction bearing, 9, in the upper end of the hub, 33<sup>a</sup>, of the base, 33, within the diverging arms, 33<sup>b</sup>, and 9<sup>b</sup>, represents a cap or cover for this step bearing. On the upper side of the turbine casing, 31, there is mounted a shaft-bearing standard or spider, 17, comprising a central hub, 17<sup>a</sup>, downwardly diverging arms, 17<sup>b</sup>, and an annular rim connecting the extremities of the arms, said rim being



seated and centered on the upper side of the casing, 31, and bolted thereto. The hub of this spider is formed with an upwardly open chamber which accommodates a ball bearing, 18, for the turbine shaft, 6, above which is mounted a collar, 19, which is fast on the turbine shaft, 6, and has a horizontal flange, 19<sup>a</sup>, which forms a cover for said chamber to inclose and protect the ball bearing. The turbine shaft, 6, projects above said collar, and at its upper end has secured rigidly to it a cap, 7, which is exteriorly tapered and at its lower end has a horizontal flange, 7<sup>a</sup>, from the outer periphery of which a cylindrical flange, 7<sup>b</sup>, projects downward, encompassing the spider, 17, and the ball bearing. This cylindrical flange, 7<sup>b</sup>, is designed to operate as a brake wheel, a brake strap, 27, being provided, extending about it, having one end attached to a stationary bracket arm, 28, rigid with the spider, 17, and the other end to a bell-crank-lever support, 29, which is fulcrumed on the spider and has an arm, 30, projecting horizontally and protruding through the cylinder, 37, forming a brake handle, to be operated at will for drawing the strap tight upon the brake wheel, which is done by lifting the arm, 30. The weight of the arm, 30, thus operates to slacken the brake strap when the operator releases the brake handle. It will be understood that the turbine motor has suitable governing devices, 16, for insuring uniformity of speed, the centrifugally operated elements of such governor being connected by lever, 21, and link, 23, with the operating handle, 24<sup>b</sup>, of the steam inlet valve, 24<sup>a</sup>. The detail construction of this governor is not a part of this invention and will not be further particularly described.

Upon the upper end of the turbine shaft, 6, and more specifically upon the tapered cap, 7, rigid with said shaft, there is mounted the separator bowl. This bowl comprises a bottom consisting of three elements, 8, 69 and 70, hereinafter more particularly described; a cylindrical shell, 1, having projecting inwardly from its cylindrical wall horizontal shelves or ledges, 46, and a central element which consists of an axial tube, 44, having exteriorly projecting horizontal annular shelves or flanges, 47, at horizontal planes of the shelves, 46, of the outer shell, 1. Two of the elements of the bottom, 69, and 70, constitute what may be termed the permanent bottom, and the third element, 8, constitutes a movable bottom. The element, 70, is a slightly dished annulus, having at its exterior circumference a flange, 70<sup>a</sup>, fitting within the lower end of the outer shell, 1, and riveted thereto. The other member of the fixed bottom, 69, is a frusto-conical spider, comprising at its upper end a hub from which extends a flaring apertured web, whose lower outward circumferential edge

is seated in a rabbet, provided at the outer side of the inner circumferential margin, 70<sup>b</sup>, of the element, 70, said web having a plurality of apertures, 69<sup>b</sup>, for free communication with the cavity of the bowl when the movable bottom is withdrawn. Said movable bottom, 8, comprises a hub which has in its lower end a frusto-conical socket for fitting upon the frusto-conical cap at the upper end of the shaft, 6. From said hub at about the middle of its length projects a downwardly flaring web, 8<sup>a</sup>, whose outer circumferential margin engages under the inner circumferential marginal portion of the element, 70, that is, opposite the rabbet, 70<sup>b</sup>, in which the element, 69, of the fixed bottom is seated as described. From the hub, 8, an axial threaded stem, 8<sup>c</sup>, projects upward through the hub of the element, 69, which is centrally apertured, and a nut, 72, applied on said stem above the hub of the element, 69, serves to draw and bind the parts, 69, and 8, against the opposite surfaces of the inner circumferential margin of the element, 70, for closing up the bottom. The central element of the bowl comprising the tubular axial part, 44, is connected with the part, 69, of the fixed bottom, by means of a frusto-conical collar, 73, having its lower end fitted about the upper end of the hub, 69, and having at its upper end a flange, 73<sup>a</sup>, which is bolted to the lowest horizontal shelf or ledge, 47, of said central element. This frusto conical collar has a plurality of apertures, 73<sup>b</sup>, between which there are provided projecting outwardly, a like plurality of blades or vanes, 73<sup>c</sup>, which have the function of accelerating the communication to the liquor of the rotary movement of the bowl for the purpose of the centrifugal separating action desired.

The outer diameter of the shelves or ledges, 47, of the central element of the bowl is less than the inner diameter of the shelves or ledges, 46, of the outer element by a small amount, so that there is left between the outer circumference of the shelves, 47, and the inner circumference of the shelves, 46, a narrow, annular aperture, 48.

The liquor to be treated is supplied through the axial tube, 44, of the central element of the bowl and passes out through the openings, 73<sup>b</sup>, at the bottom of said tubular element, being accelerated in its rotation by the vanes, 73<sup>c</sup>, with the effect of causing the heavier solids to be deposited below the shelves, 46, and the lighter solids or "float" material to be caught under the shelves, 47, while the clarified liquor of intermediate density passes up through the annular aperture, 48, between the shelves of the outer and central elements respectively, additional deposits of solid material, light and heavy, being made under the several shelves as the liquor passes up. The upper



disk or head, 46<sup>a</sup>, of the outer element, 1, of the bowl has its central aperture, 46<sup>b</sup>, of greater diameter than that of the several shelves, 46. The central element has projecting from the inner tubular member, 44, a horizontal flange, 44<sup>a</sup>, which covers the central aperture, 46<sup>b</sup>, of the head, 46<sup>a</sup>, and secured to said flange at the outer or upper side, there is a flanged collar, 44<sup>b</sup>, whose vertical, cylindrical element is concentric with said tubular element, 44. The flange, 44<sup>a</sup>, is provided with a multiplicity of apertures, 45, just inside the flange collar, 44<sup>b</sup>, so that the liquor which has passed through the upper annular aperture, 48, between the two horizontal shelves, 46, and 47, of the outer or inner members of the bowl, is discharged through said apertures, 45, into an annular pocket formed between the vertical cylindrical member, 44<sup>b</sup>, and the axial tube, 44. On said collar, 44<sup>b</sup>, there is mounted so as to project horizontally from its upper end an annular disk, 44<sup>a</sup>, which extends out over the central aperture, 40<sup>a</sup>, of a cover, 40, which is provided to close the upper end of the shell, 47, said disk serving to conduct the liquor which passes into said annular chamber of the collar, 44<sup>b</sup>, and is discharged centrifugally therefrom, beyond the central opening of the cover, 40, and deliver it sloping upon the top of said cover, from which it flows into an annular receptacle, 41, which is provided encompassing the upper end of the shell, 47. From this receptacle liquor passes continually or as desired, by a discharge spout or conduit, 41<sup>a</sup>. A cover, 40<sup>b</sup>, is provided for the receptacle, 41, and is preferably connected rigidly with the cover, 40, by straps, 40<sup>c</sup>, said cover, 40 being overhung at its inner circumference by the annular disk, 44<sup>a</sup>, will engage said disk, when said cover is lifted. These covers being first removed, the central element, 44, of the bowl, may be lifted out carrying the lighter impurities on its shelves, 47, which pass out through the central aperture of the main or outer element. The said central element being removed for emptying and cleaning, the outer member of the bowl, may next be lifted off the cap, 7, at the upper end of the turbine shaft, and carried laterally away from the shell to a suitable position for discharging the solid contents deposited under its shelves, 46. For ready access for removing such deposit, the nut, 72, will be screwed up on the stem, 8<sup>c</sup>, by means of a socket wrench extended down through the central openings of the shelves, 46, and thereby the movable bottom, 8, will be dropped away from the fixed bottom and may be removed entirely if desired, giving free access through the apertures, 69<sup>b</sup>, of the central member of the bottom, into the cavity of the outer element of the bowl from whose shelves and bottom, the solid material may be scraped for dis-

charge through the apertures of the central member of the fixed bottom.

The separator thus far described, is preferably positioned under an overhead trolley track, 50, upon which trolley hangers or carriages, 51, and 52, are mounted, for traveling past the separator above the same. Grappling hooks, 53, and 54, of suitable sizes are suspended from the trolley hangers or carriages for grappling the cover, 40, and the central element, 44, the latter having suitable eyes, 44<sup>x</sup>, on its top plate for engagement of the grappling hooks, so that first the cover and afterward the central element may be readily withdrawn upward and carried out of the way by the carriages on the track, 50. A third trolley carriage, 53, is then brought into position and its grappling device, 55, dropped into position for engaging the main or outer element of the bowl which is lifted off the cap, 7, at the upper end of the turbine shaft, and carried away by the trolley carriage to a position for discharging the solid contents. Meanwhile the trolley carriages, 52, and 53, are disengaged from the elements, 44, and 1, respectively, and engaged with duplicate parts which may be brought back into position above the shell of the separator and assembled for operation while the parts which have been removed are being emptied and cleaned. By this means the operation is practically continuous, the necessary interruption for moving one bowl and substituting another being very short.

It is intended that the same structure as to motor and inclosing casing, should be employed in the process of sugar making for drying the sugar, and for that purpose it is only necessary to substitute for the bowl described above, a suitable centrifugal drying bowl, such as illustrated in Fig. 3. This bowl has the ordinary construction of centrifugal drier, except as to the bottom, which is identical with the bottom of the separator above described, comprising three parts, 69, 70, and 8, the last of which fits upon the tapering cap, 7, at the upper end of the turbine shaft. To adapt the structure as a whole for this substitution, the outer shell, 37, is provided with an annular drainage-pan 37<sup>a</sup>, positioned below the bottom of the rotating separator or drier, into which the liquid discharged over the top of the rotating drier is received, from which it is discharged and drawn off by a spout, 37<sup>b</sup>.

We claim:

1. In combination with a rotary motor having its axis vertical, a centrifugal separator bowl having a bottom comprising three members, the outer member being annular and dished so that it slopes downward from its outer to its inner circumference; the second member being frusto-conical and aper-



tured in its sloping area and at its lower and wider base seated upon the inner circumferential margin of the dished member, the third member having a threaded stem which penetrates the center of the second member, and a frusto conical flange which at its margin fits under the inner circumferential margin of the dished member opposite the seat of the second member, and a nut on the threaded stem for clamping the second and third members onto the dished member, said third member being socketed on its under side and constituting the means of mounting the bowl upon the shaft.

2. In a centrifugal separator, a bowl having its axis vertical, and means upon which it is mounted for rotation about such vertical axis, said bowl comprising an outer cylindrical element having horizontal annular shelves or ledges projecting from the inner surface of its outer cylindrical wall; an inner element having an axial chamber, and having annular horizontal shelves or ledges projecting from its outer circumference at the planes respectively of the shelves or ledges of the outer element; the outer diameter of the annular shelves of the inner element being slightly less than the inner diameter of the shelves of the outer element, whereby narrow annular passages are formed between the edges of said shelves respectively; the bottom of the bowl comprising a central member which supports said inner element, the latter being apertured below the lowest of the shelves for communication of its axial chamber with the cavity of the bowl outside said inner element.

3. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about such axis, such bowl comprising an axial chamber open at the top for reception of the material to be treated; an annular chamber encompassing the axial chamber; a closed bottom for the entire bowl comprising an annular member fixed with respect to the bowl, a central member which is movable downwardly from the annular member and an apertured or false bottom above the removable central member.

4. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about its axis, comprising an axial chamber and an annular chamber encompassing the axial chamber; a plurality of annular shelves or ledges projecting at the same planes from the inner and outer walls respectively of the annular chamber, having respectively their outer and inner circumferences slightly separated forming narrow annular passages between them; the top of the bowl being apertured for escape of the liquid at an annular area or zone, and having an upwardly and outwardly extending flange projecting from the top out-

side said annular area; an annular cover overhanging the bowl and having its inner circumference overhung by said flange, and a liquid receptacle within which said annular cover terminates at said outer circumference.

5. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about such axis, comprising an axial chamber open at the upper end to receive the material to be treated and an annular chamber encompassing such axial chamber; a plurality of annular shelves projecting at the same planes from the inner and outer walls respectively of said annular chamber having respectively their outer and inner circumferences separated forming annular passages between them; the top of the bowl being apertured for discharge at an annular area and having an upwardly and outwardly extending flange encompassing said annular discharge area; an annular receptacle encompassing the upper part of the bowl and having its top or cover extending above an annular area whose inner circumference is the outer circumference of said flange; whereby the liquid is discharged from said flange under said cover.

6. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about said axis, comprising an axial chamber and an annular chamber encompassing the same; the axial chamber having communication at its lower end with the lower part of the annular chamber; shelves or ledges in the annular chamber formed with passages through which the liquid may move upward past said shelves; the top of the chamber being apertured for discharge at an annular area, and having an outwardly extending flange encompassing said area; a fixed annular receptacle encompassing the bowl, having covers extending inwardly from its outer and inner circumferences respectively overhanging the bowl, said flange terminating at its outer circumference between said covers for discharge of the liquid which passes over it between the covers for delivery thereby into said annular receptacle.

7. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about said axis, comprising a central member having an axial chamber and an outer member inclosing an annular chamber between the two members; a closed bottom for the entire bowl, and a false bottom above the central portion of the closed bottom apertured at an annular area outside the lower end of the axial chamber, the closed bottom having a movable central member below said apertured false bottom.

8. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about such axis, comprising



a central member having an axial chamber and an outer member inclosing an annular chamber between the two members; a bottom for the entire bowl on which the central member is removably stepped at its lower end; a plurality of annular shelves projecting outwardly from said central member and inwardly from the outer member, spaced apart to form annular passages between them, the top of the outer member having a central aperture through which the shelves of the inner member can pass.

9. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about such axis, such bowl comprising a central member having an axial chamber open at the upper end for reception of the material to be treated, and an outer member inclosing an annular chamber between the two members; a bottom for the entire bowl on which the lower end of the central member is stepped and by which the axial chamber of said central member is closed at said end; said central member having at its lower portion above said bottom apertures leading into the annular chamber; vanes or accelerators extending outwardly into said annular chamber intermediate said apertures, and shelves in said annular chamber apertured for the passage of liquid upward past them.

10. In a centrifugal separator, a cylindrical bowl having its axis vertical and mounted for rotation about its axis, comprising an annular member having an axial chamber open at the upper end; an outer member encompassing the inner member and inclosing an annular chamber between them; a bottom for the entire bowl comprising an outer annular member; a central member which closes the central aperture of the annular member and fits underneath the same, and a third member seated above the central aperture of the inner member and apertured at an annular area; the central member being seated upon said last mentioned member of the bottom within said inner apertured area, the second mentioned member of the bottom having an axial threaded stem, and the last mentioned member having a central aperture through which said stem extends, and a nut on said stem above said last mentioned member for clamping the second and third members against opposite sides of the annular member.

11. In a centrifugal separator, in combination with a fixed shell, a cylindrical bowl having its axis vertical, and a motor having a vertical shaft on which such bowl is mounted for rotation about its axis, the motor and bowl being both inclosed within the fixed shell; a cover for the shell; an annular chamber encompassing the shell and a cover for such chamber; the bowl comprising an outer member and a central member which is removable vertically through the top of the outer member; the central member having an axial chamber which is open at its upper end; the covers being apertured above said open end of the central member; the top of the bowl being apertured for discharge of the liquid therefrom at an annular area; a flange encompassing said annular area terminating at its outer circumference between said covers of the shell and receptacle; said two covers being connected and said flange being separable by upward movement from the bowl; whereby the covers and flange may be removed together.

12. A centrifugal separator comprising a rotary motor having its axis vertical and the upper end of its shaft terminating for mounting the separator bowl thereon, a shell which incloses the motor and extends thereabove for inclosing the bowl; an annular pan mounted on the inner side of the shell below the position of the separator bowl in position to be overhung by the latter, and a conduit from such pan leading out through the shell.

13. A centrifugal separating device comprising a rotary motor having its axis vertical, the upper end of its shaft adapted for removably mounting a bowl thereon; a shell encompassing the motor and extending thereabove for inclosing the bowl, an annular pan mounted within the shell in position to be overhung by the bowl, and an annular receptacle mounted outside the shell on the upper end thereof; a removable annular cover for the shell and a removable cover for the exterior annular receptacle.

In testimony whereof, we have hereunto set our hands at Chicago, Illinois, this 7th day of December, 1909.

GEORGE E. SANFORD.  
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HENRY E. PROCUNIER.

Witnesses:

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