No. 725,440. PATENTED APR. 14, 1903.

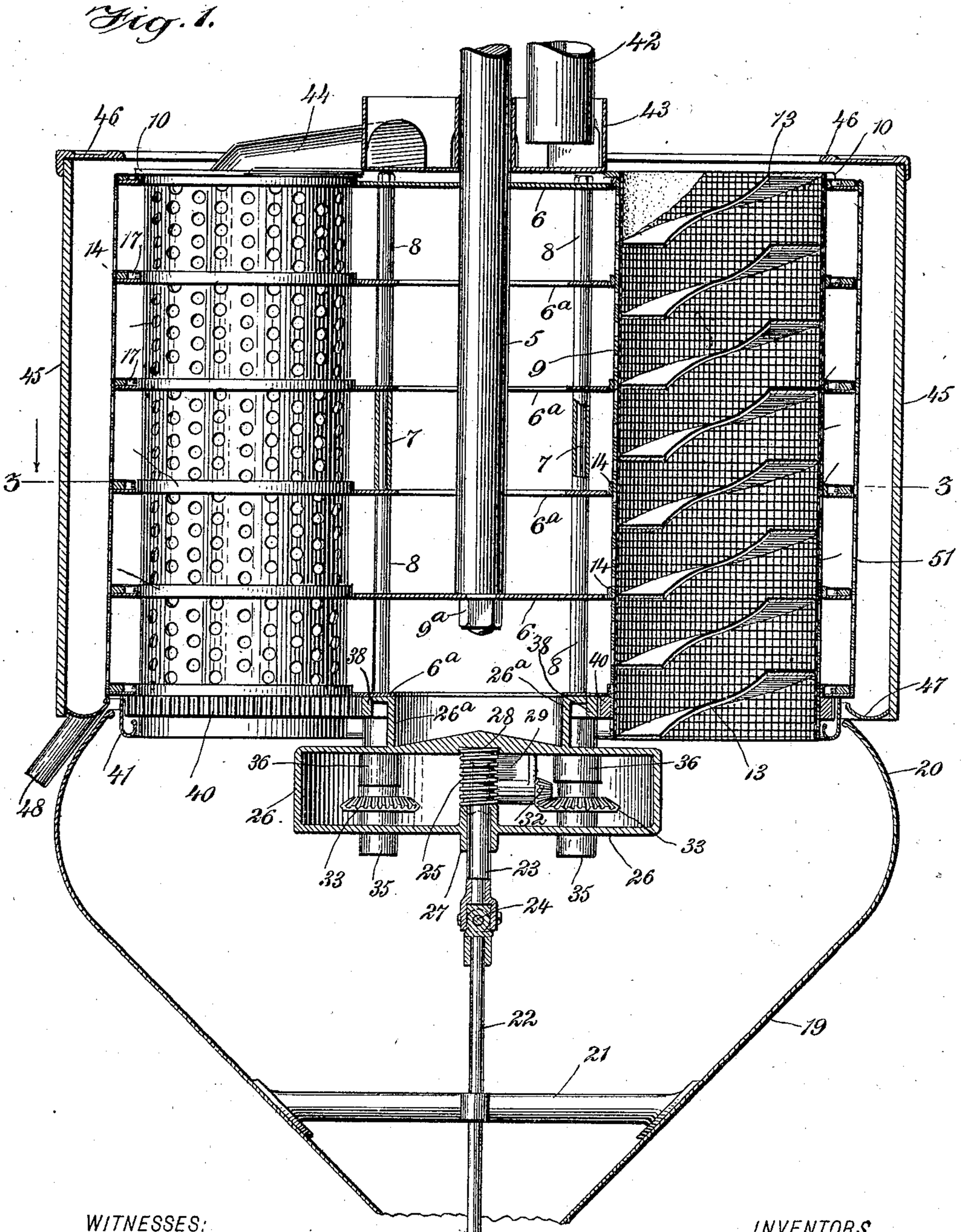
W. G. HALL & W. A. RAMSAY.

CENTRIFUGAL MACHINE.

APPLICATION FILED JULY 18, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 5.

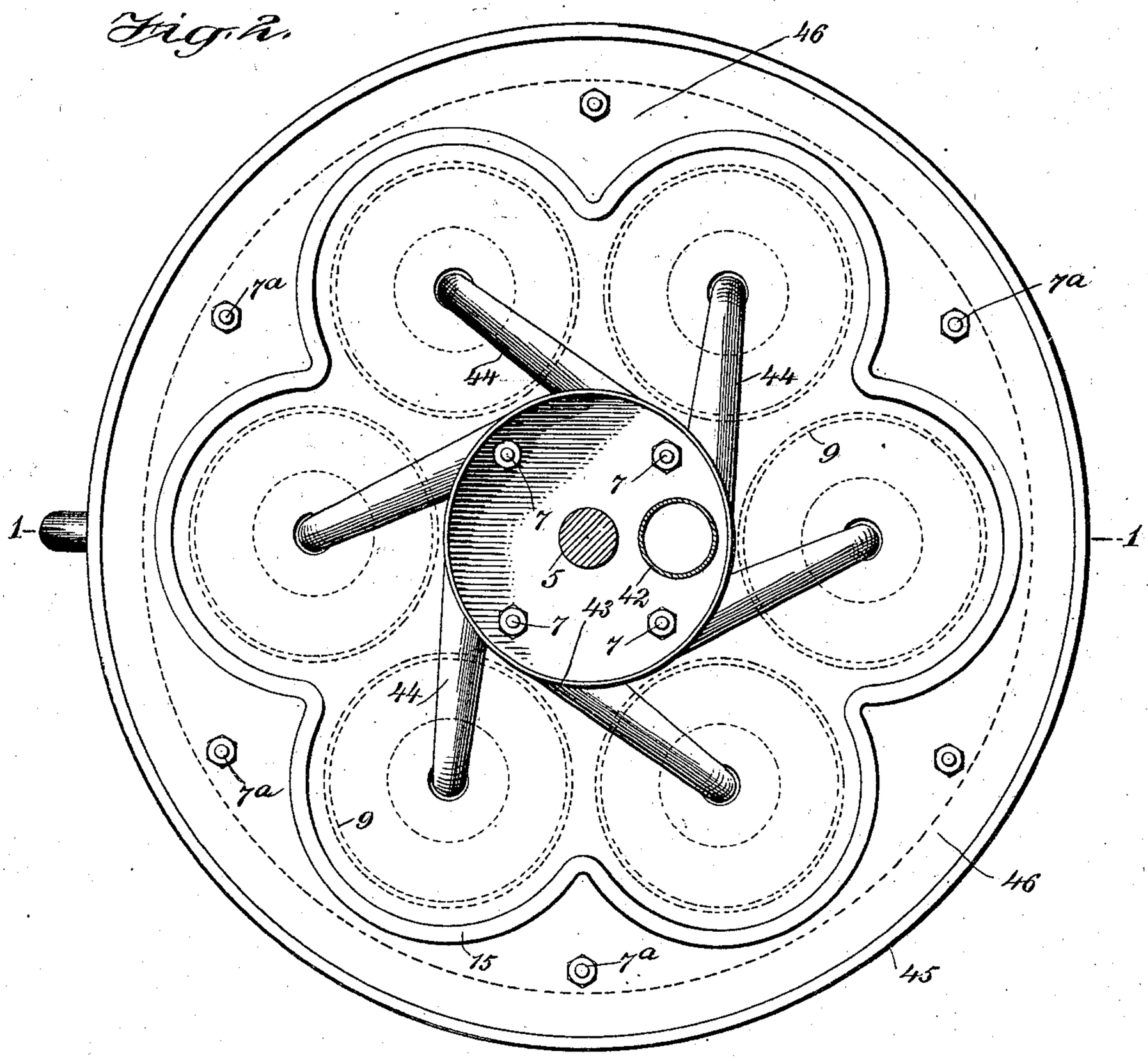
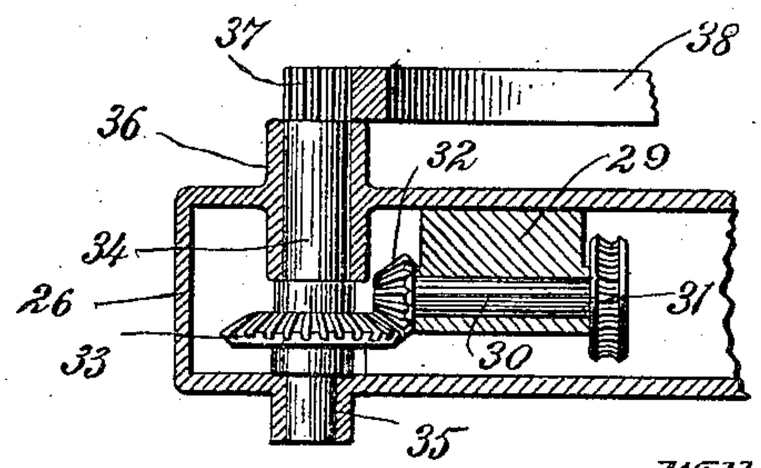


Fig. 6.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

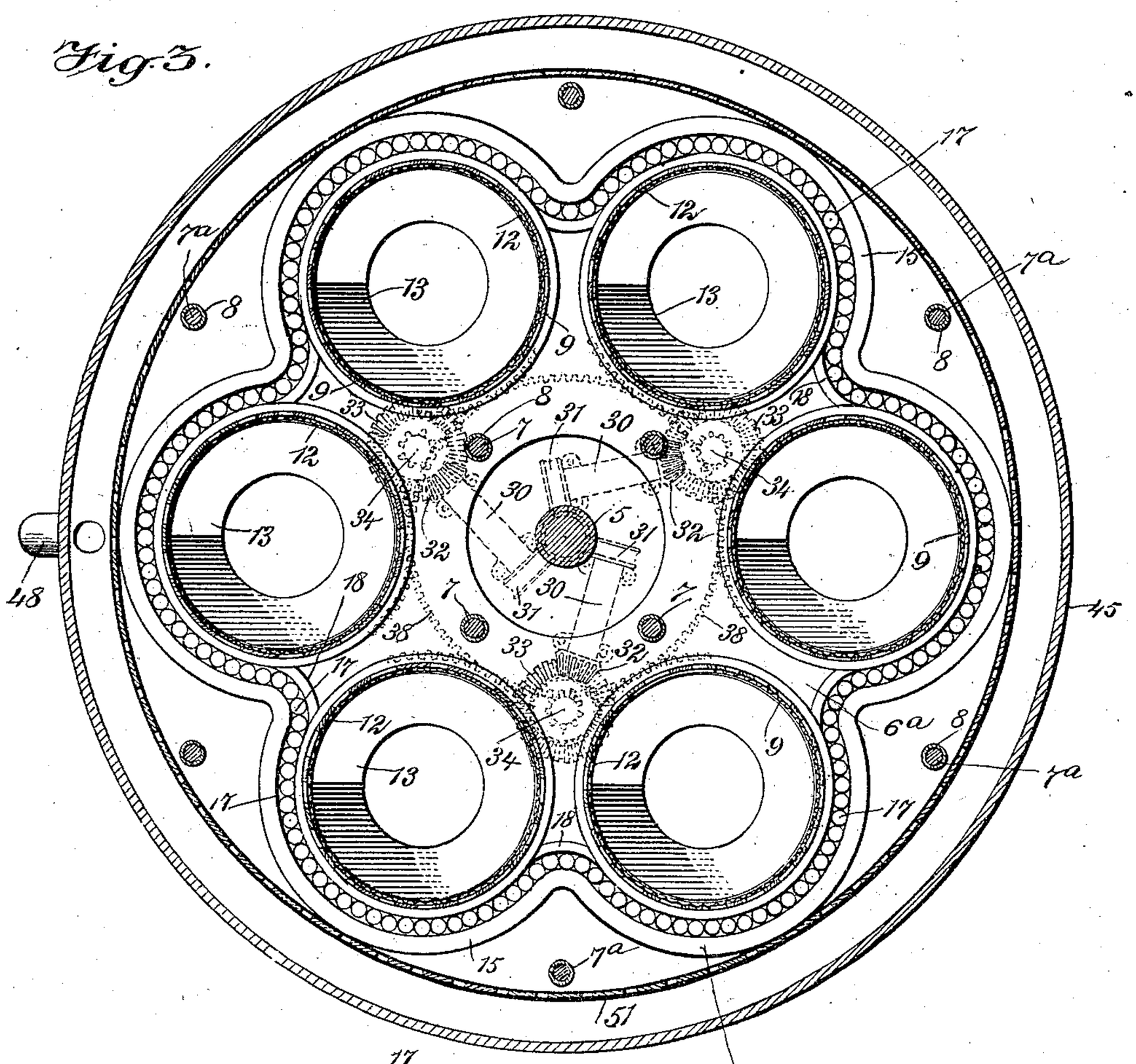


Fig. 4.

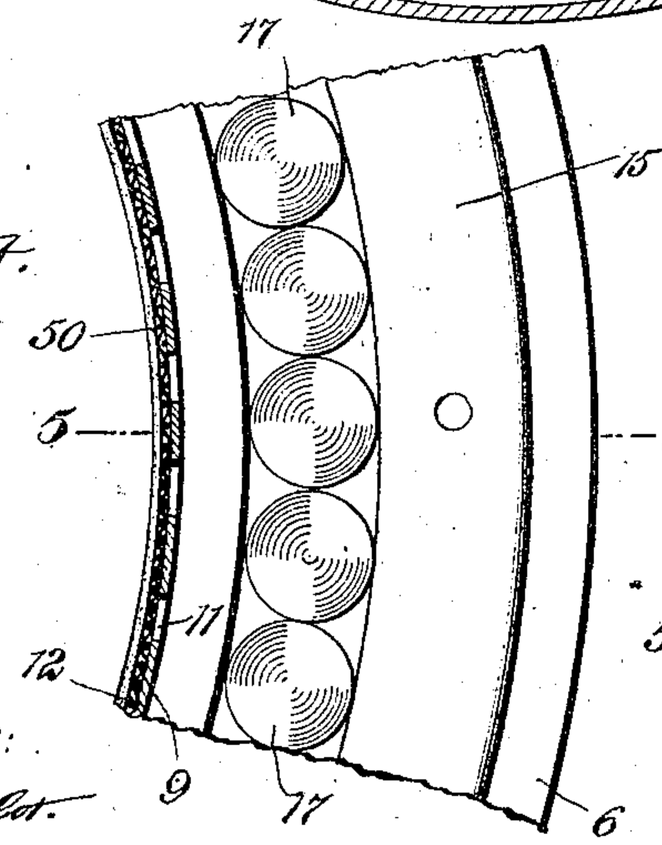
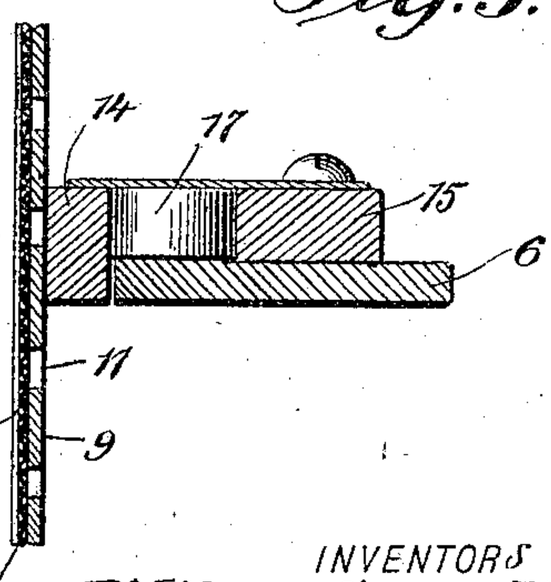


Fig. 5.



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CENTRIFUGAL MACHINE.

SPECIFICATION forming part of Letters Patent No. 725,440, dated April 14, 1903.

Application filed July 18, 1902. Serial No. 116,066. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM GARVIE HALL and WILLIAM ARTHUR RAMSAY, subjects of the King of Great Britain, and residents of Honolulu, Territory of Hawaii, have invented new and useful Improvements in Centrifugal Machines, of which the following is a full, clear, and exact description.

Our invention relates to improvements in centrifugal separators adapted for the treatment of different kinds of substances—such, for example, as sugars—although it will be understood that some of the parts may be embodied in the construction of machines for treating other substances, like brine or viscid liquids or other materials.

One object of the present invention is to provide a simple, compact, and efficient machine wherein the material may be fed and distributed continuously and while the parts are rotating at high speed, thus overcoming any stoppage of the machine to place the material therein and saving the time and power incidental thereto and of the necessity for slowing down the machine and starting the same up to the required speed; to make provision for the thorough separation and isolation of the liquid from solid matters and of forcing the latter positively through the machine; to insure the positive rotation of the treatment-cylinders at slow speed and in the same direction as the rapidly-driven drum; to provide for the free rotation of the treatment-cylinders on their axes and to reduce the friction and wear thereon, which might otherwise be considerable, owing to the high speed of the cage or drum, and to provide for the lubrication of the cylinder-driving mechanism.

With these ends in view the invention consists in the novel combination of devices and in the construction and arrangement of parts which will be hereinafter fully described, and the actual scope of the invention will be defined by the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a vertical sectional elevation of a centrifugal machine embodying the improvements of our invention. Fig. 2 is a plan view thereof, illustrating the means for continuously feeding the material into the plurality of treatment-cylinders. Fig. 3 is a transverse sectional plan view in the plane of the dotted line 3 3 of Fig. 1. Fig. 4 is an enlarged plan view, partly in section, illustrating the fragment of a raceway and a portion of a series of antifriction-rollers for reducing the friction and wear on one revoluble treatment-cylinder. Fig. 5 is a cross-section in the plane of the dotted line 5 5 of Fig. 4, and Fig. 6 is an enlarged detail sectional view through a portion of the gear-casing and illustrating means whereby the cylinder-driving gear is operatively connected with the stationary worm-gear to be hereinafter described.

5 designates a vertical shaft, which is adapted to be mounted and driven in any of the usual ways known to those skilled in the art, and on this shaft is mounted a drum adapted to carry the revoluble treatment-cylinders. This drum consists of a series of horizontal plates, rings, or equivalents, (indicated at 6 6 and 6ª,) the series of stay bolts or rods 7 7ª, and the spacing sleeves or thimbles 8. The driving-shaft 5 is disposed centrally with respect to the plates of the drum, and this shaft extends through all of the plates except the bottom one, 6ª, the lower end of said shaft passing through the plate indicated at 6 in Fig. 1 and receiving the nut 9ª. The top plate 6 and the plate indicated at 6 next to the last one of the series are secured firmly to the shaft 5 in order that the drum may be mounted rigidly on the shaft and adapted to rotate at the required speed therewith. The other plates (indicated at 6ª) are arranged equidistant from each other and from the rigidly-attached plates 6 6, and all the plates are united together by means of the bolts 7 7ª. The plates 6ª have large central openings, so as to loosely surround the shaft, and all the plates of the series are shaped or fashioned with the scalloped or curved edges, the shape of the top plate and one of the intermediate plates being indicated very clearly by Figs. 2 and 3. The scalloped edges of the plates

provide for a reduction of the quantity and weight of metal employed in the construction of the rotary drum, and the plates comprising said drum are provided within the scalloped edges thereof with the large openings adapted to receive the series or plurality of treatment passages or cylinders, the latter being indicated by the numeral 9. The connecting-bolts 7 7ª are disposed in two groups, the bolts 7 constituting an inner group and passing through the series of parallel drum-plates inside of the circular boundary of the cylinders 9. The bolts have their end portions secured firmly to the top and bottom plates of the drum, and these plates are spaced apart by means of thimbles or sleeves 8, each having its end portions engaging with two plates and a series of these thimbles being provided on each stay-bolt, whereby a very light, strong, and substantial construction of drum is provided for the carriage of the group of cylinders 9.

Any desired number of cylinders may be employed in the group, and these cylinders are arranged in vertical positions and for the axes to lie parallel to the axis of the shaft 5, whereby the group of cylinders are disposed in compact circular order around the shaft which supports and drives them, as well as the drum. The cylinders are loosely fitted in the large openings which are provided in the plates of the drum, and these cylinders are provided at their upper ends with the suspension-rings 10, the latter extending circumferentially from the cylinders and having overlapping order or relation to the upper plate 6 of the drum, whereby the weight of each cylinder and its contained parts is superposed upon the drum.

Each cylinder 9 is constructed, preferably, of sheet metal of any suitable kind, and this cylinder has a very large number of slots, holes, or perforations 11, through which the liquid can make its escape when acted on by the centrifugal energy developed by the high rotary speed of the machine. Each perforated metallic cylinder is provided with an interior lining 12, of wire screen or other foraminous material, adapted to closely hug the interior surface of the cylinder and to extend across the slots or perforations 11 therein. The meshes or interstices of the foraminous lining are smaller than the slots or openings of the perforated cylinder, and this lining serves to retain within the cylinder any solid particles of matter, such as the granules of sugar or salt, while it allows the liquid matter, of whatever thick consistency, to be thrown by centrifugal force through the lining and the perforated cylinder. Each cylinder is furthermore provided with an internal spiral feeder 13, which consists of a broad blade or strip of metal bent into a continuous helix of uniform diameter and arranged to present the spiral active surface, which is preferably uniform in width. This spiral feeder is disposed within the cylinder and its lining so as to closely engage with said wire-fabric lining and to hold the latter in the desired active engagement with the inner surface of the cylinder. Furthermore, the spiral feeder may be secured within or to the cylinder by any suitable means, and said feeder extends from the upper open end of the cylinder to the lower end thereof, both ends of the cylinder being open.

Each treatment-cylinder is furthermore provided with an annular series of track-bands 14, said bands being firmly secured to the perforated cylinder in spaced concentric relation to each other and at distances corresponding to the intervals between the plates 6 6ª of the drum. Said drum-plates are provided at their scalloped edges with the raised flanges 15, which are curved to conform to the cylinder and in opposing relation to the track-bands 14 of the cylinders, and the spaces between the cylinder-bands 14 and the raised flanges 15 of the carrier-plates form the scalloped raceways 16, the same adapted to receive the antifriction rollers or balls 17, as shown more clearly by Figs. 3, 4, and 5. These rollers or balls fill the raceway formed by the flanges 15 and the bands 14, and said rollers or balls are kept from displacement between the cylinders by means of the bridges 18. (See Fig. 3.) Each drum-plate 6 or 6ª is provided with the raceway and the bridges for the accommodation of the continuous series of rollers or balls, which engage with the outer surfaces of the cylinders forming the group in the carrier, and as these plates of the drum are equipped individually with the raceway and the bearing-rollers it will be seen that the entire group of the cylinders are supported at equidistant points along their length by a plurality of series of bearing rollers or balls. The described means for mounting the cylinders in the drum tends to largely reduce the friction and wear on the cylinders, so that the latter will rotate easily and freely through the drum, thus materially overcoming the increase of friction due to the high speed of rotation of the drum.

The entire group of cylinders carried by the rotary drum are adapted to discharge the dry or solid material into a common receptacle 19, having an inwardly-turned flange 20 at its upper portion, said flange arranged to loosely surround the entire group of cylinders 9, so as to leave an intermediate space between the inner edge of the flange and the outer surfaces of the cylinders comprising the group. The receptacle 19 tapers toward its lower portion in order that the solid material from the group of cylinders may be discharged at a common point. (See Fig. 1.) Within this receptacle 19 is secured a horizontally stationary spider 21, from which rises an upstanding member 22 of a stationary spindle 23, said spindle and its member 22 being united adjustably together by means of a universal joint or coupling 24 of any suitable character. This spindle 23 is supported

in a practically stationary vertical position within the receptacle 19 and substantially below the rotary drum and the cylinders mounted therein. Said spindle is equipped with a screw or worm 25 at its upper portion, and this worm lies in the vertical plane of the shaft 5 and at a suitable distance below the same, said worm thus occupying a certain concentric relation to the drum and the group of cylinders.

26 designates a gear-casing, the bottom of which is provided with a sleeve or bearing 27, while the top of said casing is formed or provided with a bearing 28. This top of the gear-casing may be secured removably to the body of the casing and the bearing 28, and said casing-top may be equipped with balls or rollers adapted to reduce the frictional engagement of the gear-casing with the non-revoluble spindle 23 and the worm 25 thereof. This gear-casing is loosely mounted on the spindle by fitting its hub 27 to said spindle 23 and by bringing its bearing 28 in engagement with the end face of the non-revoluble worm 25. The gear-casing is thus free to turn on the spindle, and said gear-casing is provided with internal shaft-hangers 29, preferably three in number, as indicated by dotted lines in Fig. 3, said shaft-hangers depending from the top of the gear-casing, as represented by Figs. 1 and 6, and adapted for the support of the series of short horizontal shafts 30. We employ three of these shafts, which are mounted or contained wholly in the gear-casing and are mounted individually within the hangers, and these shafts are disposed in tangentially compact relation, as indicated by dotted lines in Fig. 3, whereby the inner ends of the shafts are adapted to be driven from the single worm 25. Said horizontal shafts 30 are provided at their inner ends with the worm-gears 31, which have intermeshing engagement with the worm 25 on the non-revoluble spindle, and said shafts 30 are furthermore provided at their outer ends with the bevel-pinions 32, the same having intermeshing engagement with the bevel-gears 33, the number of said gears corresponding to the pinions 32 and the shafts 30. These bevel-gears 33 are made fast to short vertical shafts 34, a series of three of which are employed to extend vertically through the gear-casing 26. These vertical shafts have their lower ends stepped in the bearings 35, while their upper ends pass through the sleeve-bearings 36, and on said upper ends of the group of vertical shafts 34 are provided the small gear-pinions 37. These gear-pinions are spaced equidistant around the gear-casing 26, as indicated by dotted lines in Fig. 3, and said pinions 37 have intermeshing engagement with a cylinder-driving gear 38. The gear-casing 26 is provided on its top with an upstanding annular flange 26^a, which is adapted to embrace or overhang the cylinder-driving gear 38, as shown by Fig. 1.

The group of cylinders 9 are individually provided with the gears 40, which are secured to the lower portions thereof, substantially below the lowermost track-bands 14, and said gears 40 of the cylinders mesh with the single driving-gear 38, which is propelled by the shafts 34 and 30 from the stationary worm when the carrier is driven at a high speed.

From this description, taken in connection with the drawings, it will be understood that the series of cylinders are adapted to rotate at high speed with the drum, but each cylinder is adapted to rotate on its axis at a slow speed, the direction of rotation of the cylinders on their individual axes being in the same or corresponding direction to that of the carrier. The desired slow speed of the cylinders is obtained by the employment of the worm-gearing from the non-revoluble spindle 23 to the horizontal shaft 30, and by employing the two groups of horizontal and vertical shafts 30 and 34 the cylinders are caused to rotate in the same direction as the drum, and the strain on the gearing is minimized by the equidistant arrangement of the shafts and gears.

The gear-casing 26 is adapted to be charged or filled with a suitable lubricant in order that the gears may be kept in good working order. The lubricant, which may be thrown by centrifugal energy from the gears 38 40, is adapted to be caught by the troughs 41, the latter being suspended from the bottom plate 6^a of the carrier and surrounding the gears 40 on the revoluble cylinders, as shown by Fig. 1.

The employment of the universal coupling 24 between the non-revoluble worm-spindle 23 and the spindle-section 22 allows the worm and the gear-casing to vary with the rotation of the machine, the oscillation of the gear-casing and the worm taking place from the center afforded by the pivot of the universal joint 24.

The material to be treated may be conveyed to the machine in any suitable way—as, for instance, by the pneumatic conveyer-tube 42, the same arranged to discharge into the elevated receptacle or hopper 43. Said hopper is mounted on the shaft 5 so as to rotate therewith, and from this receptacle leads a series of spouts 44, which extend therefrom on tangential lines, as shown by Fig. 2, said spouts having the downturned ends disposed to discharge the material into the central portion of the cylinders. The material supplied to the hopper or receptacle is distributed by centrifugal energy uniformly to the spouts, and these spouts discharge individually to the cylinders of the group.

The operating parts of the machine are housed or contained within a casing 45, which loosely surrounds the drum and the cylinders therein. This casing is provided with a top plate or ring 46, which makes provision for the receptacle 43 and the group of spouts 44. Said receptacle is provided in its bottom with an annular trough 47, adapted to

receive and collect the liquid matter which is thrown from and through the perforated cylinders by centrifugal energy, and from this trough leads a discharge-spout 48, as shown by Fig. 1.

Our improved machine, constructed as hereinbefore described, will be found especially useful in the treatment of low-grade sugar and the like because of the movement that the sugar or other substance is forced to undergo while passing through the machine. It will be understood that the undried sugar is free to enter the upper ends of the series of cylinders, said cylinders being carried rapidly around with the drum and rotating slowly on their axes. The feed of the sugar into the cylinders under these conditions causes a tendency to carry the sugar toward the center of the drum; but this is possible only at a slight angle when the sugar is caused to run or slip by centrifugal force toward the circumference of the cylinder and to the extent of the most distant point from the axis of the shaft 5. The spiral feeders 13 rotate with the cylinders, and said feeders operate on the solid particles of sugar, so that the sugar cannot slide outward from the center of the drum without being also forced in a downward path for a certain distance, such operation being continued until the finished product is discharged through the open lower ends of the cylinders into the receptacle 19.

The rotary motion of the perforated cylinders brings into constant use new clean surfaces of the screen-like lining, which allows the molasses or other liquid to pass out from the cylinder more readily than if the surface of the cylinder was coated with a thick wall of half-dried sugar.

Any suitable material may be employed for the jackets or coverings of the cylinders, such as the foraminous wire or sheet-metal jackets herein described; but we may use the material known as "filter-press cloth" or the like, as indicated at 50 in Figs. 4 and 5, in order to adapt the machine to the work of filtering cane-juice or other liquids.

We may also employ a thin metallic casing 51, arranged to surround the drum, in order to reduce the frictional resistance of the air to the rapid rotation of the drum.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. A centrifugal machine comprising a high-speed drum, a series of revoluble cylinders mounted in said drum to rotate therewith and capable of independent rotation on their axes, a rotary gear-casing, a stationary gear within said casing, and a series of gear-trains mounted in said casing to mesh with the stationary gear and engaging individually with said revoluble cylinders.

2. A centrifugal machine comprising a revoluble drum, a group of revoluble cylinders carried by said drum, a two-part non-revoluble spindle having its members jointed together, and independent sets of gear-trains having common engagement with a shiftable part of said spindle and geared individually to said cylinders.

3. A centrifugal machine provided with a high-speed drum, a group of cylinders mounted therein, a cylinder-driving gear having intermeshing relation with the cylinders forming the group, a non-revoluble worm in central relation to the group of cylinders, and worm-gearing between said worm and the cylinder-driving gear, said parts being combined substantially as and for the purposes set forth.

4. A centrifugal machine provided with a high-speed drum, a group of cylinders mounted to rotate at high speed with said drum and each adapted to turn on its axis, a non-revoluble worm in central relation to said drum, a rotary gear-casing mounted to turn freely around said worm, a cylinder-driving gear having intermeshing relation to the group of cylinders, horizontal shafts mounted in said gear-casing and meshing with said worm, and other shafts geared to said horizontal shafts and to the cylinder-driving gear.

5. A centrifugal machine provided with a high-speed drum, a series of cylinders mounted to rotate at high speed with said drum, a non-revoluble worm movable from a center afforded by a jointed coupling to a stationary support, and cylinder-driving mechanism engaging with said worm and having operative relation to the group of cylinders.

6. A centrifugal machine comprising a shaft, a drum fast therewith, a group of revoluble cylinders carried by the drum, a non-revoluble jointed spindle disposed in alinement with said shaft, a casing mounted on a shiftable part of the spindle, a stationary gear carried by said shiftable part of the spindle, and a series of gear-trains supported by the casing and meshing with the stationary gear and with the revoluble cylinders.

7. A centrifugal machine comprising a shaft, a drum having a series of parallel connected plates secured to the shaft and each provided with raceways, a group of cylinders revolubly mounted in the drum and each provided with a number of track-bands which are in opposing relation to the raceways on the drum-plates, antifriction-bearings confined in the raceways and engaging with the track-bands to secure free rotation of the cylinders in the drum, and means for rotating the cylinders on their axes as they rotate with the drum.

8. A centrifugal machine comprising a revoluble drum, a casing surrounding the drum and provided at its lower end with a gutter, a series of cylinders revolubly mounted in the drum and each provided with a gear, an annular collecting-trough carried by the drum around the gears of the cylinders and within said gutter of the casing, and trains of gearing meshing with the gears of the cylinders to rotate the latter on their axes.

9. In a centrifugal machine, a high-speed

drum comprising a series of plates, the raceways on said plates, the connecting-bolts attached to the plates for holding them in parallel relation, and a shaft to which the plates are fastened, combined with rotary cylinders having track-rings disposed in opposing relation to the raceways, antifriction-bearings confined in said raceways, means for feeding the material to the cylinders, and means for rotating the cylinders on their axes.

10. A centrifugal machine comprising a revoluble drum, a group of cylinders mounted in said drum and each having a gear, a non-revoluble spindle having a shiftable member jointed thereto, a casing revolubly mounted on the spindle, a stationary gear attached to the shiftable spindle member and disposed within the casing, horizontal shafts journaled in the casing and geared to the stationary gear, and vertical shafts also journaled in the casing and geared to the horizontal shafts and to the gears on the cylinders.

11. A centrifugal machine comprising a revoluble drum having a series of parallel plates each provided with a raceway, a group of perforated cylinders mounted in the plates of the drum within the raceways thereof and each having an open-mesh lining on the inner surface thereof, a spiral feeder extending through each cylinder and engaging with the lining thereof, a series of track-bands fixed to the outside of each cylinder and disposed in opposing relation to the raceways, antifriction-bearings between the raceways and the track-bands, and means for rotating the cylinders on their axes.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM GARVIE HALL.
WILLIAM ARTHUR RAMSAY.

Witnesses:
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LOUIS J. WARREN.