J. J. BERRIGAN.

CENTRIFUGAL SEPARATOR.

APPLICATION FILED OCT. 28, 1905.

998,949.

Patented July 25, 1911

3 SHEETS—SHEET 1.

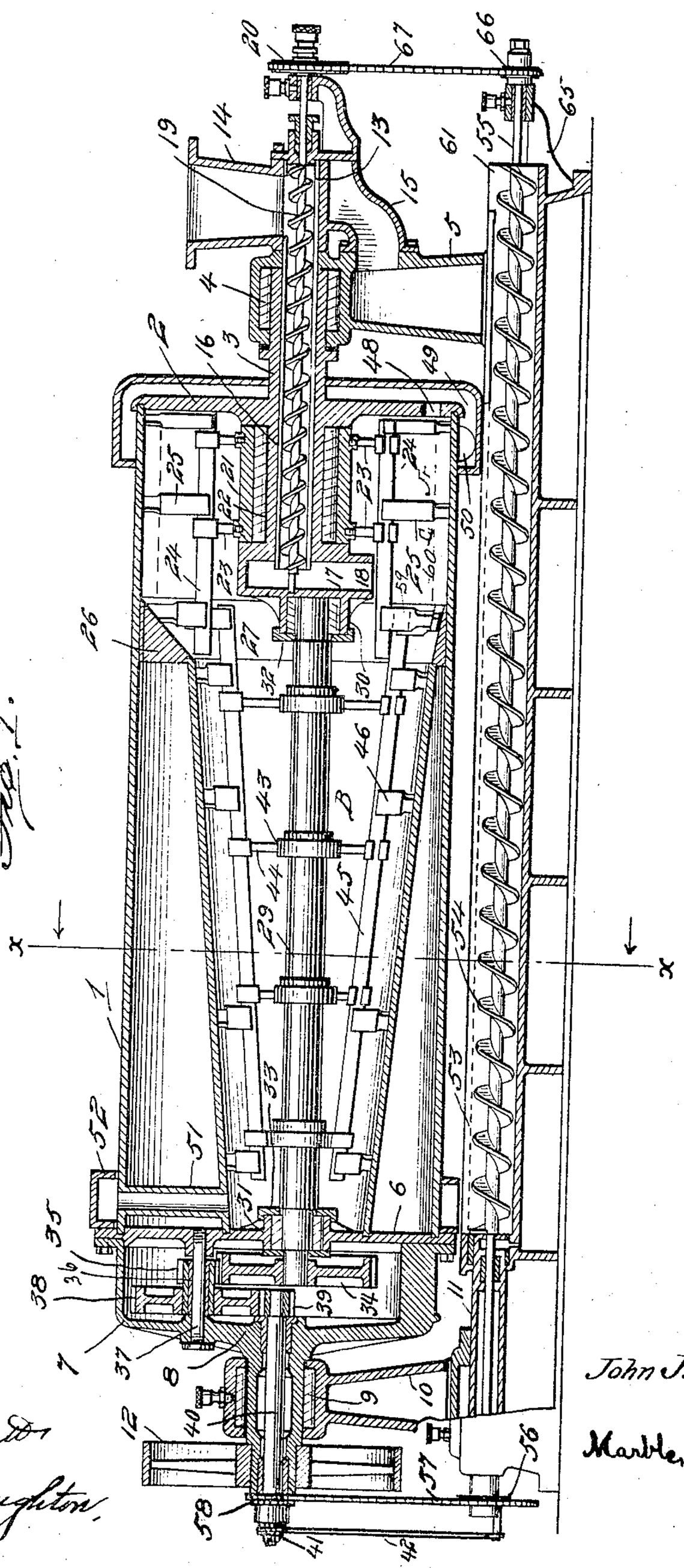


Fig. 1.

Witnesses

B. M. Offutt

A. M. Houghton

Inventor

John J. Berrigan

by

Marble, McElroy & Matty

Attorneys

J. J. BERRIGAN.

CENTRIFUGAL SEPARATOR.

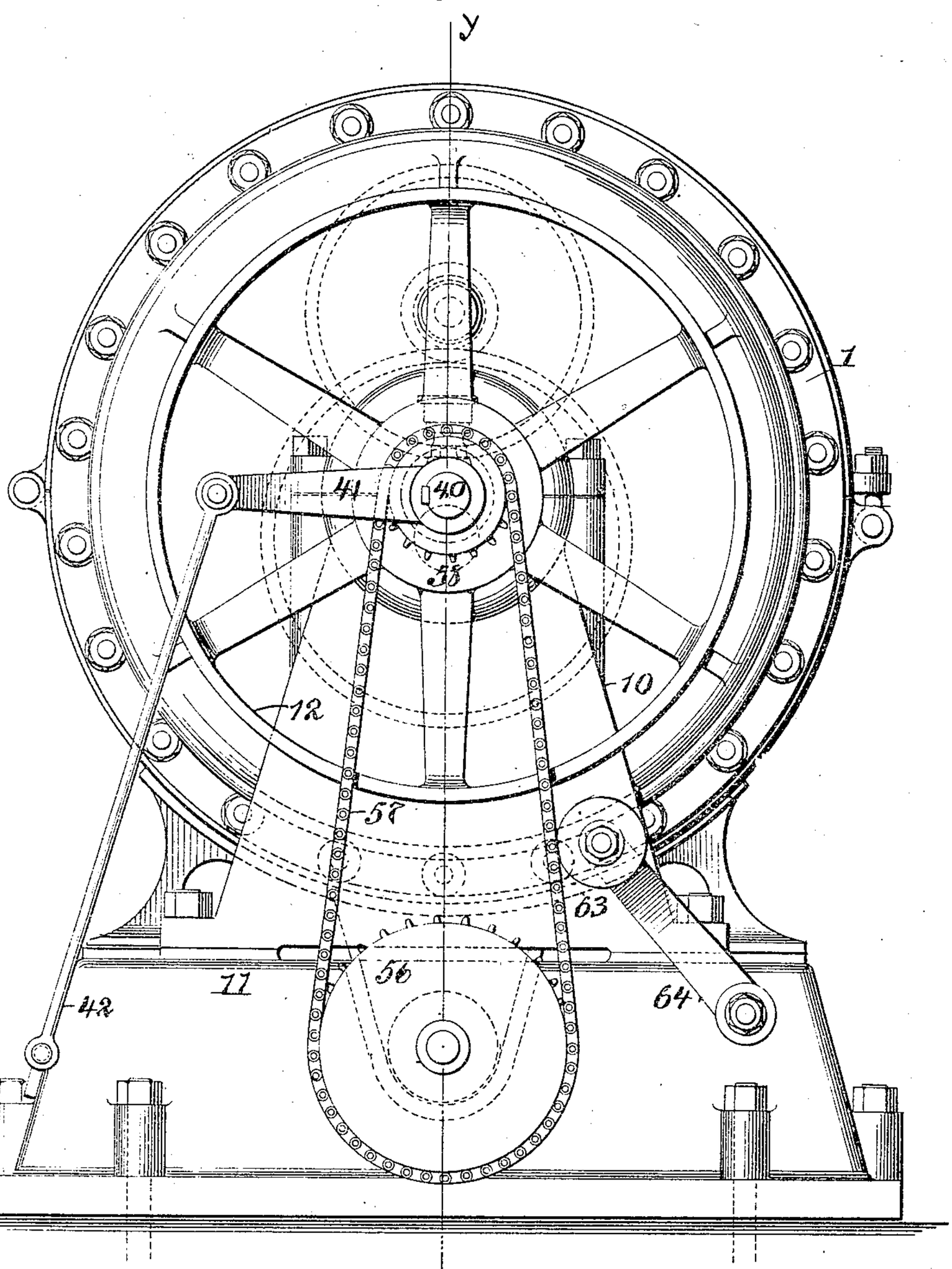
APPLICATION FILED OCT. 28, 1905.

998,949.

Patented July 25, 1911.

3 SHEETS—SHEET 2.

*Fig. 2.*




WITNESSES:

Gustav Dieterich

Edwin H. Dieterich.

INVENTOR

John J Berrigan

BY Clark Berrigan

his ATTORNEY

J. J. BERRIGAN.

CENTRIFUGAL SEPARATOR.

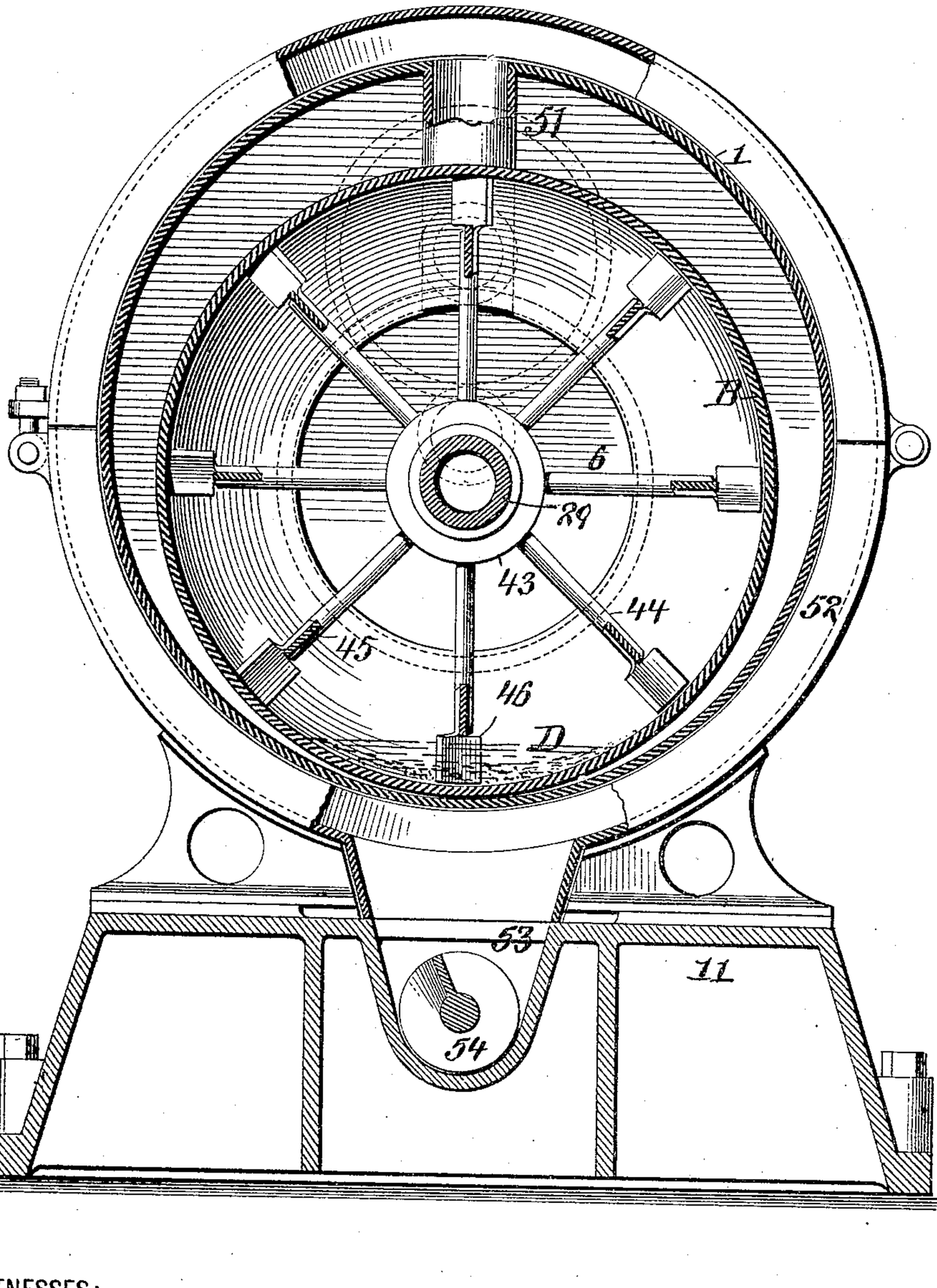
APPLICATION FILED OCT. 28, 1905.

998,949.

Patented July 25, 1911.

3 SHEETS—SHEET 3.

*Fig. 3.*




WITNESSES:

Gustave Dieterich.

Edwin H. Dieterich.

INVENTOR

John J. Berrigan

BY Paul Benjamin

ATTORNEY

# UNITED STATES PATENT OFFICE.

JOHN J. BERRIGAN, OF ORANGE, NEW JERSEY.

## CENTRIFUGAL SEPARATOR.

998,949. Specification of Letters Patent. Patented July 25, 1911.

Application filed October 28, 1905. Serial No. 284,793.

*To all whom it may concern:*

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

The invention relates to centrifugal separators for combined solids and liquids.

The invention comprises means for separating mixed solid and liquid materials into concentric annuli of liquid and solid respectively, and for moving the solid material of the solid annulus toward the axis and so away from the liquid annulus while returning liquid which separates from the solid material so moved, to the liquid annulus; also important features of construction and arrangement and combination of parts.

In the accompanying drawings—Figure 1 is a vertical longitudinal section of a complete machine under the present invention; Fig. 2 is an elevation of the delivery end of the machine; and Fig. 3 is a cross section on the line *x*—*x* of Fig. 1.

Similar numbers and letters of reference indicate like parts.

1 is a horizontal cylinder wherein the working parts of the machine are inclosed. On the cylinder head 2 is formed the hollow trunnion 3 which is received in roller bearings 4 in the fixed standard 5. Bolted to the opposite head 6 of said cylinder, is a cylindrical casing 7 on which is formed a hollow trunnion 8, which is received in a roller bearing 9 in the fixed standard 10. Standards 5 and 10 rest upon the bed 11 of the machine. The driving pulley 12, Fig. 1, is fast upon a shouldered prolongation of the trunnion 8. Power is communicated to said pulley by any suitable belt (not shown) and in that way cylinder 1 is caused to rotate. Within the hollow trunnion 3 is the feed tube 13, with the interior of which the feed hopper 14 communicates. Said feed hopper is supported on a bracket 15, extending from the standard 5. In prolongation of the trunnion 3 and extending into the cylinder 1 is a tube 16, having at its inner end a chamber 17, which at 18 opens into the cylinder 1. Stepped in one wall of the chamber 17 is the shaft of a spiral feed conveyer 19; the other end of said shaft passes through bearings supported on the brackets 15 and carries a sprocket wheel 20. Surrounding the tube 16 is a sleeve 21 between which sleeve and said tube 16 bearing rollers 22 are interposed, so that said sleeve may rotate freely on said tube. Extending radially from said sleeve are arms 23, which carry bars 24, on which bars are secured conveying scrapers 25.

Within the cylinder 1 is a ring 26 forming a conical eccentric passage 27, seated in which is the larger end of the conical vessel B; the other end of said vessel is seated in the cylinder head 6. The chamber or compartment A in cylinder 1 between head 2 and ring 26 forms one separating vessel and the conical vessel B is another separating vessel. The separating vessel B being thus eccentrically placed in the cylinder 1 contains a central shaft 29, one end of which is stepped in a roller bearing in a sleeve 30 formed on one wall of the chamber 17 and having an annular cover. The other end is journaled in a roller bearing in a sleeve 31 in cylinder head 6. Said sleeve is provided with annular covers 32 and 33, which bear against shoulders formed on the shaft. The end of the shaft 29 extends into the casing 7, and fast upon it is a gear 34. Gear 34 engages with pinion 35, the hub 36 of which turns freely on the shaft 37 which is secured in the cylinder head 6 and casing 7. Also on the hub of pinion 35 is a gear 38 which engages with the pinion 39, which is fast on the shaft 40. Said shaft extends through the hollow trunnion and driving pulley and carries at its end a lever arm 41, Fig. 4, which is immovably secured to a bolt on the bed of the machine by means of the rod 42. It will, therefore, be understood that the pinion 39 does not rotate.

On the shaft 29 in the conical separating vessel B are a number of fixed collars 43 which carry arms 44 and these arms support bars 45 which in turn carry the conveying scrapers 46. The said scrapers are disposed with their outer edges in proximity to the inner periphery of the separating vessel. The bars 45 extend through the opening 27 in the ring 26, and the scrapers at their ends meet either the bars 24 or the scrapers 59 as the case may be, so that the scrapers 25 through the free rotation of the sleeve 21 will also be set in rotation as will be more particularly explained hereafter.

In the cylinder head 2 is a liquid escape opening 48 which communicates with an annular trough 49 in which the cylinder 1

freely turns and which has a delivery outlet at 50. Extending from the interior of the conical separating vessel B, through the wall of cylinder 1 is pipe 51, through which the separated solids are delivered into the annular fixed trough 52 in which trough said cylinder freely turns and this trough in turn communicates with a horizontal trough 53 in the bed of the machine. Within the trough 53 is disposed a long spiral conveyer 54, one end of the shaft 55 of which extends through a bearing in the bed and carries at this end a sprocket wheel 56, to which by means of a chain 57 motion is communicated from a sprocket wheel 58 fast on the hub of the driving pulley 12. The other end of the conveyer shaft 55 is journaled in a bracket 65, Fig. 1, and carries a sprocket wheel 66, from which motion is communicated by chain 67 to the pulley 20, which actuates the feed conveyer 19.

When the driving pulley 12 is set in revolution, the cylinder 1, as already stated, turns on its trunnions. In so doing it carries the gear 38 around the fixed pinion 39 in a planet movement, thereby causing a revolution of said gear 38 on its axis 37. The pinion 35 on the same hub as gear 38 is thus rotated and communicates its motion to the gear 34, and so to the shaft 29 in the separating vessel B.

It will be obvious that certain of the scrapers 25 in chamber A move around an axis concentric with the axis of said chamber (or, in other words, of the cylinder 1) and therefore remove any material which may be on the inner surface of said chamber, and convey the same toward the conical separating vessel B. There are certain scrapers, however, shown at 59, Fig. 1, which owing to the eccentricity of the opening in ring 26 do not act everywhere around the inner surface of said opening. This is clearly shown in Fig. 2, where the upper scraper 59 is shown acting in close proximity to said surface, while the lower scraper 59 is at a considerable distance therefrom. In order to insure that all of the surface of said opening shall be scraped, I make the inclination of that part of it which is not acted upon by the scrapers 59 coincident with the inclination of the wall of the separating vessel B, and then extend the bars 45 sufficiently into the chamber A to allow them to carry scrapers 60, which act upon said part. As the scrapers 60 overlap the scrapers 59 or the bars 24 carrying said scrapers 59, according to position, the motion of rotation of the shaft 29 is thus communicated to all the scrapers in the chamber A.

I will now describe the operation of the apparatus: The combined solid and liquid materials to be separated are fed into the hopper 14 and thence are carried by the rotary screw conveyer 19 into the chamber 17 from which they are delivered through the opening 18 into the chamber A. This chamber A being a rapidly rotating centrifugal separating chamber, the liquid and solid material will separate more or less completely and form annuli of liquid and solid material respectively, the solid material, which is usually the heavier, being next the periphery of chamber A, and the liquid within the annulus of solid material. The dotted line C, in Fig. 1, indicates approximately the inner limit of the liquid annulus, this limit being fixed by the liquid discharge opening 48, through which the liquid overflows into the trough 49 and thence passes to the outlet 50. The solid material is moved along by the scrapers 25 to the ring 26, and thence upward over said ring, by the scrapers 59 and 60, to the conical chamber B. The solid material is then moved along the walls of this chamber B, by scrapers 46, toward the smaller or outlet end of said chamber. By the means described the solid material is moved through and away from the liquid annulus, liquid which separates from such solid material after the latter leaves said liquid annulus flowing backward to the liquid annulus again. Owing to the eccentricity of the chamber B, the solid material is continually carried nearer the axis of rotation, as said chamber revolves with cylinder 1, and thereby the separation of the liquid from the solid material is greatly facilitated and hastened, the solid material being continually lifted from points of greater eccentricity to points of less eccentricity and so being carried away from the liquid very quickly; the liquid being, of course, free to flow from points of less eccentricity to points of greater eccentricity. The solids are projected centrifugally through pipe 51 to the annular chamber 52 in a thoroughly dried state. From the chamber 52, they flow by gravity into the trough 53, and are finally delivered at the outlet end of said trough. The rod 42 and arm 41 which serve to hold shaft 40 in fixed position is merely an expedient for doing this; any other means to hold said shaft may be employed. The chain belt 57 is kept tight by means of an idle roll 63 carried on the swinging shaft 64, said roll resting by gravity against the belt. The function of the cylinder 1 in addition to forming the wall of chamber A is to serve as a balancing device for the whole.

I claim:

1. A centrifugal separator comprising in combination a rotatable vessel adapted to separate wet material within it, by centrifugal action, into concentric annuli of liquid and solid matter, means for moving the solid matter toward the axis while returning liquid which separates to the liquid annulus and for discharging dried solids from a

point nearer the axis than the said solid annulus, and means for feeding wet material to be dried into said vessel, the space in said vessel between said feeding means and said annuli being substantially unobstructed, said vessel having liquid discharge means more distant from the center of rotation than said feeding means.

2. A centrifugal separator comprising in combination a rotatable vessel adapted to separate wet material within it, by centrifugal action, into concentric annuli of liquid and solid matter, means for moving the solid matter toward the axis in a direction oblique to the axis in both longitudinal and transverse planes and means for feeding wet material to be dried into said vessel, the space in said vessel between said feeding means and said annuli being substantially unobstructed, said vessel having liquid discharge means more distant from the center of rotation than said feeding means.

3. A centrifugal separator comprising in combination a cylindrical centrifugal chamber and a coned centrifugal chamber communicating therewith, the former concentric with its axis of rotation, said cylindrical chamber being provided with a liquid discharge opening and said coned chamber being provided with means for discharging solids, means for removing solids from the peripheral surface of said cylindrical chamber and advancing the same through said coned chamber toward the smaller end thereof while allowing liquid to flow back into the cylindrical chamber, and means for feeding wet material into said cylindrical chamber, the space between said feeding means and the annuli within said cylindrical chamber being substantially unobstructed, said liquid discharge opening being more distant from the center of rotation of the cylindrical chamber than said feeding means.

4. A centrifugal separator comprising in combination a cylindrical centrifugal chamber concentric with its axis of rotation and an eccentrically set coned centrifugal chamber communicating therewith, said cylindrical chamber being provided with a liquid discharge opening and said coned chamber being provided with means for discharging solids, and means for removing solids from the peripheral surface of said cylindrical chamber and advancing the same through said coned chamber toward the smaller end thereof while allowing liquid to flow back into the cylindrical chamber.

5. A centrifugal separator comprising in combination a cylindrical centrifugal chamber concentric with its axis of rotation and a coned centrifugal chamber in communication therewith, said cylindrical chamber being provided with means for discharging liquid at one end and solids at the other and said coned chamber being provided with means for discharging solids, and means for removing solids from the peripheral surface of said cylindrical chamber and advancing the same through said coned chamber toward the smaller end thereof while allowing liquid to flow back into the cylindrical chamber, and means for feeding wet material into said cylindrical chamber, the space between said feeding means and the annuli within said cylindrical chamber being substantially unobstructed, said liquid discharge opening being more distant from the center of rotation of the cylindrical chamber than said feeding means.

6. A centrifugal separator comprising in combination a cylindrical centrifugal chamber concentric with its axis of rotation and a coned centrifugal chamber in communication therewith and eccentric to its axis of rotation, said cylindrical chamber being provided with means for discharging liquid at one end and solids at the other with intermediate means for feeding in raw material, and said coned chamber being provided with means for discharging solids, and means for removing solids from the peripheral surface of said cylindrical chamber and advancing the same through said coned chamber toward the smaller end thereof while allowing liquid to flow back into the cylindrical chamber.

7. A centrifugal separator comprising in combination a cylindrical centrifugal chamber, and an eccentric coned centrifugal chamber and an internally coned annulus intermediate the interior surfaces of said cylindrical and coned chambers, said separator provided with means for supplying material to be treated to the cylindrical chamber and with means for the escape of separated liquid and solid materials, and conveying means for transferring the solid material to the coned chamber and moving it therethrough.

8. A centrifugal separator comprising in combination a cylindrical chamber concentric with its axis of rotation and a coned centrifugal chamber in communication therewith, conveying means for moving solid material along the cylindrical chamber, and other conveying means for moving solid material along the coned chamber.

9. A centrifugal separator comprising in combination a cylindrical chamber and a coned centrifugal chamber in communication therewith, conveying means for moving solid material along the cylindrical chamber, and conveying means for moving solid material along the coned chamber, the latter conveying means arranged to drive the former.

10. A centrifugal separator comprising in combination a rotary centrifugal separating drum, means for rotating the same, a conveyer therein, means for rotating said con-

veyer comprising a stationary shaft concentric with the axis of rotation of the drum, a pinion thereon and planetary gearing carried by the drum and rotating around and driven by said pinion, and means for holding said shaft and pinion stationary comprising a projecting arm and means for securing the same to a fixed point.

11. A centrifugal separating machine comprising in combination a cylindrical centrifugal chamber concentric with its axis of rotation, a conical separating chamber eccentrically mounted with respect thereto and in open communication therewith, and means for feeding materials successively through said chambers, said means comprising means for feeding raw materials to one end of the cylindrical chamber and removing solid materials from the opposite end of the coned chamber and means for advancing solid materials from the first stated end to the second stated end, and means for removing liquid from the first stated end.

12. In a centrifugal machine, means for forming concentric annuli of separated solids and liquids, means for advancing the solids from the solid annulus over the interior of a coned surface, eccentric to said annuli in an annulus eccentric to the first stated annuli, means for delivering separated solids from the smaller end of the coned surface and means for delivering separated liquid from the opposite end of the means for forming concentric annuli.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN J. BERRIGAN.

Witnesses:
WM. H. SIEGMAN,
PARK BENJAMIN, Jr.