J. W. PHILLIPS.

CENTRIFUGAL APPARATUS.

APPLICATION FILED JUNE 17, 1920.

1,382,930. Patented June 28, 1921.

2 SHEETS—SHEET 1.

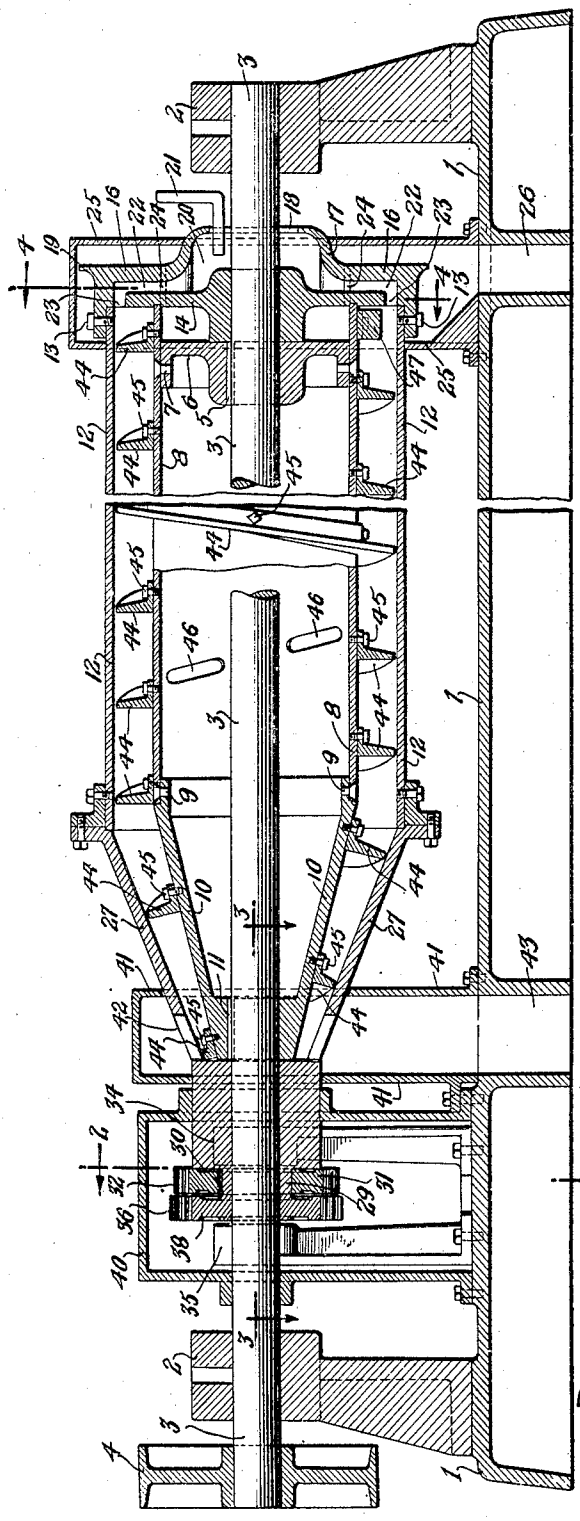


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

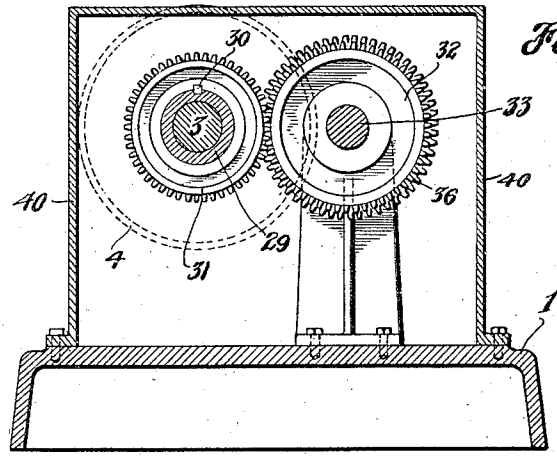


Fig. 3.

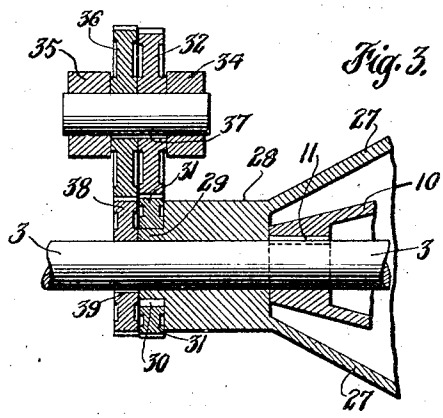
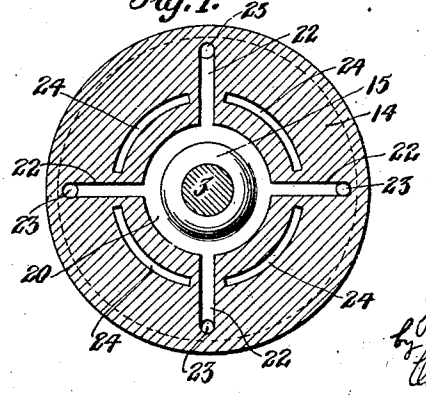


Fig. 4.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL APPARATUS.

1,382,930. Specification of Letters Patent. Patented June 28, 1921.

Application filed June 17, 1920. Serial No. 389,569.

To all whom it may concern:

Be it known that I, JOHN W. PHILLIPS, a citizen of the United States, residing in Meriden, county of New Haven, State of Connecticut, have invented certain new and useful Improvements in Centrifugal Apparatus, of which the following is a specification.

My invention relates to centrifugal apparatus for operating upon liquid by centrifugal force to separate therefrom contents differing from the liquid in specific gravity.

My invention resides in centrifugal apparatus, particularly of the continuously operating type, in which there is provided means for positively transporting and discharging separated material, such means, in the example of my invention herein described, comprising a screw rotating at a speed differing from the speed of the centrifugal drum.

My invention resides in centrifugal apparatus of the character hereinafter described and claimed.

For an illustration of one of the various forms my invention may take, reference is to be had to the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view, partly in elevation, of apparatus embodying my invention.

Fig. 2 is a cross sectional view on the line 2—2 of Fig. 1, some parts shown in elevation.

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 1, some parts being shown in plan.

Fig. 4 is a vertical cross sectional view taken on the line 4—4 of Fig. 1.

Referring to the drawings, upon the base 1 are disposed the bearings 2, 2 for the shaft 3 rotated by any suitable means, as for example, the pulley 4. Secured by key 5 to the shaft 3 is the hub of the spider 6 on the outer ends of whose arms is secured by screws 7 the inner drum 8 which, in the example illustrated, is cylindrical. At its other end the drum 8 is secured by screws 9 to a flange upon the hollow conical member 10 secured by key 11 to the shaft 3 which rotates the inner drum 8 and its conical end or extension 10.

Inclosing the drum 8 is the outer drum 12 secured as by bolts 13 to the member 14 having the hub 15 bearing upon the shaft 3. The member 14 forms an end closure for the drum 12 and has the thickened portion 16 having the inwardly extending flange 17 having the aperture 18 surrounding and spaced from the shaft 3. The part 16 has the outwardly extending flange or lip 19. Between the flange 17 and the hub of the member 14 is formed an inlet chamber 20 into which is delivered the liquid to be operated upon through pipe 21 extending through the aperture 18. With the chamber 20 communicate the outwardly extending channels or passages 22 in the member 14, these passages delivering at 23 into the space between the inner and outer drums 8 and 12. Between the passages 22 are formed within the member 14 the passages 24 communicating with the interior of the drum 8 and extending to the outside of the member 14, 16, these passages 24 discharging liquid to the exterior of the member 16 within the housing 25 inclosing the end of the drum 12 and its end closure 14, 16 and communicating with the discharge passage or outlet 26 in the base 1.

At its other end the outer drum 12 is secured to the outer hollow conical member or extension 27 terminating in the hub 28 bearing upon the shaft 3 and itself having the hub 29 of smaller diameter, to which is secured by key 30 the gear 31 which meshes with and is driven by the gear 32 upon the counter-shaft 33 supported in the bearings 34, 35 supported upon the base 1. Disposed upon the shaft 33 is the third gear 36, the key 37 securing both gears 32 and 36 to the shaft 33. Meshing with and driving the gear 36 is the gear 38 secured by key 39 to the shaft 3. A housing 40 secured to the base 1 incloses the gears and the bearings 34 and 35.

At the end of the conical member 27 is disposed a housing 41 into which separated material is delivered from the space between the conical members 10 and 27 through the discharge apertures 42 in the member 27 into the housing 41, which communicates with the discharge outlet 43 in the base 1.

Operating in the space between drums 8 and 12 and their conical ends or extensions 10 and 27 for transporting separated material from right to left, Fig. 1, is the member 44 in the form of a helix encircling and secured to the members 8 and 10 by bolts 45. That portion of member 44 on drum 8 is of

uniform pitch, and that portion on extension 10 may also be of uniform pitch, but preferably is of progressively increasing pitch from the larger to the smaller end of cone 10. The crest or outer edge of the helix or screw 44 has slight clearance from the interior surface of the drum 12 and cone 27, this clearance preferably being made as small as practicable.

At suitable distance from the left end of the drum 8 there is formed therein a plurality of circumferentially spaced discharge apertures 46 whereby liquid from the space between the drums 8 and 12 passes through the apertures 46 to the interior of the drum 8. Discharge apertures 42 and the inner edge of aperture 18 are at a substantially less radial distance from the axis of the shaft 3 than are the discharge apertures 46, thus preventing the discharge of liquid through apertures 42. On the exterior of the drum 8 at its right end, Fig. 1, is secured a suitable number of outwardly projecting agitators, paddles or members 47 suitably spaced circumferentially from each other.

The operation is as follows:

The shaft 3 is rotated at suitable speed by the pulley 4, thus driving the drum 8 and cone 10 and the attached screw 44 at a predetermined suitably high speed. The gear 38 drives the gear 36, which in turn drives the gear 32, which in turn drives the gear 31 which rotates the cone 27 and the outer drum 12 at a speed which, due to the differential gearing described, is slightly less than the speed of rotation of the drum 8, cone 10 and screw 44. For example, the shaft 3 and therefore the drum 8, cone 10 and screw 44 may rotate at a speed of 906 revolutions per minute, and the drum 12 and cone 27 at a slightly different speed, for example, 900 revolutions per minute. Both the inner and outer drums and cones rotate in the same direction, which direction is such that the screw 44 will tend to move separated material from the right toward the left, as viewed in Fig. 1.

The liquid to be operated upon, as sewage or any other liquid containing solids or semi-solids, is introduced through the pipe 21 into the chamber 20, from which it is delivered under the action of centrifugal force through the passages 22 and 23 into the right end of the space between the drums 8 and 12, where the agitators or paddles 47 cause it to be brought up to high speed, whereupon, due to centrifugal force, the solids or semi-solids or both are thrown outwardly toward the inner surface of the drum 12, while the lighter liquid is forced to occupy a region of less diameter nearer the outer surface of the drum 8. The solids or semi-solids, as the sludge of sewage, so separated by centrifugal action, are moved from right toward the left by the conveyer screw 44, and due to the progressively increasing pitch of screw 44 on extension 10 is carried forward along the wall of conical extension 27 against the centrifugal force and discharged through apertures 42. These solids or semi-solids, or both, as sewage sludge, is accordingly delivered throughout the length of the drum 8 and thence through the space between the cones 10 and 27 to the left end of the apparatus, where it is discharged through the apertures 42 into the housing 41 and is delivered through the discharge outlet 43. The clarified liquid also progresses from right to left in the space between the drums 8 and 12, but due to its greater fluidity, is not carried out through apertures 42, but forms a layer of substantially uniform thickness on the wall of drum 12 which is retained by conical member 27. This layer increases in thickness as material is supplied through pipe 21 until it completely fills the space between drums 8 and 12, whereupon clarified liquid passes through apertures 46 into the interior of the drum 8 against whose inner wall the clarified liquid is held by centrifugal action and passes toward the right through the space between the arms of the spider 6, thence out through the passages 24 to the exterior of the member 16 into the housing 25, the liquid as it discharges through the passages 24 flowing outwardly by centrifugal force, but being retained by the housing 25 to the bottom of which it drops and passes out through discharge outlet 26. The rib or flange 19 confines the liquid delivered into the housing 25, preventing it from flowing to the left of the flange 19, where substantial quantities might otherwise escape between the housing 25 and the outer surface of the drum 12.

What I claim is:

1. Centrifugal apparatus comprising rotatable co-axial drums, means for feeding material between said drums, means for positively advancing material between said drums, and means for separately removing separated materials from between said drums comprising an outlet through the outer drum for one of the separated materials and a passage from between said drums to the interior of the inner drum for another of said materials, and a discharge from the interior of said inner drum for said other of said materials.

2. Centrifugal apparatus comprising inner and outer co-axial drums, means for rotating said drums in the same direction at different rates of speed, means for feeding liquid between said drums adjacent one end thereof, means for positively advancing said liquid toward the other end of said drums, and means for separately withdrawing said liquid and material separated therefrom from between said drums comprising an outlet for said material and a liquid passage

from between said drums to the interior of said inner drum, and a liquid discharge from the interior of said inner drum.

3. Centrifugal apparatus comprising an inner cylindrical drum and an outer cylindrical drum, said drums being co-axial, means for rotating said drums in the same direction at different rates of speed, means for feeding materials of different densities to be separated between said drums adjacent one end thereof, means for positively advancing said materials toward the other end of said drums, an opening at said other end of said outer drum for discharging the material of greater density, and an opening in said inner drum for discharging material of lesser density into the interior of said inner drum, and a discharge outlet from the interior of said inner drum.

4. Centrifugal apparatus comprising horizontally disposed inner and outer co-axial drums, means for rotating said drums in the same direction at different rates of speed, means for feeding materials to be separated between said drums, a helical rib on said inner drum approaching said outer drum, and means for separately discharging separated materials comprising a passage for a separated material through the outer drum and a passage for another separated material into and through the interior of said inner drum.

5. Centrifugal apparatus comprising an inner drum and an outer drum co-axial with said inner drum, converging co-axial extensions on adjacent ends of said drums, means for rotating said drums and extensions in the same direction at different rates of speed, means for feeding material between said drums adjacent their ends opposite said extensions, means for advancing said material between said drums to said extensions and between said extensions toward the vertex thereof, a passage for separated material from between said drums into the interior of said inner drum, and a discharge for said separated material from the interior of said inner drum adjacent said end opposite said extensions.

6. Centrifugal apparatus comprising inner and outer coaxial cylindrical drums, means for rotating said drums in the same direction at different rates of speed, a helical rib of pitch on one of said drums, said helix approaching the surface of the other drum, head structure at an end of said drums having a passage through which material is delivered to the space between said drums, a passage for separated material from between said drums into the interior of said inner drum, and a passage for separated material from the interior of said inner drum through said head structure.

7. Centrifugal apparatus comprising co-axial rotatable cylindrical drums, co-axial conical extensions on adjacent ends of said cylindrical drums, means for rotating said drums and conical extensions in the same directions at different speeds, means for feeding material between said drums at the end remote from said conical extensions, a helical rib on the inner of said cylindrical drums extending close to said outer drum adapted to advance material between said drums toward said conical extensions, and a helical rib on the inner of said conical extensions having a progressively increasing pitch toward the vertex of said extension.

8. Centrifugal apparatus comprising inner and outer coaxial horizontally disposed cylindrical drums, co-axial conical extensions on adjacent ends of said drums, means for rotating said drums and extensions in the same direction, said inner drum and extension rotating at greater speed than said outer drum and extension, means for feeding material between said drums, a helical rib of uniform pitch on said inner drum approaching said outer drum adapted to advance material between said drums toward said conical extensions, and a helical rib on the conical extension of said inner drum approaching the conical extension on said outer drum, said last named helical rib having a progressively increasing pitch from the end of said inner drum to the vertex of said conical extension.

9. Centrifugal apparatus comprising inner and outer co-axial cylindrical drums, conical extensions on adjacent ends of said drums, the vertex of said conical extensions being remote from the ends of said drums, means for rotating said inner drum with its conical extension and said outer drum with its conical extension in the same direction at different rates of speed, means for feeding material between said drums, means for advancing said material between said drums toward said conical extensions and between said conical extensions toward the vertex thereof, a discharge opening in the outer of said conical extensions at less radial distance from the axis thereof than said inner drum, and a discharge opening in said inner drum.

10. Centrifugal apparatus comprising inner and outer co-axial cylindrical drums, co-axial conical extensions on adjacent ends of said drums, means for rotating said drums and conical extensions in the same direction at different rates of speed, said inner drum and extension rotating at greater speed than said outer drum and extension, means for feeding material between said drums adjacent the end remote from said extensions, a helical rib on said inner drum adapted to convey said material toward said conical

extensions, a helical rib on said inner extension having a progressively increasing pitch approaching the vertex of said extension adapted to convey material toward said vertex, a discharge opening in said inner drum spaced from the end thereof to which material is fed, and a discharge opening in said outer extension at a substantially less distance from the axis thereof than is said first named discharge opening from said axis.

11. Centrifugal apparatus comprising coaxial drums spaced from each other, means for rotating said drums at different speeds, a screw on one of said drums in the space between them for advancing material longitudinally thereof, a passage from between said drums to the interior of said inner drum, head structure closing said drums at the same end and rotating with one of them, a passage through said head structure for said material from the interior of said inner drum to the exterior thereof, and an independent passage in said head structure for delivering material into the space between said drums.

12. Centrifugal apparatus comprising inner and outer co-axial drums, said drums having at the same end portions converging to smaller diameters, said drums and said extensions spaced from each other, means for driving said drums and their extensions at different speeds, a screw disposed in the space between said drums and their extensions and rotatable with one of them, head structure at the opposite end of said drums and rotating with one of them, a passage in said head structure for delivering material into the space between said drums, a passage from the space between said drums into the interior of said inner drum, and a passage through said head structure from the interior of said inner drum.

In testimony whereof I have hereunto affixed my signature this 10th day of June, 1920.

JOHN W. PHILLIPS.