April 5, 1966 G. P. GREEN 3,244,360

COMMINUTOR-CENTRIFUGE-PUMP

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Fig. 1

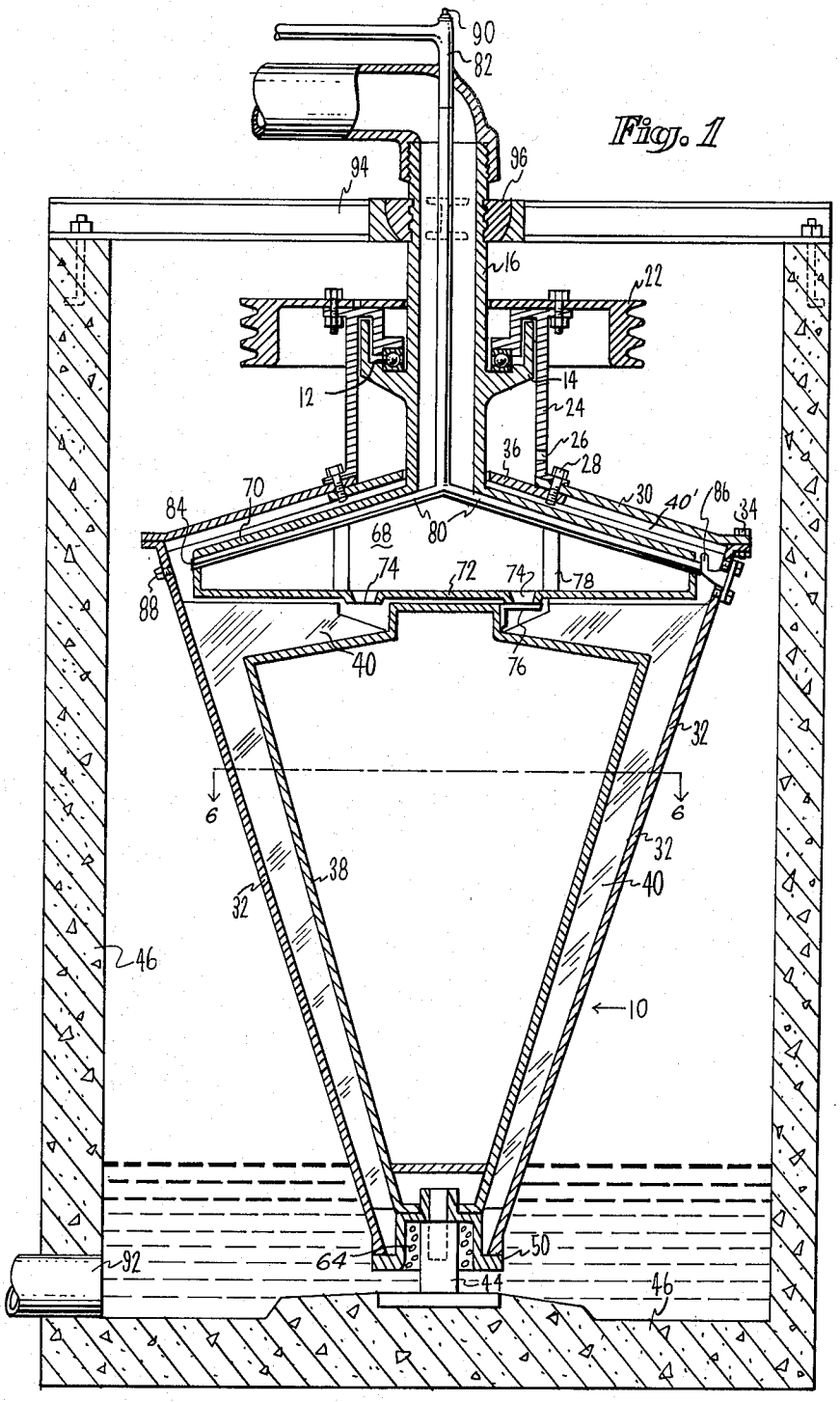

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Fig. 2

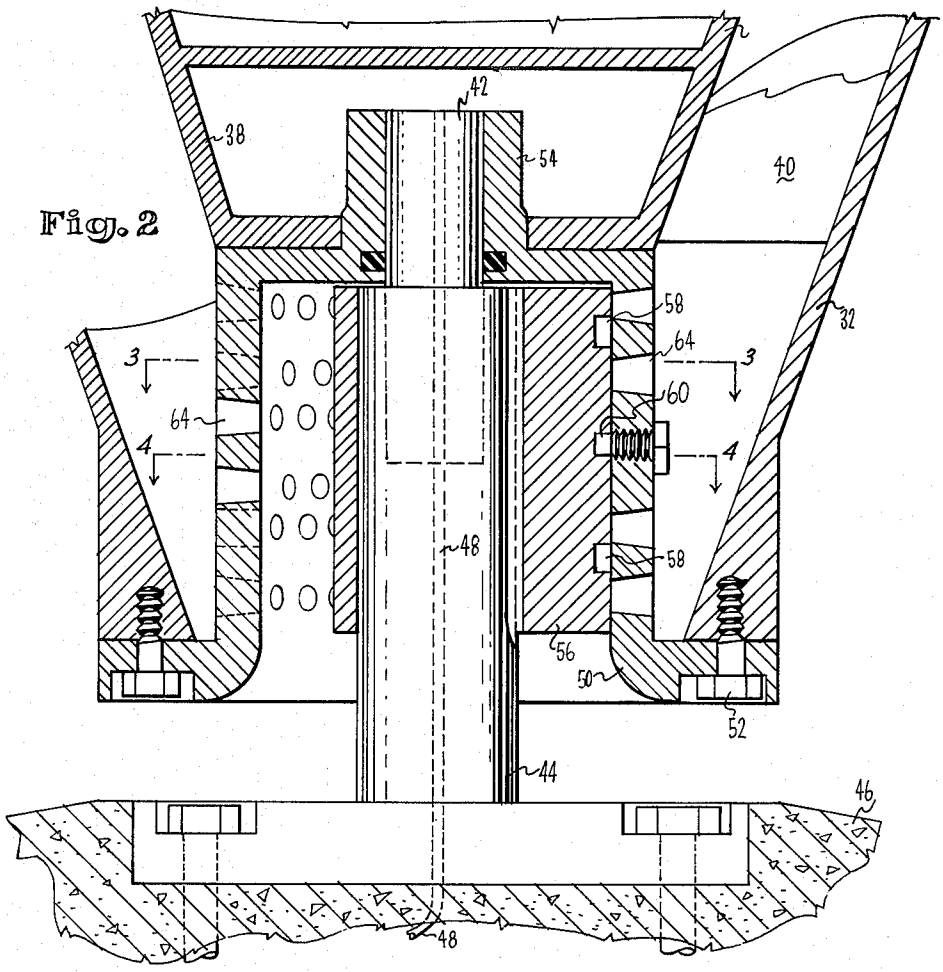


Fig. 3

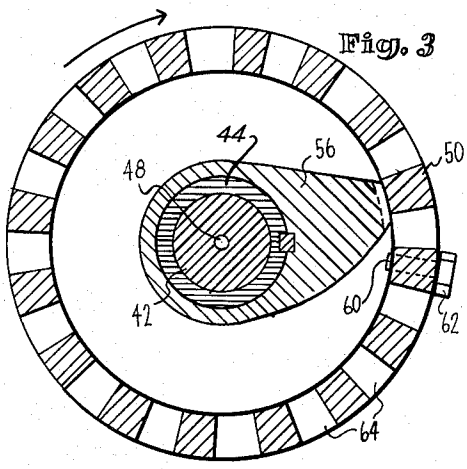
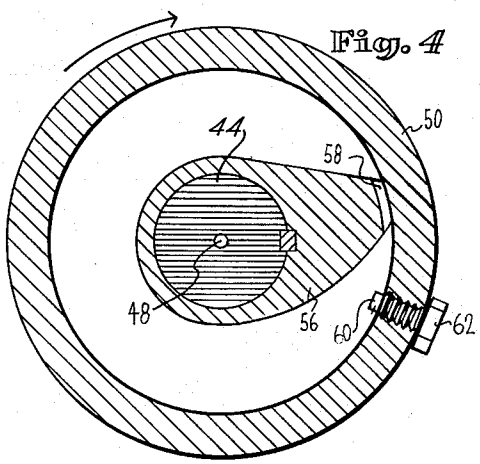


Fig. 4



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COMMINUTOR-CENTRIFUGE-PUMP

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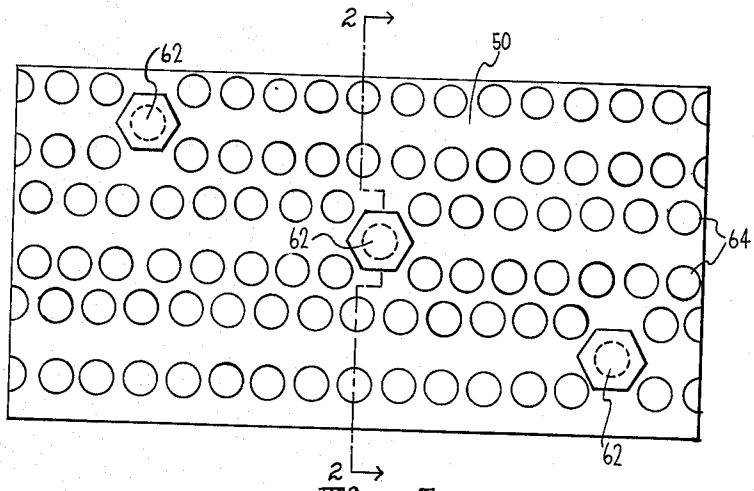

Fig. 5

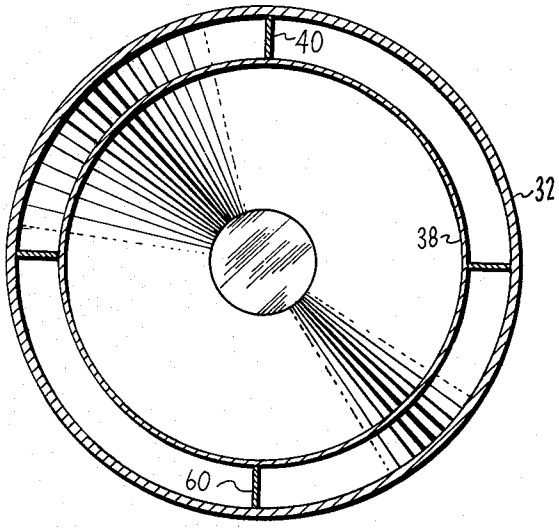

Fig. 6

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3,244,360

COMMINUTOR-CENTRIFUGE-PUMP

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Filed May 24, 1965, Ser. No. 461,596
11 Claims. (Cl. 233—2)

This application is a continuation-in-part of my prior application, Ser. No. 182,177, filed March 26, 1962, and now abandoned.

This invention relates generally to a comminutor-centrifuge-pump and particularly to a machine adapted for use in sewage treatment and other operations wherein comminutation, centrifugal separation and pumping is applicable. A typical use of the invention may be made in water or sewage treatment wherein application of centrifugal force is used to accomplish the separation of suspended solids from liquids. In general current practice suspended solids are removed by quiescent retention of the liquid in a tank sufficient time for sedimentation of the solids by gravitation, collecting, usually by scraper mechanism and removing the solids and drawing off clarified liquid in a continuous operation. The comminutor feature of the invention functions to shred and reduce the size of suspended particles, thus facilitating passage through the machine. Pumping of the separated liquids or materials is accomplished by centrifugal force resulting from operating the machine. The rotation rate and construction dimensions of the machine may be established to attain a predetermined pumping rate and head condition.

An object of this invention is to provide a more compact and quicker means of separating liquids of different densities, with or without suspended solids than can be accomplished by quiescent sedimentation.

A further object is to provide a continuous flow centrifuge with a comminutor in combination therewith to shred particles carried by the liquid to a size suitable for passing through the machine.

Another object of this invention is to provide a more economical and simplified mechanism for increasing the hydraulic head of the liquid co-incident with the application of centrifugal force for centrifuging liquids thereby eliminating the use of conventional pumps.

A further object of this invention is to provide a continuous flow centrifuge of general utility.

Still further objects are to achieve the above with a device that is sturdy, compact, durable, simple, and reliable, yet inexpensive and easy to manufacture.

The specific nature of the invention as well as other objects, uses, and advantages thereof will clearly appear from the following description and from the accompanying drawings, the different views of which are not necessarily to the same scale, in which:

FIG. 1 is an axial sectional view of a comminutor-centrifuge-pump as used in this invention.

FIG. 2 is an axial sectional enlarged view showing the details of the bottom bearing and inlet comminutor of the machine.

FIG. 3 is a cross sectional view taken on line 3—3 of FIG. 2.

FIG. 4 is a cross sectional view taken on line 4—4 of FIG. 2.

FIG. 5 is a planemetric view of the cylindrical portion of the comminutor screen as seen in FIGS. 2, 3, and 4.

FIG. 6 is a cross sectional view taken on line 6—6 of FIG. 1.

As may be seen in FIGS. 1–5 a continuous flow centrifuge is used for the practice of this invention.

The centrifuge includes a conical shaped vessel 10 rotatably supported by bearing 12 (FIG. 1). The bearing 12 is seated in a grease containing annular cupped

flange 14 which itself is fixed to stationarily supported tubular column 16. Rotation of the vessel 10 is accomplished by providing the necessary power and rotation to pulley 22. It will be understood than any suitable power source connected by belt, gear, chains, or otherwise may be applied to rotate the vessel 10. The rotatable vessel 10 is supported from the bearing 12 by annular member 24 which has hole 26 therein to allow escape of excess liquid in case it were to accumulate therein. The tubular member is attached e.g. by bolts 28 to top 30 of the vessel 10, the top itself being conic in shape. The top 30 is secured to the main lift portion 32 (which is conic in shape) of the vessel 10. The connection between the top and the lift portion may be by bolts 34. The bolts 28 also attach the enclosure flange 36 to the underside of the top. Enclosure flange 36 extends toward the downward portion of column 16. The flange 36 is separable from the top 30 and made in two pieces to facilitate assembly of the device. The pulley 22 is secured by bolts to the top of the tubular member 24.

The vessel 10 has an interior liquid type space displacement member 38 fixed in position within the lift portion 32 by webs 40. The bottom of the vessel 10 is rotatably supported on shaft 42 (FIG. 3), which is fixed to support 44. The support 44 is anchored to suitable structure 46. The structure 46 serves as a container for the device and will be described later. A passage 48 (FIG. 2) is provided to the support 44 and shaft 42 and arranged externally for the introduction of lubricant into a space formed in the bottom of the interior member 38.

A cylindrical sheer screen 50 (FIG. 2) is secured between the interior member 38 and lift portion 32 by bolts 52. The top of this member extends inward and terminates with an upward journal 54 which surrounds the shaft 42. The bottom of the interior member 38 telescopes around the journal 54 and this provides the lower connection of the interior member 38 to the lift portion 32. A comb member 56 (FIGS. 2, 3, and 4) is fixed to support 44 and is arranged with peripheral grooves 58 to mesh with projections 60. The projections are the tips of bolts 62 which are threaded through the screen 50. They act as cutters. The comb 56 is stationary and telescoped around the cylindrical support 44 and is keyed thereto to prevent its rotation.

The screen 50 has a plurality of holes 64 therethrough. The holes are tapered or wedge shaped to that they are larger on the inside of the vessel 10 which is the direction of flow. Thus, it may be seen that solid matter would not tend to become clogged in the holes 64 of the screen 50. However, should any matter become clogged in the face of the screen 50, the comb 56 would scrape it clean. Should any matter tend to become clogged at the working face or cutting edge of the comb 56, the cutters or projections 60 would tend to clean the face of the comb 56. Attention is called to the fact liquid and material is propelled by centrifugal force through screen passages 64. This results in capacity increase over other comminutors which do not thus apply centrifugal force.

A stationary housing 68 is connected to the bottom of column 16 (FIG. 1). Top 70 of the housing 68 is conical and correlative in shape to the top 30 of the vessel 10. Bottom 72 of the housing 68 is flat and is adjacent to the top of the interior member 38. The housing 68 is circular in cross section. Effort has been made in the matter of design of this portion to reduce to a minimum the fluid friction. Rotation of liquid about housing 68 is maintained by webs 40 and fin like parts 40' of top 30. Housing 68 is provided with liquid

passage sheer ports 74 positioned an optimum distance radially from the axis of the rotation to receive liquid at the desired pressure caused by centrifugal force upon rotation of the liquid. A sheer blade 76 attached to the top of interior member 38 rotates with the member 38 to effect shear cooperation with the ports 74 and keep them free of lodging material. The interior of the housing 68 is connected to pass liquid entering through the openings 74 into the hollow column 16 and thence to a desired point of disposition. Braces 78 are provided and connected between the top 70 and bottom 72 of housing 68.

Pipes 80 and 82 are disposed within the housing 68 and column 16 as shown in FIG. 1. The pipes 80 extend through the peripheral edges of the housing 68 to receive solids or more dense liquids from the more radially spaced portions of rotation of the vessel 10 where the more dense materials collect under pressure due to centrifugal force, i.e., the terminal ends 84 of the pipe 70 are placed further from the axis of the vessel 10 than the openings 74. A removable shear blade 86 is fixed to the top of the lift portion 32 to rotate therewith and cooperate with the terminals 84 of the pipe 80 to effect shear action and thus keep the terminals 84 free from lodging material or debris.

Plug 88 is provided in the top of the lift portion 32 and is in line with the pipes 80 so that a flexible member may be used to ream the pipes should they become plugged. Likewise, plug 90 is provided at the top of pipe 82 so that it might be reamed if it becomes plugged. In this illustration the structure 46 is in the form of a concrete pit and it is adapted to receive liquid through pipe 92. The liquid entering through pipe 92 fills the lower portion of the pit 46 to a level at which the pumping rate of the machine equals the rate of inflow. However, the liquid will reach the top of the screen 50 when the machine is operated at maximum capacity. It may be advantageous to provide an overflow discharge from pipe 92 or pit 46 to handle surplus flow (not shown). At the top of the pit and attached to the structure 46 are beams 94. They extend from the edges of structure 46 to ball joint 96. The column 16 is attached to the ball joint 96, thereby alignment and proper support of the bearing 12 is achieved.

The rate of discharge of the more dense material may be regulated by means of a valve placed in pipe 82 (not shown). Such valve could be manually or automatically throttled to obtain a predetermined density of the discharged material.

The machine may be arranged to operate in series with other similar machines and thus increase the extent of separation of liquids of different densities. Also the machine may be advantageously adapted to some operation in other than a vertical position.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction, materials, and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. A centrifuge adapted to pressurize fluids and to discharge the fluids of different densities comprising:
- (a) a covered vessel with an open portion at one end adapted to receive liquid material,
- (b) at least one bearing attached to the vessel to rotatably support same,
- (c) cooperative power means attached to the vessel for rotating the vessel,
- (d) a stationary nonrotating housing supported within the vessel,
- (e) passages in the housing terminating within the vessel at different distances from the axis of rotation of the vessel,
- (f) means on the vessel for shearing and removing any solid material lodged on the passage terminals,

- (g) said means for shearing and removing being in the form of shear blades.

2. The invention as defined in claim 1 wherein
- (h) said housing is circular in cross section and the fluid friction on the surface of the housing is minimized.

3. The invention as defined in claim 1 with the addition of
- (h) at least one plug in the vessel aligned with at least one passage terminal, so that the passage may be reamed should it become plugged.

4. A centrifuge adapted to pressurize fluids and to discharge the fluids of different densities comprising:
- (a) a covered vessel with an open portion at one end adapted to receive liquid materials,
- (b) at least one bearing attached to the vessel to rotatably support same,
- (c) cooperative power means attached to the vessel for rotating the vessel,
- (d) a stationary nonrotating housing supported within the vessel,
- (e) passages in the housing terminating within the vessel at different distances from the axis of rotation of the vessel,
- (f) at least one plug in the vessel aligned with at least one passage terminal, so that the passage may be reamed should it become plugged,

5. A centrifuge adapted to concentrate liquids with entrained solids comprising:
- (a) a vessel,
- (b) at least one bearing attached to the vessel to rotatably support same,
- (c) cooperative power means attached to the vessel for rotating the vessel,
- (d) a cylindrical screen with a plurality of holes,
- (e) said screen extending into the vessel at one end thereof and attached to the vessel to rotate therewith,
- (f) said screen concentric with said vessel and open on one end so that the liquid with entrained solids is fed into said vessel by centrifugal force urging the material through the screen, and
- (g) a comb member supported nonrotatably contacting the screen outside the vessel.

6. The invention as defined in claim 5 with the addition of:
- (h) projections extending from the screen, and
- (j) grooves in the comb meshed with projections from the screen to form means for shearing solids.

7. A centrifuge adapted to pressurize fluids and to discharge pressurized fluids of different densities comprising:
- (a) a covered vessel,
- (b) a fixed nonrotatable tubular column,
- (c) at least one bearing attached to the vessel to rotatably support the vessel,
- (d) said bearing surrounding said tubular column,
- (e) cooperative power means attached to the vessel for rotating the vessel,
- (f) a stationary housing attached to said fixed tubular column within the vessel,
- (g) passages in the housing terminating within the vessel at different distances from the axis of rotation of the vessel,
- (h) said passages extending through the fixed tubular column and thus through the bearing,
- (j) said passages adapted to convey material centrifugally from the vessel,
- (k) means on the vessel for shearing and removing any solid material lodged on the passage terminals,
- (m) said means for shearing and removing being in the form of shear blades,
- (n) at least one plug in the vessel aligned with at least one passage terminal so that the passage may be reamed should it become plugged,
- (p) said housing being circular in cross section and

the fluid friction on the surface of the housing being minimized,

(q) webs attached to the vessel adjacent to the housing, to maximize the fluid flow adjacent to the housing,

(r) a cylindrical screen with a plurality of holes,

(s) said screen extending into the vessel at the end opposite the column and attached to the vessel to revolve therewith,

(t) said screen concentrric with said vessel and open on the end so that the fluid is fed into said vessel by centrifugal force urging the material through the screen,

(u) said holes in the screen being tapered with the larger area on the inside vessel so that the holes do not tend to become clogged,

(v) a comb member supported nonrotatably contacting the screen outside the vessel,

(w) projections extending from the screen, and

(x) grooves in the comb meshed with projections from the screen to form means for shearing solids.

8. A centrifuge adapted to pressurize fluids and to discharge pressurized fluid of different densities comprising:

(a) a vessel with an open portion at one end adapted to receive liquid material,

(b) a shaft rotatably supporting the vessel,

(c) said shaft extending through said open portion in a manner that received fluids pass outside the shaft and into said open portion,

(d) a fixed nonrotatable tubular column,

(e) a bearing attached to the end of the vessel to rotatably support the vessel,

(f) said bearing surrounding said tubular column,

(g) cooperative power means attached to the vessel for rotating the vessel,

(h) said shaft terminating within the vessel and independent of the other rotation support set forth above,

(j) a first passage extending through the fixed tubular column and thus through the bearing,

(k) said first passage terminating within the vessel near a peripheral portion at a greater distance from the axis than the open portion at the bottom and adapted to convey centrifugally pressurized material from the vessel, and

(m) a second and separate passage extending through the tubular column and thus through the bearing,

(n) the second passage terminating within the vessel nearer the axis of rotation than the first passage and adapted to convey centrifugally pressurized material from the vessel.

9. A centrifuge adapted to concentrate liquids with entrained solids comprising:

(a) a vessel,

(b) at least one bearing attached to the vessel to rotatably support same,

(c) cooperative power means attached to the vessel for rotating the vessel,

(d) a cylindrical screen with a plurality of holes,

(e) said screen extending into the vessel at one end

thereof and attached to the vessel to revolve therewith,

(f) said screen concentric with said vessel and open on one end so that the liquid with entrained solids is fed into said vessel by centrifugal force urging the material through the screen, and

(g) a shaft rotatably supporting the vessel,

(h) said shaft extending centrally through said screen in a manner that received liquids pass outside the shaft and through the screen.

10. A centrifuge adapted to concentrate liquids with entrained solids comprising:

(a) a vessel,

(b) at least one bearing attached to the vessel to rotatably support same,

(c) cooperative power means attached to the vessel for rotating the vessel, and

(d) a cylindrical screen with a plurality of holes,

(e) said holes in the screen tapered with the larger area on the inside of the vessels so that the holes do not tend to become clogged,

(f) said screen extending into the vessel at one end thereof and attached to the vessel to revolve therewith,

(g) said screen concentric with said vessel and open on one end so that the liquid with entrained solids are fed into said vessel by centrifugal force urging the material through the screen.

11. A centrifuge adapted to pressurize fluids and to discharge pressurized fluids of different densities comprising:

(a) a covered vessel with an open portion at the bottom adapted to receive liquid material,

(b) a bearing attached to the vessel to rotatably support same,

(c) a cooperative power means attached to the vessel for rotating the vessel,

(d) a stationary nonrotating housing supported within the vessel,

(e) passages in the housing terminating within the vessel at different distances from the axis of rotation of the vessel,

(f) said housing being circular in cross section and the fluid friction on the surface of the housing being minimized, and

(g) webs attached to the vessel adjacent to the housing on at least two sides of the housing to maximize the fluid flow adjacent to the housing.

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