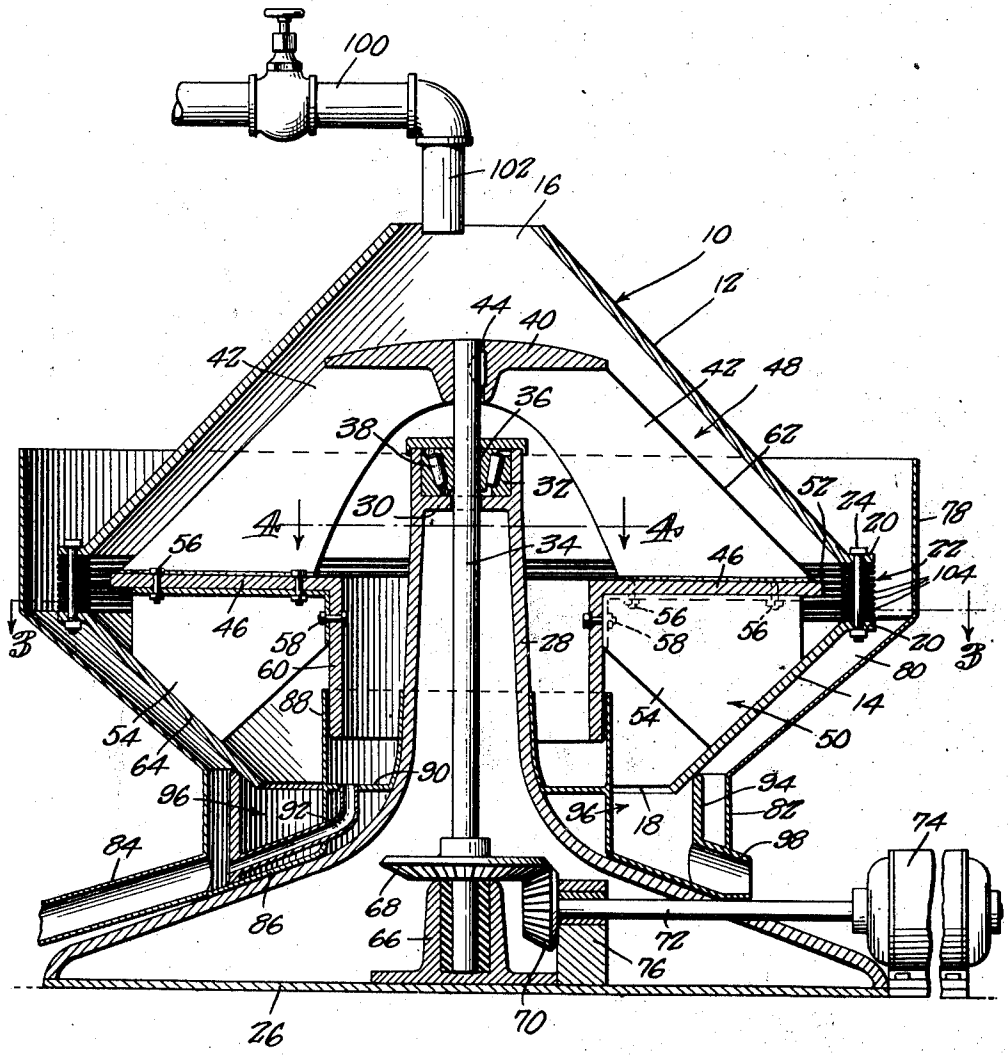
Feb. 10, 1948. G. I. WOOLAVER 2,435,665

CONTINUOUS PROCESS CENTRIFUGE

Filed Nov. 9, 1943 3 Sheets-Sheet 1

Fig. 1.



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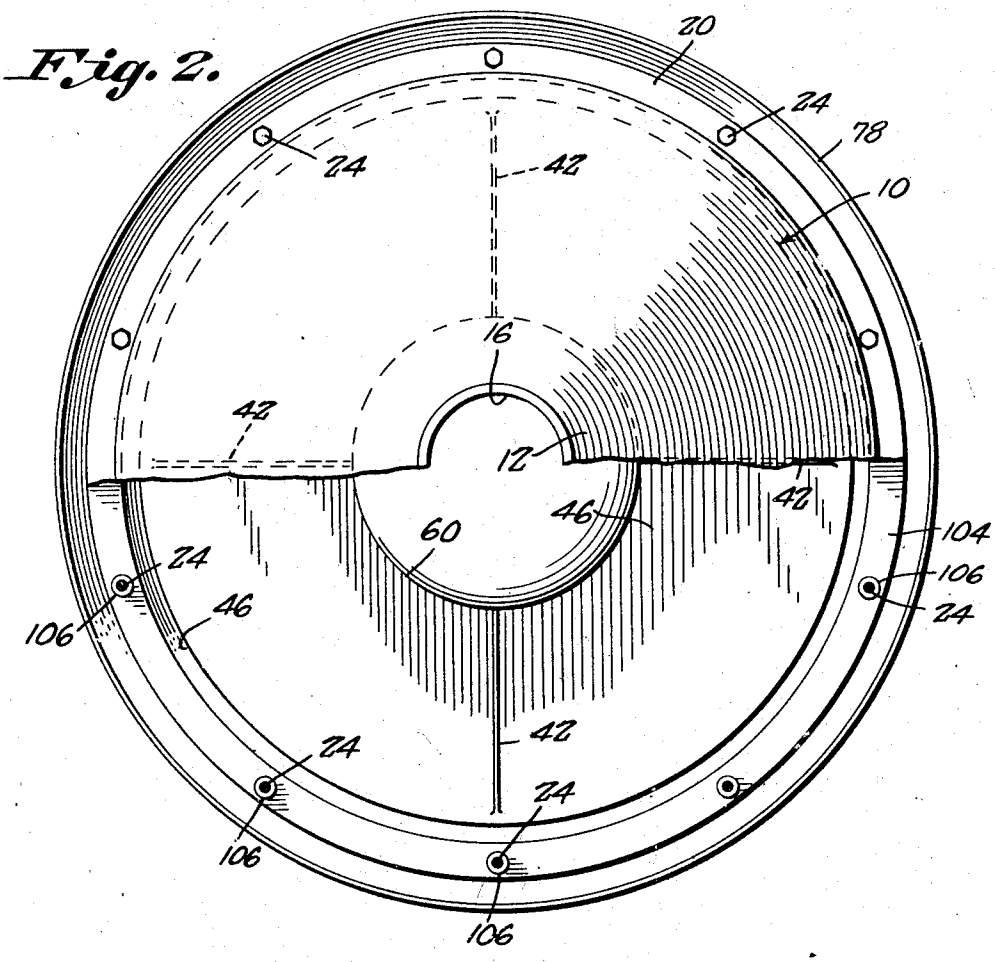
Filed Nov. 9, 1943 3 Sheets-Sheet 2

Fig. 2.



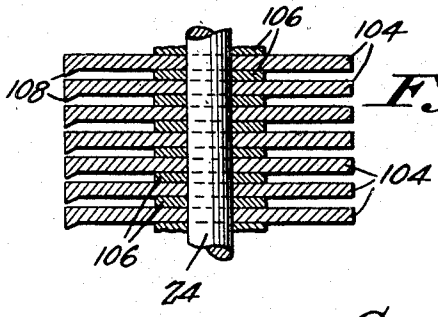


Fig. 5.

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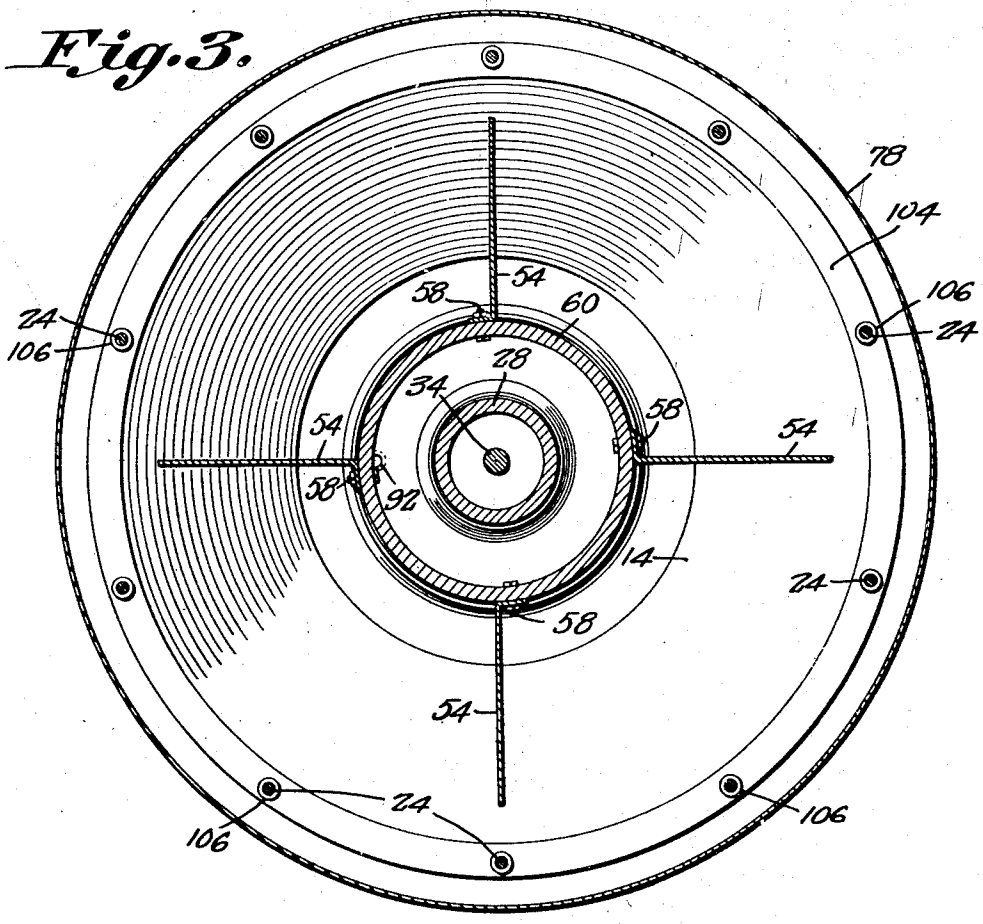
Filed Nov. 9, 1943 3 Sheets-Sheet 3

Fig. 3.



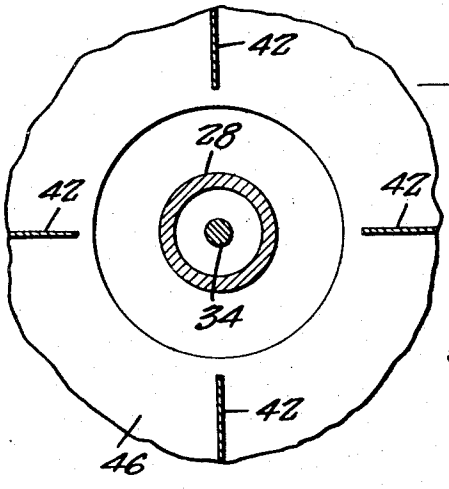


Fig. 4.

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Patented Feb. 10, 1948 2,435,665

UNITED STATES PATENT OFFICE

2,435,665

CONTINUOUS PROCESS CENTRIFUGE

George I. Woolaver, Milford, N. J.

Application November 9, 1943, Serial No. 509,621

9 Claims. (Cl. 233—2)

1

My invention relates to the separation of fluid materials, such as sand containing water, or other mixed fluid materials, and has among its objects and advantages the provision of an improved continuous process centrifuge.

More specifically, I provide a rotating shell having a central opening at its top for the introduction of materials to be separated. The shell is provided with a central opening at its bottom through which separated or processed material is discharged. The rotating shell is divided horizontally, as by a disk fixedly related to the shell, to divide the latter into at least two chambers or zones interconnected by a throat at the perimeter of the disk.

In one chamber an overbalancing initial centrifugal pressure is generated to force the materials through the machine where it will assume orbits of rotation natural to their respective gravity characteristics. Each of these orbits is separately forced through the machine to separate deliveries by an excess of initial centrifugal pressure.

The initial excess pressure is established only as additional material is supplied to the inlet of the machine, so that flow of material will occur only when pressure above the dividing wall exceeds the opposing pressure beneath the dividing wall.

Normally the throat is choked by flowing material under great pressure, so that the throat is sealed against the passage of the lighter liquids. These lighter liquids are excluded from the mass and forms an orbit of rotation inwardly over the more solid mass. The excess of fluids thus formed may flow downwardly to a separate delivery at the axis of the disk. The shell is shaped with a bulge having its greater diameter lying in the plane of the disk and provided with a screen about its area of greater diameter for the passage of fluid rejects.

In the accompanying drawings:

Figure 1 is a vertical sectional view of a machine in accordance with my invention.

Figure 2 is a top view partly in section.

Figure 3 is a sectional view taken substantially along the line 3—3 of Figure 1.

Figure 4 is a sectional view along the line 4—4 of Figure 1, and

Figure 5 is an enlarged vertical sectional view through the screen at the point of largest diameter of the shell.

In the embodiment of the invention selected for illustration, I make use of a shell or bowl 10 comprising a top section 12 and a bottom section 14. The section 12 is in the nature of a hollow frustum having its small end arranged upwardly to provide an inlet opening 16. The section 14 is of similar contour but is inverted so that its small end points downwardly to provide an outlet opening 18. The inlet and outlet openings are coaxial, but the outlet opening is of larger diameter than the inlet opening. The section 14 is also somewhat shorter than the section 12. Both sections are provided with flanges 20 about their larger ends and between which is arranged a screen 22. The screen and the two flanges 20 are secured into a unitary structure by bolts 24.

2

The shell 10 is mounted on a hollow base 26 having a tubular upstanding post 28. This post is provided with a flange 30 upon which is supported an outer bearing race 32. A drive shaft 34 extends loosely through the flange 30, and is provided with an inner bearing race 36 fixed thereto and coacting with the outer bearing race 32 through the medium of angular thrust rollers 38.

To the upper end of the shaft 34 is fixedly connected a head 40 to which are welded four depending and vertically arranged webs 42 positioned radially with respect to the shaft 34. The head 40 is keyed at 44 to the shaft 34, and the lower ends of the webs 42 are welded to a horizontal disk 46 lying in the plane of the screen 22 and dividing the shell 10 into chambers 48 and 50 having communication through the medium of an annular throat 52 lying between the perimeter of the disk 46 and the screen 22.

Webs 54 are bolted at 56 to the disk 46 and at 58 to an annular flange 60 depending from the disk 46 and constituting an opening in the disk located centrally thereof and coaxially with the post 28. While the webs 42 have their outer edges 62 spaced from and generally conforming to the wall of the section 12, the webs 54 have edges 64 lying against the inner face of the section 14, but having contact therewith only through limited intermediate areas of the section.

A bearing 66 is provided at the lower end of the base 26 for supporting the shaft 34. This shaft is provided with a bevel gear 68 meshing with a bevel gear 70 attached to a shaft 72 driven by a motor 74. A bearing 76 supports the shaft 72 adjacent the gear 70.

A screen guard and collector bowl 78 encloses the greater part of the shell 10 but is spaced therefrom to provide an annular passage 80 extending downwardly and communicating with an annular neck 82 located beneath the lower end of the

section 14. Material flowing downwardly in the passage 80 and through the neck 82 may be withdrawn through the medium of a conduit 84. The bowl 78 is stationary and includes a bottom 86 resting on the base 26 and an annular flange 88 extending upwardly but loosely about the lower end of the flange 60. Materials flowing downwardly through the flange 60 are received in a trough 90 extending about the post 28 and provided with an outlet conduit 92 leading into the neck 82. The trough 90 is fixed to the flange 88 and closely embraces the post 28.

Arranged concentrically with and inside the neck 82 is an annular flange 94 extending a short distance above the lower end of the section 14 and exteriorly thereof. This flange extends upwardly from the bottom 86 and coacts with the flange 88 to provide an annular trough 96 into which material flows from the section 14. The trough 90 is separate from the trough 96 and the latter is separate from the neck 82. An outlet 98 is provided for the trough 96.

A valve controlled material feeding pipe 100 is arranged above the shell 10, the pipe having a delivery end 102 extending a short distance inside the section 12 and to one side of its axis.

The screen 22 comprises flat rings 104 of the same diameter as the flanges 20. Washers 106 are mounted on the bolts 24 and positioned between the rings 104 to space the rings one from the other. The inner faces of the rings are provided with flanges 108 which terminate flush with the inside edge faces of the rings. The flange 108 on each ring is spaced a predetermined distance from the flat face of an adjacent ring, the spacing being determined by the thickness of the washers 106, which washers may be changed for other washers of different thicknesses to vary the spacing between the flanges 108 and the cooperating rings, depending upon the nature of the material to be screened therethrough.

My invention embodies a pressure and separating zone, a sealing throat below the separating zone, and a counterbalancing pressure zone beneath the throat, where the flow is opposed and stopped at the point of a minimum safe sealing condition, until the addition of heavy material, displacing lighter material in the separating zone, builds up a greater centrifugal pressure to overcome the opposing pressure, thus moving the seal and discharging the excess above balanced requirements.

The material introduced into the shell 10 builds up in the nature of a wall against the shell so that liquids and the like may spill down through the flange 60. The screen 22 vents entrained fluids from the heavier material. The separated material is isolated from the lighter materials. The lighter materials are evacuated from the trough 90 and the neck 82 by gravity, and the separated or processed material from the trough 96 is preferably evacuated by air suction.

Without further elaboration, the foregoing will so fully explain my invention, that others may, by applying current knowledge, readily adapt the same for use under various conditions of service.

I claim:

1. In a fluid material separator, the combination of a shell having an inlet and an outlet located below the inlet, said shell being shaped with a progressively increasing diameter to a point intermediate the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell and fixedly related thereto, said wall having a central opening and being of

such diameter as to provide a throat located between its perimeter and said shell, said shell being mounted on a hollow base having a tubular upstanding post, a flange at the upper end of said post, a bearing supported on said flange, a drive shaft journalled in said bearing, a head keyed to the upper end of said shaft, a plurality of depending and vertically arranged webs secured to said head radially of said shaft, said wall being secured to the ends of said webs, a plurality of webs secured to said wall on the undersurface thereof in vertical alignment with said first mentioned webs, said last said webs having contact with said shell whereby said wall is fixedly related to said shell for the rotation thereof by said shaft.

2. In a fluid material separator, the combination of a shell having an inlet and an outlet located below the inlet, said shell being shaped with a progressively increasing diameter to a point intermediate the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell and fixedly related thereto, said wall having a central opening and being of such diameter as to provide a throat located between its perimeter and said shell, said shell being mounted on a hollow base having a tubular upstanding post, a flange at the upper end of said post, a bearing supported on said flange, a drive shaft journalled in said bearing, a head keyed to the upper end of said shaft, a plurality of depending and vertically arranged webs secured to said head radially of said shaft, said wall being secured to the ends of said webs, a plurality of webs secured to said wall on the undersurface thereof in vertical alignment with said first mentioned webs, said last said webs having contact with said shell, whereby said wall is fixedly related to said shell for the rotation of said shell and said wall by said shaft, and a screen in the wall of said shell in the plane of its largest diameter.

3. In a fluid material separator, the combination of a shell having an inlet and an outlet located below the inlet, said shell being shaped with a progressively increasing diameter to a point intermediate the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell and fixedly related thereto, said wall having a central opening and being of such diameter as to provide a throat located between its perimeter and said shell, said shell being mounted on a hollow base having a tubular upstanding post, a flange at the upper end of said post, a bearing supported on said flange, a drive shaft journalled in said bearing, a head keyed to the upper end of said shaft, a plurality of depending and vertically arranged webs secured to said head radially of said shaft, said wall being secured to the ends of said webs, a plurality of webs secured to said wall on the undersurface thereof in vertical alignment with said first mentioned webs, said last said webs having contact with said shell whereby said wall is fixedly related to said shell for the rotation of said shell and said wall by said shaft, said shell comprising two sections, and a screen interposed between said two sections.

4. In a fluid material separator, the combination of a shell having an inlet and an outlet located below the inlet, said shell being shaped with a progressively increasing diameter to a point intermediate the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell and fixedly related thereto, said wall

being of such diameter as to provide a throat located between its perimeter and said shell, said shell being mounted on a hollow base having a tubular upstanding post, a flange at the upper end of said post, a bearing supported on said flange, a drive shaft journalled in said bearing, a head keyed to the upper end of said shaft, a plurality of depending and vertically arranged webs secured to said head radially of said shaft, said wall being secured to the ends of said webs, a plurality of webs secured to said wall on the undersurface thereof in vertical alignment with said first mentioned webs, said last said webs having contact with said shell whereby said wall is fixedly related to said shell for the rotation of said shell and said wall by said shaft, said outlet being of larger diameter than said inlet, and said wall having a central opening arranged coaxially of the outlet but separated therefrom.

5. In a fluid material separator, the combination of a shell having an inlet and an outlet located below the inlet, said shell being shaped with a progressively increasing diameter to a point intermediate the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell and fixedly related thereto, said wall being of such diameter as to provide a throat located between its perimeter and said shell and having a central opening, means for rotating said shell and the horizontal wall, said means including a post mounted on a hollow base, said post having a flange to receive an inner bearing brace, a driven shaft rotatably supported in said bearing brace in said post and provided with a head, and webs fixedly connecting said head with said wall.

6. The invention described in claim 5 wherein webs are interposed between said wall and the bottom portion of said shell.

7. The invention described in claim 1, wherein there is provided a receptacle extending about said shell, and a screen interposed in said shell in the plane of its larger diameter and beneath the top limit of said receptacle.

8. In a fluid material separator, the combination of a shell having an inlet and an outlet located below the inlet, said shell being shaped with a progressively increasing diameter to a point intermediate the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell and fixedly related thereto, said wall having a central opening and being of such diameter as to provide a throat located between its perimeter and said shell, said shell being mounted on a hollow base having a tubular upstanding post, a flange at the upper end of said post, a bearing supported on said flange, a drive shaft journalled in said bearing, a head keyed to the upper end of said shaft, a plurality of depending and vertically arranged webs secured to said head radially of said shaft, said

wall being secured to the ends of said webs, a plurality of webs secured to said wall on the undersurface thereof in vertical alignment with said first mentioned webs, said last said webs having contact with said shell whereby said wall is fixedly related to said shell for the rotation of said shell and said wall by said shaft, said shell comprising a top section and a bottom section, a screen interposed between said top and bottom sections, and bolts securing said sections and said screen into a unitary structure, said top section being contoured in the nature of a hollow frustum with its small end pointing upwardly and said bottom section being of like formation but inverted to project its small end downwardly.

9. In a fluid material separator, the combination of a shell having an inlet and an outlet located beneath the inlet, said shell being circular in horizontal cross section and having an increased diameter area located between the inlet and the outlet, a horizontal wall lying in the plane of the larger diameter of said shell, said wall having a central opening and being of such diameter as to provide a throat located between the perimeter of the wall and said shell, said shell being mounted on a hollow base having a tubular upstanding post, a flange at the upper end of said post, a bearing supported on said flange, a drive shaft journalled in said bearing, a head keyed to the upper end of said shaft, a plurality of depending and vertically arranged webs secured to said head radially of said shaft, said wall being secured to the ends of said webs, a plurality of webs secured to said wall on the undersurface thereof in vertical alignment with said first mentioned webs, said last said webs having contact with said shell whereby said wall is fixedly related to said shell for the rotation of said shell and said wall by said shaft.

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