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CENTRIFUGE FOR SEPARATING THREE COMPONENTS

Filed June 9, 1958

2 Sheets-Sheet 1

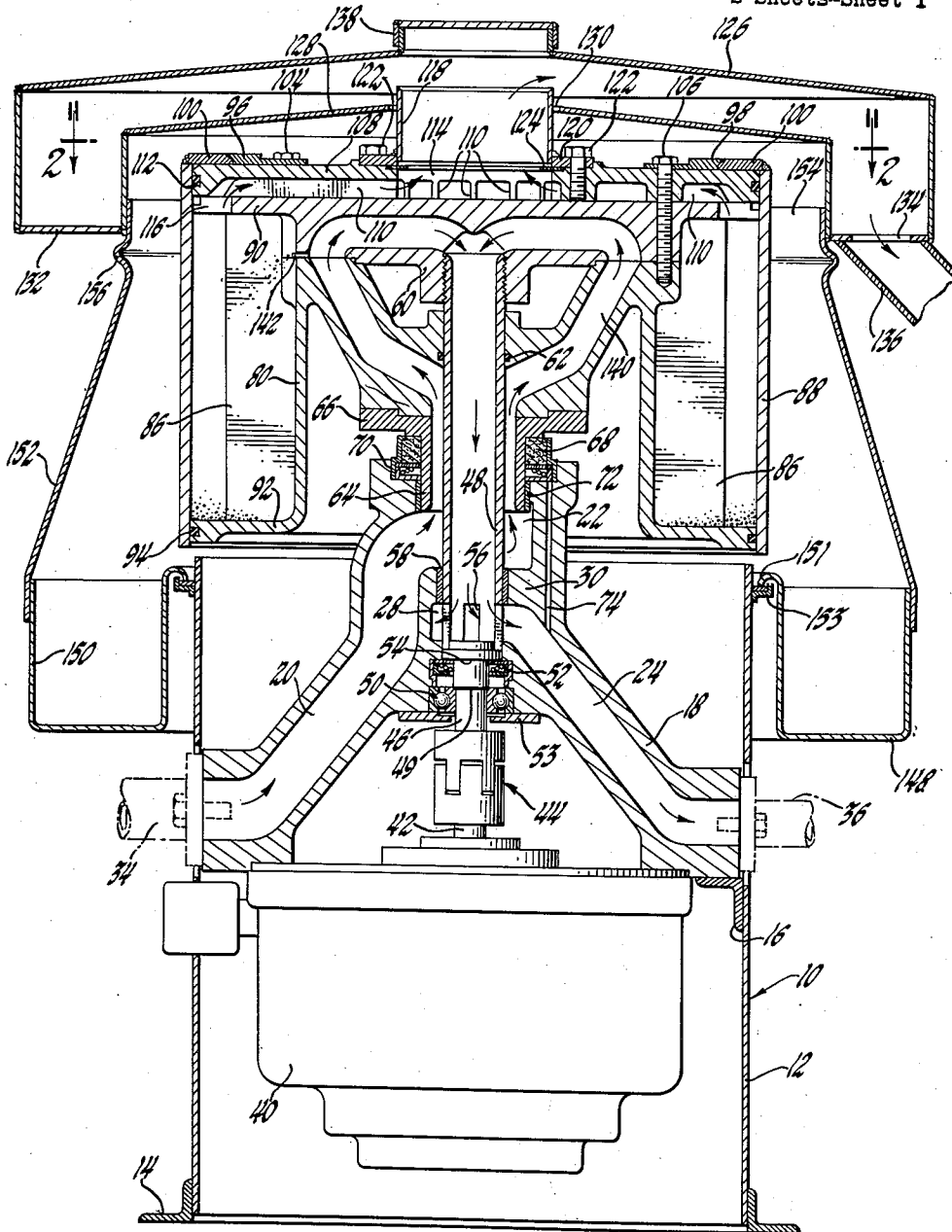


Fig. 1

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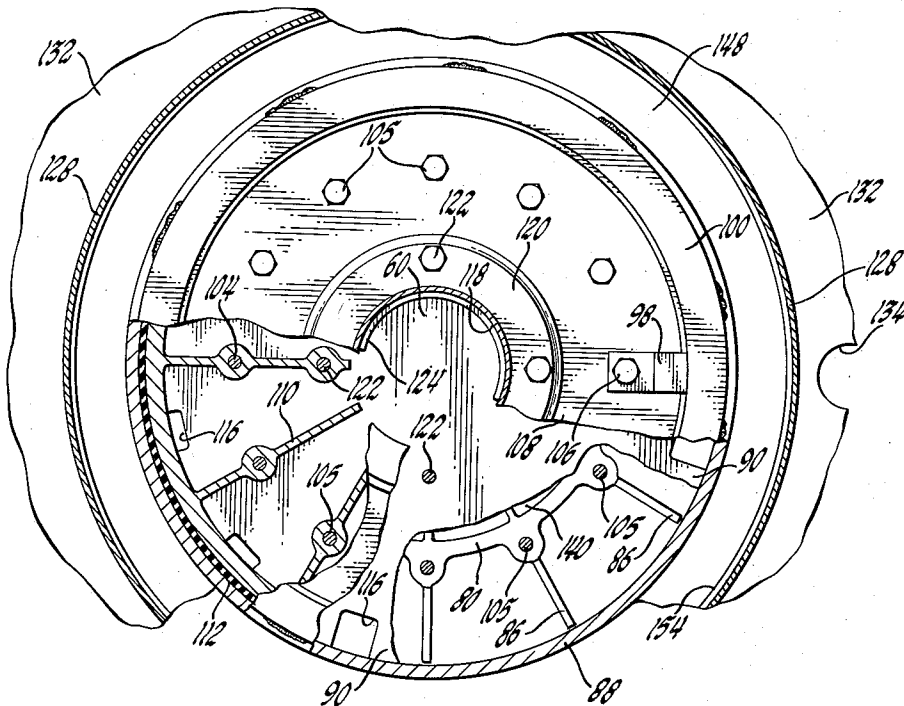


Fig. 2

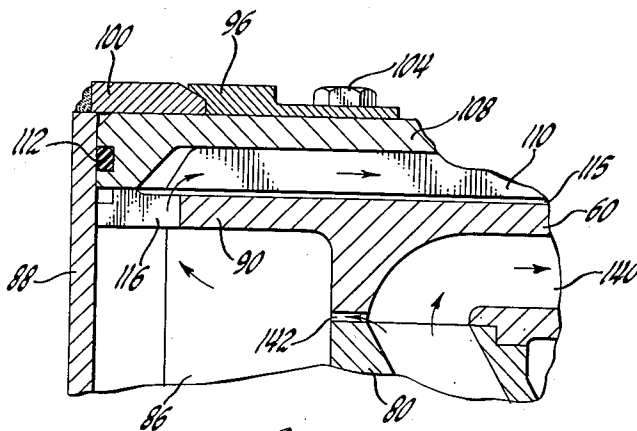


Fig. 3

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3,022,937 CENTRIFUGE FOR SEPARATING THREE COMPONENTS

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1 Claim. (Cl. 233-28)

This invention relates to centrifuges for treating fluids and more particularly to centrifugal separators for separating each of three components, such as solid impurities, water and oil, from a feed liquid.

In separating such components as water and solids from a fluid of less specific gravity such as oil, difficulties have been experienced in utilizing centrifugal separators because of the periodic cleaning of the latter which cleaning has been inconvenient and burdensome; and it has become difficult in treating certain liquid feed solutions because water forms a substantial proportion of the initially fed liquid.

When water is not too noticeable or objectionable as a component, then it often need not be separately taken from the centrifuge; and, in such an event, a centrifugal apparatus such as disclosed in United States patent application Serial No. 493,090 filed March 9, 1955, in the name of Robert L. Dega and entitled "Centrifuge for Clarifying Fluid" may be used. This application issued August 4, 1959 as Patent No. 2,898,037. This present invention constitutes an improvement of the apparatus disclosed in the aforementioned patent in that provision is now made for separately drawing off a third component, such as water, from the solid impurities which are separated from the fluid fed to a centrifuge.

An object of the present invention is to provide an improved centrifuge in the use of which suspended solid impurities may be separated and deposited for easy removal and a third component, such as water, may be withdrawn, this separating action taking place despite turbulence which is generally existent in centrifugal apparatus.

To these ends, a feature of the present invention pertains to a centrifuge with its main operative parts accessible at one end for disassembly and cleaning, the body of the centrifuge being provided with a port through which a heavy liquid, such as water, may be withdrawn separately.

The above and other important features of the invention will be described in detail in the specification and then pointed out more particularly in the appended claim.

In the drawings:

FIG. 1 is a sectional and elevational view taken in a plane passing through the vertical axis of a centrifuge in which the present invention is embodied, a power source therefor being shown in elevation;

FIG. 2 is a sectional view at various levels and looking in the direction of the arrows 2-2 in FIG. 1; and

FIG. 3 is a detail sectional view of part of the construction shown in FIG. 1 drawn to a larger scale.

In the drawings, the centrifuge disclosed is shown to comprise a support generally indicated at 10. This support comprises a vertical and cylindrical shell 12 having an annular angle bar 14 surrounding and attached to its base to provide an adequate footing. An intermediate portion of the shell 12 is provided with a flanged member or ring 16 in its interior and upon which a conical casting 18 is mounted. This casting is so made as to provide a fluid inlet passage 20 which extends from outside the shell 12 upwardly and inwardly to an annular chamber 22 formed in an upper portion of the casting. The latter also is so formed as to provide an outwardly directed passage 24 which communicates with an annular

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chamber 28 coaxial with the chamber 22 and separated from the latter by a web portion 30 of the casting. The passages 20 and 24 are arranged to connect with an inlet pipe 34 and an outlet pipe 36, respectively, and as shown in dot-and-dash lines in FIG. 1. The passage 20 is larger than the passage 24 in cross section. The pipe 34 is arranged to communicate with a source of supply of contaminated fluid, such as oil, having water and gritty particles in it. The pipe 36 is for conveying clarified or clear oil to a container for receiving the same or to the place of use.

Electric motor 40 is mounted within the support 10 in such a way that its shaft 42 is directed upwardly for connection by means of a universal joint 44 with a reduced and solid end 46 of an otherwise hollow shaft 48. The lower end 46 of this shaft is journaled in the casting 18 with the help of a ball bearing arrangement 50 and a fluid tight sealing arrangement 52. A bearing retainer plate 53 is attached to the underside of the casting 18 by means of cap screws not shown. The shaft 48 bears a shoulder 54 which rests upon the sealing arrangement 52. The major portion of the weight of the centrifuge rotor, however, is supported by a second shoulder 49 on the shaft resting on the inner race of the ball bearing 50. The shaft is also provided with four radial slots 56 by means of which the interior of the shaft communicates with the chamber 28. The shaft 48 is also journaled within a bushing 58 retained within the casting portion or web 30. The upper end of the shaft is open and is threaded to receive a top portion 60 of the centrifuge body. Spaced from the open end of the shaft is a sealing ring 62 which is retained within an annular groove formed in the centrifuge body.

Also journaled on the casting 18 is a hollow shaft 64 which is arranged coaxially with the shaft 48 and is provided with a stepped flange 66 at its upper end. This flange rests upon a packing arrangement 68 surrounding the shaft 64 and which is placed in a recess 70 formed in the top of the casting. The lower end of the shaft 64 is journaled within a bushing 72 fixed to the casting. A vertical drain passage 74 extends downwardly from the sealed recess 70 and communicates with the outlet passage 24.

A main portion 80 of the centrifuge body is surrounded by an outer and removable sleeve 88. Twelve radial and equally spaced vanes 86 are made integral with the main body 80 and extend outwardly to cooperate with two annular end flanges 90 and 92 in defining dirt pockets. The flange 90 is a part of the portion 60 and the flange 92 is integral with the main body portion 80.

The flange 92 is recessed around its periphery to receive an O-ring 94 forming a seal against the inner surface of the sleeve 88. Diametrically disposed and welded to the top end of the sleeve 88 are two inwardly directed assembly plates 96 and 98. The inwardly directed ends of the plates 96 and 98 are formed with inclined surfaces for engaging the matching inclined surfaces of the inner periphery of a ring 100 welded to the top edge of the sleeve 88. The plates 96 and 98 are held in position on the rotor by means of two bolts 104 and 106. The latter pass down through a cover member 108 and the top portion 60 into the main body 80. There are ten bolts 105 (FIG. 2) which serve much like the bolts 104 and 106 but they do not pass through assembly plates.

The cover member 108 is recessed on its underside and this recess is divided by twelve radial vanes 110. Each vane 110 lies in the same plane as a vane 86. The cover member 108 also bears a peripheral recess 112 with a sealing ring therein bearing against the inner side of the sleeve 88. The radial passages formed by the cover and separated because of the ribs 110 all communicate with a discharge port 114 which is coaxial with the shafts 48

and 64. The top surface of the portion 60 between adjacent ribs 110 is recessed as shown at 115 in FIG. 3. The outer ends of the passages in the portion 108 communicate with ports 116 formed in the body port on 60 and at the latter's periphery. A water discharge tube 118 extends upwardly from the centrifuge body cover 108 and is attached thereto by means of a flange 120 made integral with the tube by welding. The flange is fixed to the cover member 108 by means of four bolts 122.

An annular recess is made in the cover member 108 at the periphery of the port 114 for the reception of a ring 124 (FIG. 1). This ring defines an orifice which determines the head at which fluid will be discharged through the port, and by changing the ring the orifice or head can be varied dependent upon requirements and as the specific gravities of the materials being treated may vary.

An overall and removable cover member 126 is made of sheet metal and this member has an underside wall 128 which is slightly conical and which defines a slight clearance 130 around the tube 118. The cover member 126 is so made as to present an annular trough 132 surrounding the centrifuge apparatus and this trough bears a discharge opening 134 and a spout 136 through which the water or heavy fluid may be discharged. Operation of the machine may be checked visually by removal of a small supplementary cover 138 threaded to a neck integral with the overall cover.

As in the United States Patent No. 2,898,037, previously referred to, an annular series of passages 140 are formed in the centrifuge body. They extend radially in planes each extending from and including the axis of the rotor body and serve to connect the shaft 64 to the shaft 48. A slot 142 is defined between the two portions 60 and 80 of the centrifuge body to give communication between an intermediate portion of each passage 140 and a pocket defined by two vanes 86 and the flanges 90 and 92. There are twelve slots 142 and the dirt pockets, as well as the radial passages 140, are much like those shown in the application heretofore referred to.

Around the shell 12 and near the upper end thereof is placed a gutter 153, and resting within that gutter in such a way that detachment may easily be undertaken is a downturned flange 151 which is a portion of a trough 148. The trough surrounds the shell 12 and the outer wall 150 thereof is joined to a conical portion 152 to constitute a receptacle for receiving impurities previously separated from the oil and water as will subsequently appear. A reduced upper end 154 of the receptacle is formed to present an outwardly extending ridge 156 upon which may rest the inner edge of the trough 132.

As in the patent previously referred to, the sleeve 88 may be removed (after removal of the cover 126) and the dirt deposited in the pockets of the rotor during normal centrifuge operation may be cleaned away and carried away from the apparatus with the use of the annular trough 148. A variation in the operation occurs in the present instance, however, in that when water in any substantial quantity is in the fluid to be separated it is removed separately from the solid impurities; and, to that end, such water passes through the slots 142 into the dirt pockets. From these pockets the water will rise through the openings 116 and pass by way of the radial passages in the cover member 108 to the discharge port 114 and eventually find its way to the spout 136 for discharge.

In the initial operation of the centrifuge, the rotatable body or rotor is completely filled with fluid. During subsequent rotation by the motor 40 for normal operation, impurities of a solid nature are retained within the dirt pockets and a volume of liquid flows back through the slots 142 into the liquid stream of the passages 140. The resulting counter-current flow of impurities and liquid in the slots has no appreciable effect on efficient operation as the quantity of liquid displaced toward the rotor and axis and within the slots in any given time interval is very small whereas centrifugal force imparted to the impurities and water is considerable.

The centrifugal force effective in the passages 140 of the rotor supplements the charging pressure to produce a total pressure at the slots 142. To counterbalance this head, it is necessary to maintain a column of heavier fluid or water extending inwardly to the discharge opening in the annulus or ring 124. In beginning operation it is necessary first partially to fill the centrifuge with water and thereby establish a water trap before introducing the lighter fluid. Once this trap is formed it is not necessary to bleed in additional water in continuing the separation of the three feed components.

It is to be noted that the fluid emanating from the passage 24 is discharged with a positive working head while the heavier fluid or water is discharged and drained from the top of the machine by gravity. This result is due to the balance of pressures referred to in the previous paragraph.

The machine is capable of continuously handling a feed constituting 0-100% (any proportion) of either of the two liquids in addition to separating the small quantities of solids deposited in the dirt pockets between the vanes 86. Obviously, the balance of pressures must be such that the water or heavier fluid will pass inwardly through the cover member 108 and the heavy solid particles will remain behind.

I claim:

A centrifuge comprising a support, two vertical coaxial tubular shafts journaled in said support, a centrifuge rotor body defining an annular series of passages, each of the latter extending radially in a vertical plane including the axis of said shafts, said shafts and rotor body being joined together as a unit and said shafts communicating with opposite ends of each of said passages, pockets in said body located outside said passages, openings leading from intermediate portions of said passages to said pockets, a liquid discharge port in an upper portion of said body coaxial with said shafts, a replaceable restrictive ring mounted in said discharge port to regulate its effective flow capacity and having an inner diameter greater than the inner diameter of each shaft, said rotor body having a cover portion defining discharge passages connecting outer zones of said pockets to said port, and means for rotating said unit.

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