

Jan. 19, 1937.

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2,068,520

CENTRIFUGAL SEPARATOR BOWL

Filed Sept. 16, 1933

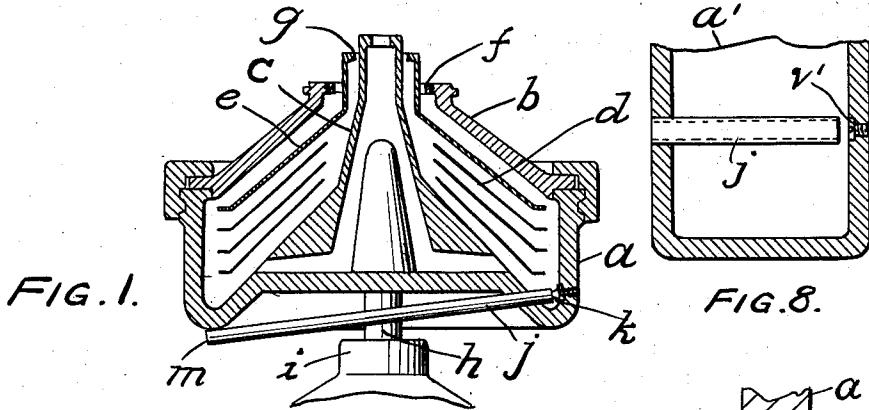
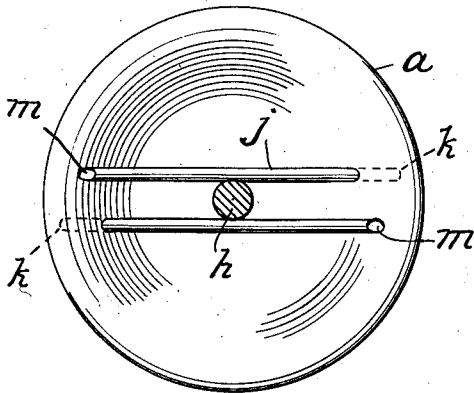


FIG. 2.

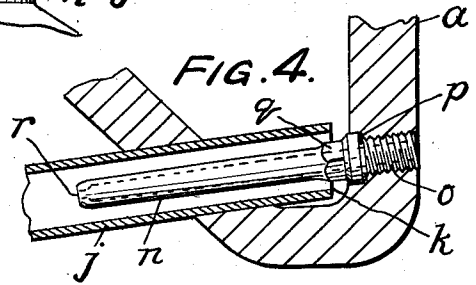


FIG. 4.

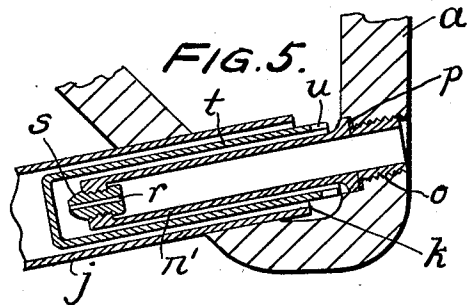


FIG. 5.

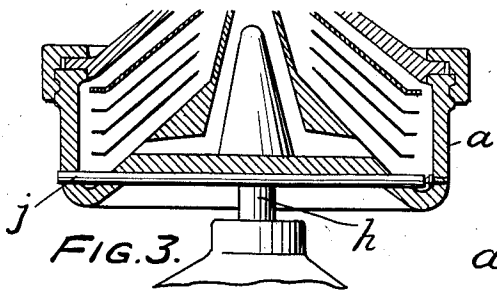


FIG. 3.

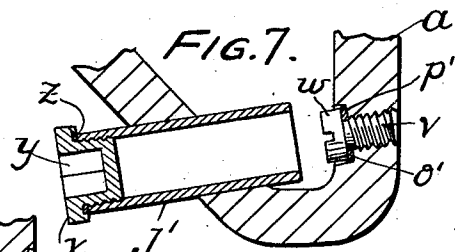


FIG. 7.

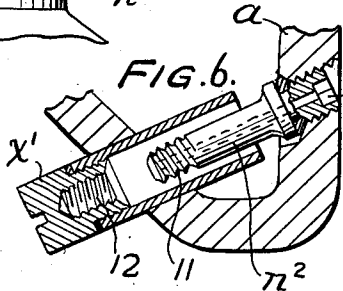


FIG. 6.

WITNESS:

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2,068,520

CENTRIFUGAL SEPARATOR BOWL

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Application September 16, 1933, Serial No. 689,707

13 Claims. (Cl. 233—47)

My invention relates to centrifugal bowls for the separation of acid sludge from oil and is particularly adapted for use in cases where a small quantity of free acid separates from both the oil and the sludge.

One object of the invention is to provide a centrifugal bowl in which the relation between separated oil and sludge will be unaffected by simultaneous separation of small quantities of acid heavier than either the oil or the sludge, in which centrifugal force will help to hold any removable members in place, and the removable members of which can be exchanged without disassembly of the bowl. Another object of the invention is to facilitate the thorough removal from the bowl, at the conclusion of the separating operation, of heavy matter deposited on the bowl wall.

The invention is particularly well adapted for use in self draining bowls of the type disclosed in my co-pending application, Ser. No. 663,295, filed March 29, 1933, now Patent No. 2,000,459, but may be used with bowls that are not self draining.

In treating oils with acid (usually concentrated sulfuric acid) there are always two resultants namely: oil having a specific gravity between .7 and 1.0 and sludge having specific gravity between 1.10 and 1.40. Frequently there is a third resultant; namely: residual acid having a specific gravity of 1.6 or higher.

When separation is carried on in a centrifugal bowl having two outlets adjusted for oil and sludge, any separated residual acid collects around the inside of the bowl shell until it shuts off the sludge outlet. If, on the other hand, the outlets are adjusted for oil and acid, there is danger that all of the sludge will escape and permit oil to flow from the sludge outlet.

I know that it is old to provide, in the bowl shell, leakage holes for the escape of any free acid that may collect. Because of the high pressure (500 lbs. per sq. inch and upwards) at this point the holes must be so very small that they are sometimes completely closed by dirt and sludge. At other times they may be corroded and eaten by acid and enlarged to such an extent that a large quantity of sludge can escape through them. Either of these can put a bowl out of commission.

I also know that it is old to provide bowls having orifices through the shell with removable, renewable or exchangeable nozzles screwed in from the outside against a gasket of deform-

able material, like lead, but centrifugal force tends to throw such nozzles away from the seat or gasket, and when corrosive materials are being handled the thread may be eaten away and weakened until it will not hold the nozzle.

I also know that it is old to provide nozzles each having a flange larger than the threaded part, the nozzle being screwed into a bowl wall from the inside with the flange against a seat or a gasket so that centrifugal force tends to force it tighter in place, the flange, instead of the threads, taking all stresses due to either centrifugal force or hydraulic pressure; but such devices previously made can be removed, adjusted or exchanged only while the bowl is disassembled.

In the accompanying drawing, which illustrates embodiments of my invention:

Figure 1 is a vertical section a little one side of the center of a complete bowl showing the preferred form of my invention.

Figure 2 is a bottom view of the same.

Figure 3 is a partial vertical section showing an alternative form.

Figure 4 is an enlarged detail in vertical section of the acid outlet.

Figures 5, 6, 7 and 8 are views, similar to Fig. 4, of alternative constructions.

a is the shell of a bowl having a top *b* and containing a tubular shaft *c*, a nest of separating discs *d* and a top disc *e*. The discharge for heavy liquid (sludge) is at *f* and that for light liquid (oil) is at *g*. At least one of these discharge openings is adjustable, in any well known manner, as by an exchangeable ring which, in Fig. 1, is shown applied at the heavy liquid discharge. A spindle *h*, revolving in a bearing *i*, supports and drives the bowl.

In the construction shown in Figures 1 and 2, two drain tubes *j* start from *k* very near to the inside of the bowl wall and pass close to the side of the spindle *h* with a downward slope to just touch the bottom of the bowl, at *m*, nearly opposite the starting point. In the construction shown in Figure 3 the tubes are horizontal and extend through the opposite part of the bowl. Though, for the reasons given in the aforementioned application, the tubes *j* preferably extend across the bowl, as shown in Figures 1, 2 and 3, they may terminate near the center of rotation or may be still shorter and have their ends capped or plugged.

Tubes of the form shown in Figure 2 may be used at any desired height in hollow bowls (bowls without separating discs).

In Figure 4 the end k of the tube j is shown near to, but not touching, the inside of the bowl shell a . A nozzle n has a threaded portion o screwed into the bowl shell and made tight by a gasket p . The nozzle is first inserted through the more distant end m of the tube j and is then screwed into the bowl shell. A long socket wrench, fitting the square portion q of tube n , may be used to screw in and change nozzles. The entrance opening r to the nozzle n is preferably smaller than the remainder of the passage.

In Figure 5 the tube or nozzle n' is provided with a removable plug s in which the orifice r is drilled and is surrounded by a tubular cup t of smaller diameter than the tube j and having notches u in its sides at the open end.

In the construction shown in Figure 6 the tube or nozzle n^2 has, in its outer end, a square socket 10 and, in its inner end, a thread 11 adapted to fit a thread 12 in the plug x' .

In Figure 7 a plug v in the bowl wall may or may not have an orifice through it. This plug has a threaded portion o' and a head with a flange w which makes a tight joint against a gasket p' . In this modification the tube j' is short with its inner end closed by a plug x having a square hole y to receive a tool for screwing it out. A gasket z assists in making a tight joint.

Figure 8 illustrates the application of the invention to a bowl which does not have its bottom sloping downward toward its periphery and which may be an "open" bowl, that is, one unprovided with discs. In this construction the tube j extends through one peripheral wall of the bowl a' and terminates opposite an outlet in the opposite part of the bowl wall, said outlet containing a plug v' , similar to plug v of Fig. 7, or a tube as shown in Figs. 4, 5 and 6, e. g., tube n of Fig. 4.

It will be noted that all devices insertable in the bowl wall are screwed from a more central position toward a more distant position and have a shoulder or flange that abuts against a companion surface on the bowl shell and so relieves the thread of all stresses except that of the initial tightening.

Before operation the openings f and g are adjusted for the relative specific gravities of the sludge and oil as instructed in Snyder Patent No. 1,283,343 to bring the inner side of the sludge zone at the desired location. By similar calculations there is determined the location for the orifice r required to cause the inner wall of the heaviest acid likely to be collected in the bowl to be at the same or a slightly greater radius than k , which should always be greater than the radius of the bottom of the top disc e , and nozzles n of the correct length are inserted.

In operation the acid-treated oil, with the sludge formed in it, is fed into the bowl, where the oil and sludge are separated. The oil passes up near the center of the bowl and escapes at g . The sludge is thrown toward the outside of the bowl, passes around the bottom edge of the top disc e and escapes at f . If there is any free acid it collects against the bowl wall until it covers and is forced into the end k of the tube j down which it passes to the orifice r and escapes through the nozzle n (or n' or n^2). If there is no free acid, some sludge will escape at the acid outlet, but its viscosity is high and, because the orifice r is relatively near the center of rotation, the pressure is low and the quan-

tity is very small; and hence exact adjustment of the orifice r is not required.

Because the location of the orifice r is set to keep the inside radius of the acid wall always greater than the radius of the bottom of the top disc e , the flow of sludge around that bottom will always be the same as if no acid were present.

With the construction shown in Figure 5 with the cup t fitting with small clearance 10 around the tube n' , the quantity of sludge to be forced out before flow of acid can begin is so small that there will be little delay in discharge of acid. By changing the plug s it is possible to have the smallest size orifice r that will permit proper flow of acid or sludge.

At the end of a day's run it is desirable that all acid and sludge be removed from the bowl. With the constructions shown in Figures 4 and 5, the nozzle n (or n') may be unscrewed or removed by means of a tool inserted from the opposite end of the tube j . With the construction shown in Figure 6 a square plug may be inserted in the socket 10 and the tube n^2 unscrewed from the bowl shell. Inward pressure will move the tube until the thread 11 engages the thread 12 , which holds the tube n^2 away from the hole in the bowl. With the construction shown in Figure 7 removal of the plug x will permit the insertion of a tool by means of which the plug v can be taken out. With the construction shown in Figure 8, a tool may be readily inserted through tube j and the plug v' removed. In any of these cases the opening is effected without disassembling the bowl, and on starting the machine all acid, sludge and any other matter contained in the bowl will be thrown out.

It will be understood that one of the objects of the invention, namely, the cleaning out of the bowl after the conclusion of the centrifugal separating or purifying action, is not dependent upon the use of the bowl for separating three, or even two, constituents of different specific gravities, or upon the provision of three, or even two, outlets for separated liquid, during the purification operation. Thus if, for example, the construction of Figure 7 or Figure 8 should be used and the plug in the bowl wall should not be provided with an outlet, the bowl, if used to separate sludge and oil, will not operate as described to maintain the desired relation between these separated constituents. The principal object secured by constructions like that of Figure 7 and 8 is to provide an outlet controlling device which will not function during the regular separation or purification process except to maintain the outlet as absolutely closed as if the bowl wall were solid, but which, at the conclusion of the separating or purifying process, may be removed without disassembly of the bowl so as to enable the bowl to be flushed out and thereby thoroughly cleared of all solid or semi-solid matter that has collected on the bowl wall. The constructions of Figures 4, 5 and 6 may also be modified in like manner, that is, by closing the restricted acid escape outlet, and when so modified will still accomplish the object of the invention last described. It should also be stated that the threading of the plug or nozzle into the bowl wall, while preferred, is not absolutely essential, since the plug or nozzle and the orifice in the bowl wall may have a smooth fit; leakage around the plug or nozzle, during the regular centrifugal operation, being

prevented by the pressure of the liquid holding the head of the plug or nozzle firmly on its seat.

The most efficient operation of the bowl requires the use of the discs d , but successful operation is not dependent on the use of discs. The bowl may be of the open type.

In a bowl embodying my invention in its preferred and complete form, continuous separation of sludge and oil may be carried on without danger of interference by collection in the bowl of free acid incidentally separated from the oil and sludge; there will be small contamination of acid with sludge; corrosion and erosion of the acid escape orifice will cause a minimum change in operation; all matter contained therein may be discharged without disassembling; and the loads on the removable members due to centrifugal force and hydraulic pressure do not come on screw threads.

Attention is called to the fact that though none of the discharge passages, except that shown in Figure 8, are truly radial, the axes of all of them diverge from a vertical radial plane by only the small angle required to permit them to pass at one side of the spindle h , and they diverge from a horizontal plane by only the small angle required to permit them to pass under the bottom of the bowl, as shown in Figure 1 and Figure 2. Where in the claims the words "approximately radial" occur they are intended to include all positions from truly radial to the positions, nearly but somewhat divergent from radial, shown in the drawing.

What I claim and desire to protect by Letters Patent is:

1. In a centrifugal bowl, the combination with a disc having a central opening for lighter separated liquid and a bowl top having a larger central opening for heavier separated liquid, of a discharge for still heavier liquid comprising a tube leading from close to the bowl wall inward beyond the periphery of the zone defined by said central opening in the bowl top, and a nozzle whose admission end is within said tube and outside the periphery of said zone and which terminates outside the bowl.

2. A centrifugal bowl provided with an outlet in its peripheral wall, a plug sealing said outlet and removable from the inside of the bowl and adapted to be held in liquid tight relation with the bowl during centrifugation by the pressure of the liquid therein, and a tube one end of which opens into the interior of the bowl opposite said plug and which extends through the bowl wall and through which a tool may be inserted to effect the removal of the plug.

3. In a centrifugal bowl having a liquid outlet concentric with the bowl axis, the combination, with the bowl shell, of a tube whose admission end is close to the inside of the peripheral part of the bowl wall and which extends therefrom inward beyond the periphery of a zone having a radius less than that of the liquid outlet, there being a hole in the bowl wall in line with the admission end of said tube, and an outlet control device insertable by an approximately radially outward movement into said hole through said tube.

4. In a centrifugal bowl, the combination with a top disc having a central opening for lighter separated liquid and a bowl top having a larger central opening for heavier separated liquid, of means providing a discharge for still heavier separated liquid, comprising an approximately radial passage leading, from a point, within the separat-

ing chamber of the bowl, nearer the bowl wall than the radius of the top disc, toward the bowl axis, and a second passage smaller than and substantially coaxial with the first named passage and communicating at its inner end with the first named passage and in sealed relation at its outer end with an escape opening in the peripheral part of the bowl wall.

5. In a centrifugal bowl provided with outlets for a lighter separated liquid and a heavier separated liquid, means, providing a discharge for still heavier separated liquid, comprising an approximately radial passage leading from a point, within the separating chamber of the bowl, near the peripheral part of the bowl wall toward the bowl axis and a second passage smaller than and substantially coaxial with the first named passage and communicating at its inner end with the first named passage and in sealed relation at its outer end with an escape opening in the peripheral part of the bowl wall, said means comprising also means to adjustably vary the length of that part of the passage leading from the peripheral part of the bowl toward the bowl axis.

6. In a centrifugal bowl provided with outlets for a lighter separated liquid and a heavier separated liquid, a tube leading from and communicating with the peripheral portion of the bowl interior and extending inward beyond the bowl axis, and a removable nozzle positioned within the entrance end of the tube and having a substantial portion of its length surrounded thereby and leading to the outside of the bowl through a point in the bowl wall adjacent to the entrance end of said tube.

7. In a centrifugal bowl having an outlet in the peripheral part of the bowl wall, an outlet controlling device having a smaller diameter portion positioned in said outlet and a part of larger diameter at approximately the inner face of the bowl wall, combined with means, including an opening, aligning with said outlet, in a part of the bowl wall spaced from its periphery, and a tool-engageable element carried by said part of larger diameter, whereby said device can be removed and replaced while the bowl is assembled.

8. In a centrifugal bowl having an outlet in the peripheral part of the bowl wall, an outlet controlling device having a smaller diameter portion positioned in said outlet and a part of larger diameter at approximately the inner face of the bowl wall, combined with means, including a tool-engageable element carried by said part of larger diameter and an opening in the bowl bottom opposite said outlet and through which a tool is insertable to engage said element, whereby said device can be removed and replaced while the bowl is assembled.

9. A centrifugal bowl provided with an outlet in its peripheral wall, and a seat adjacent the inner end of said outlet and facing toward the interior of the bowl, a device controlling the flow through said outlet and removable from the inside of the bowl and having a flange engaging said seat and thereby adapted to be held in liquid tight relation with the bowl during centrifugation by the pressure of the liquid therein, and a tube one end of which opens into the interior of the bowl opposite said device and which extends through the bowl wall and through which a tool may be inserted to effect the removal of said device.

10. In a centrifugal bowl provided with outlets for a lighter separated liquid and a heavier

separated liquid, means, providing a discharge for still heavier separated liquid, comprising an approximately radial passage leading from a point, within the separating chamber of the bowl, near the peripheral part of the bowl wall toward the bowl axis, and a second passage smaller than and substantially coaxial with the first named passage and communicating at its inner end through a restricted orifice, of substantially smaller diameter than the second named passage, with the first named passage and in sealed relation at its outer end with an escape opening in the peripheral part of the bowl wall.

11. In a centrifugal bowl provided with outlets for a lighter separated liquid and a heavier separated liquid, means affording an outlet for still heavier separated liquid, said means providing an annular passage having an entrance opening in the interior of the bowl close to its peripheral wall and extending thence inward in an approximately radial direction to a restricted orifice central of said passage and nearer to the axis of rotation than the entrance to said passage, and a central passage of substantially greater diameter than said orifice extending from said orifice toward and thence through the peripheral wall of the bowl.

12. In a centrifugal bowl provided with outlets for a lighter separated liquid and a heavier separated liquid, means affording a discharge for still heavier separated liquid to the outside of the bowl, said means providing a passage of restricted volume having an inlet mouth inside the bowl near its peripheral wall and extending toward the bowl center to a restricted orifice within and surrounded by said passage, and a passage of smaller diameter than the first passage but of substantially greater diameter than said orifice leading from said orifice to the outside of the peripheral bowl wall.

13. In a centrifugal bowl provided with outlets for a lighter separated liquid and a heavier separated liquid, means affording a discharge for still heavier separated liquid to the outside of the bowl, said means providing a passage of restricted volume having an inlet mouth inside the separating chamber of the bowl near its peripheral wall and extending thence toward and beyond a point nearer the axis of the bowl, and an outlet conduit within and surrounded by said passage and having a restricted inlet orifice of substantially less diameter than said outlet conduit located at said point and thence extending toward and through the peripheral wall of the bowl.

GEORGE J. STREZYNSKI.