July 29, 1952 C. C. S. LE CLAIR 2,605,046

CENTRIFUGAL CLARIFIER

Filed Jan. 7, 1948 4 Sheets-Sheet 1

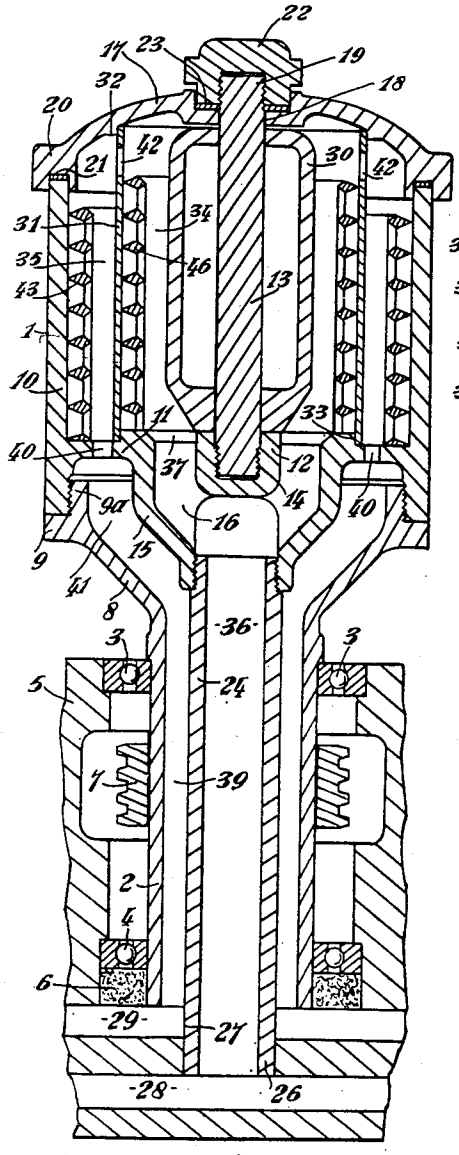


Fig. 1.

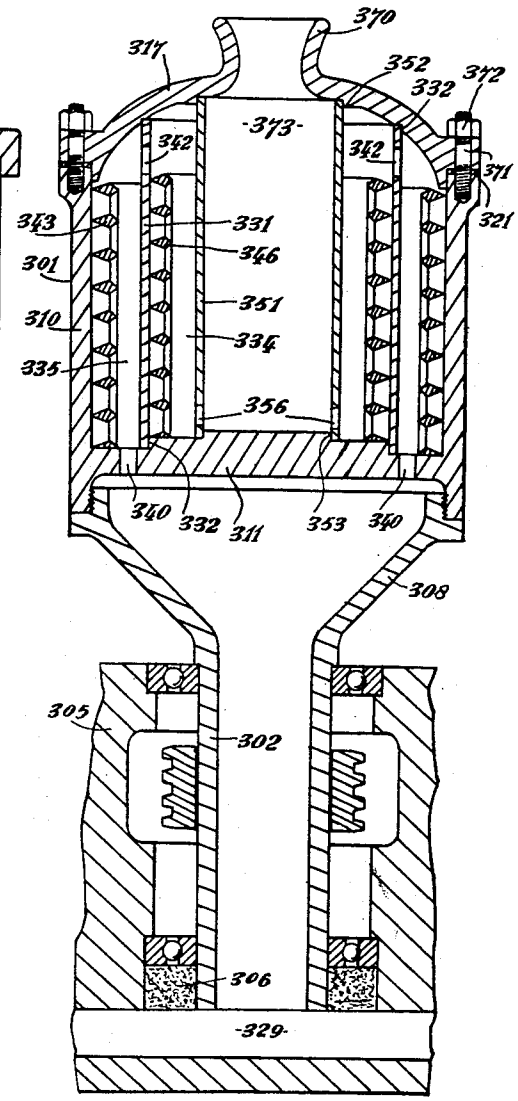


Fig. 5.

INVENTOR:
CAMILLE CLARE SPRANKLING LE CLAIR
By Kinkle, Horton, Ehlberg, Hausmann & Wappler
ATTORNEYS

July 29, 1952 C. C. S. LE CLAIR 2,605,046

CENTRIFUGAL CLARIFIER

Filed Jan. 7, 1948 4 Sheets-Sheet 2

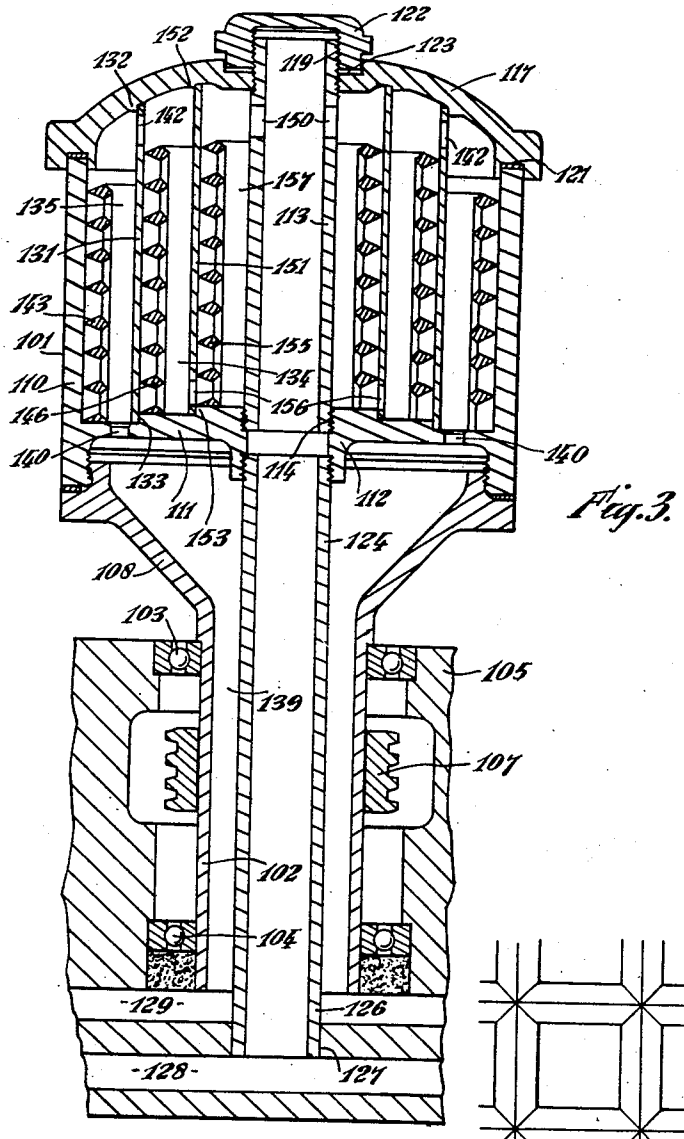


Fig. 3.

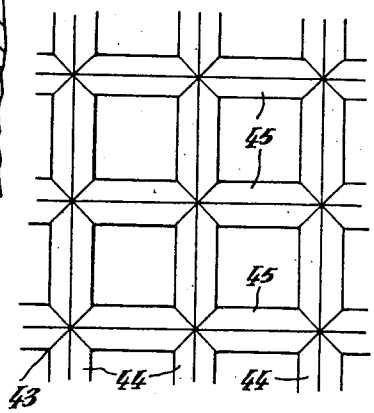


Fig. 2.

INVENTOR:
CAMILLE CLARE SPRANKLING LE CLAIR
By Heikkila, Norton, Ahlberg, Hausmann & Wupper
ATTORNEYS

July 29, 1952 C. C. S. LE CLAIR 2,605,046

CENTRIFUGAL CLARIFIER

Filed Jan. 7, 1948 4 Sheets-Sheet 3

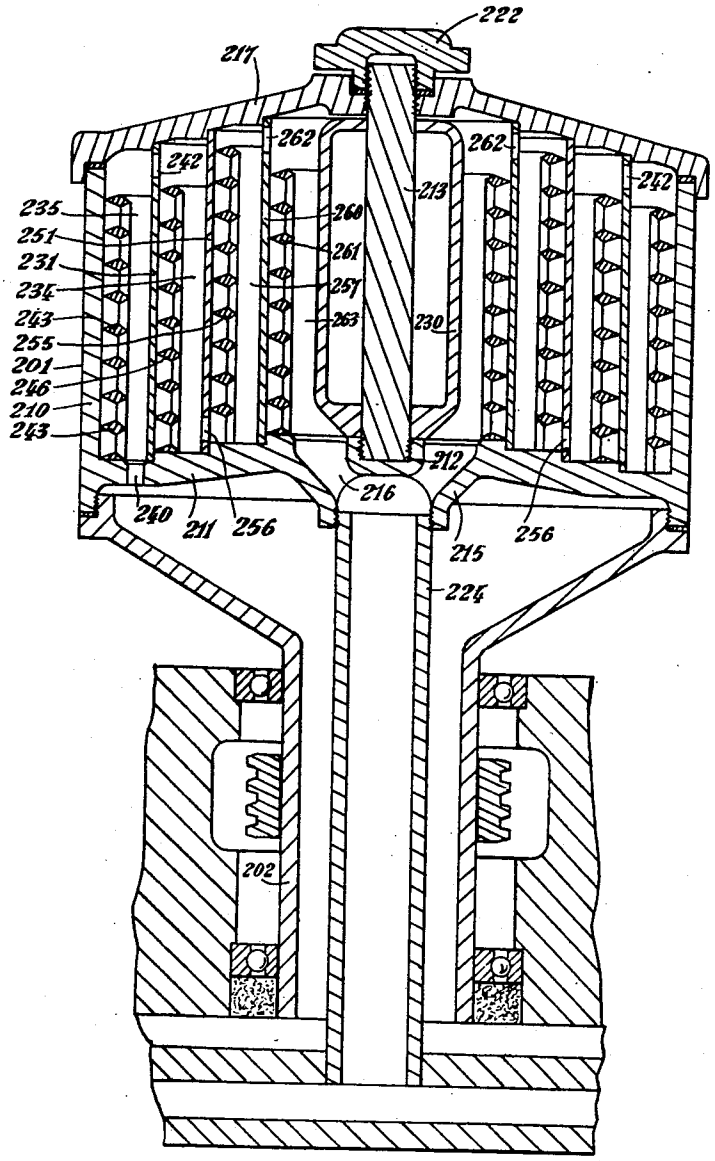


Fig. 4.

INVENTOR:
CAMILLE CLARE SPRANKLING LE CLAIR
By Hinkle, Horton, Ahlberg, Hausmann & Wuppa
ATTORNEYS

July 29, 1952 C. C. S. LE CLAIR 2,605,046

CENTRIFUGAL CLARIFIER

Filed Jan. 7, 1948 4 Sheets-Sheet 4

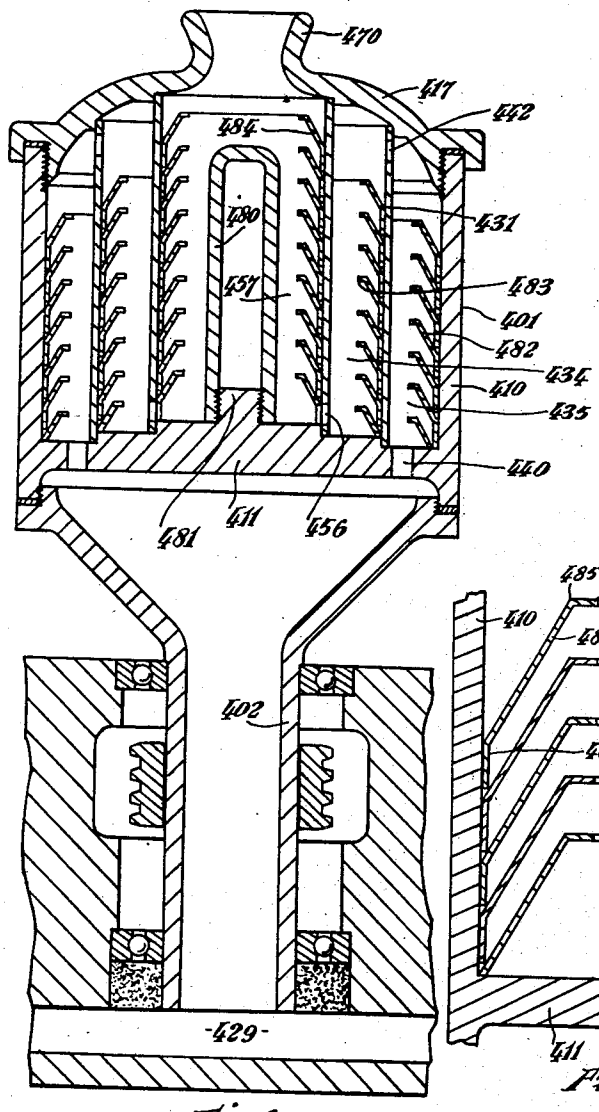


Fig. 6

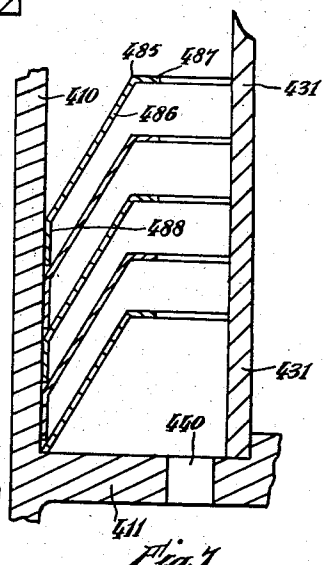


Fig. 7.

INVENTOR:
CAMILLE CLARE SPRANKLING LE CLAIR
By Dinkler, Horton, Ahlberg, Hansmann & Wuppe
ATTORNEYS

Patented July 29, 1952

2,605,046

UNITED STATES PATENT OFFICE

2,605,046

CENTRIFUGAL CLARIFIER

Camille Clare Sprankling Le Clair, Acton, London, England, assignor to Tecalemit Limited, Brentford, England, a corporation of Great Britain

Application January 7, 1948, Serial No. 912
In Great Britain January 17, 1947

6 Claims. (Cl. 233—18)

1

This invention relates to centrifuge machines and more particularly to such machines which are intended for the removal of suspended matter or impurities from liquids such as, for example, from lubricating oils. It is one of the principal objects of the invention to provide an improved centrifuge machine of this kind which is particularly adapted for cleaning the lubricating oil in an internal combustion engine, such as, for example in the engine of a motor vehicle or aircraft.

In such engines, not only is the space available for the centrifuge machine often very restricted, but the machine is also not usually very accessible. Furthermore, owing to the limitation of space it is usually not feasible to provide a centrifuge having a bowl with a large reserve space in which suspended matter extracted by the centrifugal action can accumulate pending its removal at long intervals. Consequently it becomes necessary to clean the bowl at relatively frequent intervals.

It is, therefore, a further object of this invention to provide a centrifuge machine which not only makes good use of the space available, but which is also so arranged that the deposited matter can be rapidly and easily removed from the machine.

According to the invention the machine comprises a centrifuge bowl, means within the bowl defining a plurality of concentric annular spaces therein, through which spaces the liquid to be cleaned is caused to flow, and means in each space whereby matter separated from the liquid in the space is retained.

The means defining the said annular spaces may comprise one or more annular wall members arranged within the bowl, while the means for retaining the separated matter may comprise a trap member within each of at least two of the said spaces, the arrangement being such that the liquid is caused to flow past the inner faces of the trap members. Preferably the outermost of the trap members is arranged within and close to the outer circumferential wall of the bowl.

In one form of centrifuge machine, constructed in accordance with the invention, the bowl is of cylindrical form and its interior is divided into two concentric annular spaces by means of a central cylindrical member or core and by an intermediate cylindrical wall member which is located between and spaced from the central core member and the outer wall of the bowl. The bowl is mounted on a rotary spindle, arranged with its axis vertical, and inlet and outlet passages for the liquid are provided within the spindle. The top of the bowl is closed by means of a removable cover.

2

Two annular trap members are provided, one within and in association with the circumferential wall of the bowl and the other in and in association with the inner surface of the intermediate cylindrical wall member. The trap members are given a honeycomb, vaned, ribbed or other formation, providing recesses or cavities for the reception of matter extracted from the liquid by the centrifugal action. The liquid to be centrifuged is supplied through the inlet passage to the bottom of the inner annular space. It flows up in this space past the inner trap member and then enters the upper end of the outer annular space. It flows down this space past the inner face of the outer trap member and is discharged through the outlet passage in the spindle.

During the passage of the liquid past the two trap members any suspended impurities or solid particles are driven by the centrifugal action into the recesses or cavities of the trap members and are held there. When the centrifuge requires cleaning this can easily be done by removing the cover and taking out the trap members and also, if desired, the intermediate cylindrical member and/or the core member.

Many modifications of the above device are possible. Thus the number of trap members may be increased to three or even more, the interior of the bowl being divided into the appropriate number of annular spaces. Furthermore, different arrangements of the inlet and outlet passages may be used. Thus, the liquid may be admitted to the bowl at one end thereof and discharged from it at the opposite end. Generally, however, it is desirable that the liquid should be arranged to pass over the trap members in succession, starting with the innermost trap member and finishing with the outermost one.

For the better understanding of the invention a number of constructional embodiments thereof will now be described in greater detail, by way of example, reference being had to the accompanying drawings. In the drawings:

Figure 1 is a vertical sectional view, which is partly diagrammatic, showing a centrifuge machine constructed in accordance with the invention and having two trap members;

Figure 2 is a detail elevational view showing part of the inner face of one of the trap members;

Figure 3 is a view similar to Figure 1 showing

a modified form of centrifuge machine having three trap members;

Figure 4 is a similar view showing a centrifuge machine having four trap members;

Figure 5 is a partly diagrammatic sectional view showing a centrifuge machine having two trap members and having a different arrangement for the supply and discharge of the liquid;

Figure 6 is a like view of a centrifuge machine which is similar in construction to that shown in Figure 5 except that three trap members are provided and these trap members are of a different form of construcion;

Figure 7 is a detail sectional view showing part of one of the trap members of Figure 6.

A centrifuge machine intended for use on an internal combustion engine and having a bowl divided into two annular spaces will first be described, reference being had to Figure 1 of the drawings.

This centrifuge machine comprises a cylindrical bowl 1 which is mounted on a vertical hollow spindle 2 running in a pair of ball bearings 3 and 4. These bearings are mounted in any suitable part 5 of the engine structure. A liquid-tight seal 6 is provided below the lower bearing 4 for a purpose to be explained hereinafter, while a suitable driving gear 7 is provided on the spindle 2 between the bearings 3 and 4. This gear 7, which takes the form of a stoop-threaded worm, is adapted to be driven from the engine by a worm-wheel (not shown).

Above the upper bearing 3 the end of the spindle 2 is flared out in a conical fashion at 8 and terminates in a flange 9 and threaded spigot 9a to which the lower edge of the outer wall 10 of the bowl 1 is attached. The bottom 11 of the bowl is cast integrally with the wall 10 and is formed with a central downwardly-projecting boss 12 into which a holding down stud 13 is screwed at 14. The bottom of the bowl is also provided with an integral, downwardly-extending conical sleeve 15 which surrounds the boss 12 with which it forms an annular passage 16.

The top of the bowl 1 is closed by means of a domed cover 17 which is formed with a central hole 18 through which the upper threaded end 19 of the holding down stud 13 passes.

The cover 17 is provided with an outer grooved flange 20 which fits over the bowl wall 10. A sealing washer 21 is provided in the groove in the flange 20 to ensure a fluid-tight joint between the cover 17 and the wall 10.

The cover 17 is retained in position by means of a cap nut 22 which is screwed onto the threaded end 19 of the stud 13. A sealing washer 23 is provided to prevent the escape of the liquid at this point.

A central tube 24 is attached, as by screwing, to the lower end of the sleeve 15. This tube 24 extends down inside the hollow spindle 2 beyond the open lower end 25 of the latter. Its own lower end 26 is arranged to run at 27 in a semi-liquid-tight bearing carried or formed in the engine structure 5. If desired a liquid-tight seal (not shown) could be provided in association with this bearing.

The structure 5 is formed with two passages 28 and 29. The lower passage 28 constitutes an inlet passage and communicates with the interior of the central tube 24 at its lower end below the bearing 27, while the upper passage 29 is an outlet passage and connects with the interior of the spindle 2 at its lower end externally of the tube 24 and above the bearing 27.

A cylindrical core member 30 is provided in the bowl 1 surrounding the stud 13, while between this member 30 and the circumferential wall 10 of the bowl an intermediate cylindrical wall member 31 is fitted. The upper and lower ends of this member 31 engage and are located by spigots, recesses or grooves formed on or in the bottom 11 of the bowl 1 and the cover 17. In the construction shown the upper end of the member 31 is located within an annular stop 32 formed on the underside of the cover 17, while the lower end of the member 31 fits over an annular flange or spigot 33 projecting from the bottom 11 of the bowl.

The two cylindrical members 30 and 31 divide the interior of the bowl within the wall 10 into two concentric annular spaces 34 and 35. The inner space 34 is connected with the passage 16 and thence with the interior 36 of the central tube 24 by means of ports 37 formed in the bottom 11 of the bowl, while the outer annular space 35 is connected with the annular passage 39 between the central tube 24 and the spindle 2 by means of ports 40 formed in the bowl bottom 11 and thence by way of the conical passage 41 between the sleeve 15 and the flared part 8 of the spindle 2.

Ports 42 drilled in the wall member 31 near its upper end connect the inner annular space 34 with the outer annular space 35.

An annular, cylindrical trap member 43 is provided within the bowl 1 and is made an easy sliding fit inside the outer wall 10 thereof. This trap member 43 is of honeycomb formation (see also Figure 2) and comprises a number of circumferentially-spaced vertical ribs 44 which are intersected at right angles by a number of parallel, axially-spaced annular rings 45. For convenience of manufacture the ribs 44 and the rings 45 may be formed integrally with one another, the whole honeycomb-like trap member being either cast in some convenient metal, such as aluminum, or being moulded in a suitable plastic such as, for example, a phenol formaldehyde resin. In either case both the vertical ribs 44 and the horizontal rings 45 are, for preference, given an elongated diamond section (see Figure 1) presenting sharpened edges radially inwardly and outwardly. The inner face of this trap member 43 is spaced from the outer surface of the intermediate cylindrical wall member 31 by the relatively narrow annular space or gap shown.

Within the member 31 and arranged as an easy sliding fit in it is a second honeycomb trap member 46 constructed in the same fashion as that described above. The inner face of this second trap member 46 is spaced from the central cylindrical core member 30 by the narrow annular space shown.

The centrifuge machine as described above, may be driven by any suitable means, and the transmission gear may include a slipping and/or over-running clutch (such as, for example, that described and claimed in my prior United States patent application Serial No. 558,881, now Patent No. 2,476,377), together with any necessary gearing to ensure that the centrifuge is run at a sufficiently high speed for efficient working.

In operation, oil from the engine sump is delivered by a low pressure scavenging or other pump into the lower end of the central tube 24 via the passage 28. Thence it passes up this tube, through the annular passage 16 and the ports 37 into the bottom of the inner an-

nular space 34. In this space it flows axially upwards in a relatively thin film between the core member 30 and the inner trap member 46. During its passage through the space 34 suspended particles of matter are driven radially outwards by centrifugal force and, since the radial distance through the thickness of the oil film is very small, these particles are immediately caught and held in the spaces in the trap member 46.

On reaching the top of the space 34 the oil passes radially outwards through the ports 42 in the intermediate wall member 31 and then passes axially downwards in the outer annular space 35. The extraction of suspended particles by centrifugal force in the manner described above is here continued, the extracted particles being caught in the outer trap member 43. It may be pointed out here that as the radius of rotation of the outer annular space 35 is greater than that of the inner annular space 34 the centrifuging action is proportionately more intense.

On reaching the lower end of the outer space 35 the oil passes through the ports 40 in the bottom of the bowl into the conical passage 41 at the upper end of the spindle 2 and thence through the annular passage 39 between the tube 24 and the spindle 2 to the outlet passage 29 in the engine structure 5. From this passage the oil may be delivered to the bearings or other places of use either directly, under the pressure generated by the scavenge pump, or it may be pumped to the place of use by a second pressure pump. In the latter case the passage 29 may lead to a reservoir under atmospheric pressure.

When it becomes necessary to clean the centrifuge and to remove the deposited matter, the cover 17 is first removed by undoing the cap nut 22. The internal parts, comprising the trap members 43 and 46 and the cylindrical wall member 31 are then lifted out, washed and replaced. The cover 17 is then replaced and secured by the nut 22.

It will be appreciated that the principle of passing the liquid axially in thin films over a number of concentric trap members in series is capable of extension. Thus, instead of passing the liquid over only two such members, it may be caused to pass over three or more.

Figure 3 shows a modified construction of centrifuge in which three trap members are provided over which the liquid flows. In this construction, since the liquid has to made an odd number of passages past the trap members the liquid must flow past the first member in a downward direction. This involves certain modifications in the construction of the device.

The centrifuge comprises a bowl 101 which is mounted on the upper flared end 108 of a hollow spindle 102. This spindle is mounted by means of bearings 103 and 104 in the engine structure 105 and is provided with a driving gear 107. This method of mounting and driving the spindle corresponds exactly to that of the construction shown in Figure 1.

The bottom 111 of the bowl is formed with a central hollow boss 112. This boss 112 is threaded at its lower end to receive the upper end of a central tube 124, the lower end 126 of which tube is rotatable in a bearing 127 formed in the engine structure 105.

In place of the holding-down stud 13 and the core member 30 of Figure 1 the centrifuge of Figure 3 is provided with a hollow stud 113, the lower threaded end of which is screwed into a thread 114 in the upper part of the boss 112. The upper end of the stud 113 is threaded at 119 to receive a cap nut 122. The wall of the stud 113 is formed with one or more ports 150 near the upper end of the stud.

The bowl 101 is provided with a cover 117 which is held in place by means of the nut 122, sealing washers 121 and 123 being provided as in the case of the previous construction.

Two intermediate annular wall members 131 and 151 are provided within the bowl and are retained in position by means of steps 132 and 152 formed on the inside of the cover 117 and by means of spigots 133 and 153 formed on the inside of the bottom 111 of the bowl.

Three trap members 143, 146 and 155 are provided. The member 143 fits within the outer wall 110 of the bowl, the member 146 fits within the intermediate wall members 131 while the member 155 is fitted within the intermediate wall member 151. These trap members are constructed as previously described with particular reference to Figure 2.

The wall member 131 is formed with a number of ports 142 near its upper end, while the wall member 151 is formed with a number of ports 156 near its lower end. A number of ports 140 corresponding to the ports 40 of Figure 1 are formed in the bottom 111 of the bowl.

In operation the oil from the inlet passage 128 in the engine structure 105 passes up through the central tube 124 and the hollow stud 113 and enters the annular space 157 surrounding the stud 113 through the ports 150. The oil then flows down through the space 157 past the trap member 155, through the ports 156 into the next annular space 134 in which it flows up past the trap member 146, through the ports 142 into the outermost annular space 135, down through this space past the trap member 143 and through the ports 140 into the top of the hollow spindle 102. It then flows down through the space 139 between this spindle and the tube 124 and out through the outlet passage 129 in the engine structure.

Figure 4 of the drawings shows a construction in which four trap members are provided. The construction of the device is similar to that of Figure 1 except for the provision of two additional trap members with their associated wall members.

The device comprises a centrifuge bowl 201 having an outer wall 210, a bottom 211 and a cover 217, the bowl being mounted on the upper end of a hollow spindle 202. This spindle is supported and driven in a manner similar to that described with reference to Figure 1.

The cover 217 is retained in place by means of a cap nut 222 screwed onto the upper end of a stud 213, the lower end of which is screwed into a central boss 212 formed in the bottom 211 of the bowl. A core member 230 similar to the member 30 of Figure 1 is mounted on the stud 213.

A central inlet tube 224 is provided as before, its upper end being screwed into a conical sleeve 215. This tube communicates with the interior of the bowl 201 by means of passages 216 provided between the sleeve 215 and the boss 212.

The bowl 201 is provided with three concentric intermediate wall members 231, 251 and 260 within which are fitted trap members 246, 255 and 261 respectively. A trap member 243 is fitted within the outer wall 210.

The wall members 231 and 260 are formed with ports 242 and 262 near their upper ends, while

the wall member 251 is formed with ports 256 near its lower end. Ports 240 are formed in the bottom 211 of the bowl outside the wall 231.

In operation oil flows up through the central tube 224, through the passage 216 into the interior of the bowl 201. It then passes up through the annular space 263 within the trap member 261, out through the ports 262, down through the next space 257 past the trap member 255, out through the lower ports 256, up through the space 234 past the trap member 246, out through the ports 242 and down through the space 235 past the trap member 243. It then escapes from the bowl through the ports 240 and is discharged from the apparatus through the hollow spindle 202.

It will be apparent that in the apparatus constructed as shown in Figure 4 the oil is subjected to a particularly thorough cleansing action of progressively increasing intensity although the dimensions of the apparatus can still be kept small.

In some cases it may be desired to supply the oil or other liquid to the centrifuge from the top instead of through a central tube from the bottom of the machine as in the arrangements previously described. Figure 5 shows a machine designed for such a case, the cover being formed with a bell mouth for the entry of the liquid.

The centrifuge comprises a bowl 301 having outer walls 310, a bottom 311 and a cover 317. The cover is formed with a central bell mouth 370 and is secured to the top of the bowl 301 by means of a ring of studs 371 and nuts 372. A sealing washer 321 is provided between the cover and the bowl wall 310.

The bowl 301 is mounted on the upper flared end 308 of a hollow spindle 302 which is supported in the engine structure 305 in a manner similar to that previously described. In this construction, however, there is no central tube and there is only one passage, namely an outlet passage 329, formed in the structure 305. This passage communicates with the lower end of the tube 302 below a seal 306.

The bowl 301 is provided with two intermediate wall members 331 and 351, the first of which is provided with a trap member 346. A trap member 343 is also provided within the outer wall 310. The wall members 331 and 351 are located by means of spigots 333 and 353 formed in the bottom 311 of the bowl and by steps 332 and 352 formed on the underside of the cover 317. The wall member 331 is formed with ports 356 at its lower end, the wall member 331 is formed with ports 342 at its upper end, while ports 340 are formed through the bottom 311 of the bowl outside the wall member 331.

In operation liquid enters the bowl through the bell mouth 370, passes down through the central space 373 within the wall member 351, out through the ports 356, up through the space 334 past the trap member 346, out through the ports 342 into the next space 335, down through this space past the trap member 343 and out through the ports 340. Thence, it flows down the hollow spindle 302 into the outlet passage 329.

Figure 6 shows a modification of the construction shown in Figure 5 in which three trap members are used. These trap members are shown as being of different construction to those previously described.

The centrifuge comprises a bowl 401 having an outer wall 410, a bottom 411 and a cover 417. The bowl is mounted on a hollow spindle 402, while it is provided with two intermediate wall members 431 and 451. The construction and arrangement of all these parts is similar to that described with reference to Figure 5 except that the bowl and wall members are made of slightly increased diameter to provide space within the inner wall member 451 for a core member 480. This core member is closed at its upper end while its open lower end is attached as by screwing to a central raised boss 481 provided on the bottom 411 of the bowl. Trap members 482, 483 and 484 are provided within the walls 410, 431 and 451 respectively.

All these trap members are of similar construction. This construction is best shown in Figure 7 which is a detail view to an enlarged scale showing a part of the trap member 482. This trap member is built up from a number of annular elements 485, each of which elements comprises a frustro-conical portion 486 and a radially extending inner portion 487. The elements 485 are supported on and spaced from each other by means of annular spacing rings 488. If desired these spacing rings could be made integrally with the trap elements 485, in which case each ring 488 would be formed as a downward cylindrical extension of the frustro-conical portion 486 of the element.

In the case of the trap member 484 the lowermost trap element is supported by some suitable means (not shown). This means might take the form of a shoulder on the wall member 451 or a perforated ring member so designed as not to obstruct the ports 456 in the wall member 461.

The operation of the centrifuge shown in Figure 6 will be clear from the foregoing description. Oil enters the bowl 401 through the bell-mouth 470 of the latter and flows down through the space 457 surrounding the core 480, passing over the inner face of the trap member 484. It then passes through the ports 456, up through the space 434 past the trap member 483, out through ports 442 in the upper part of the wall member 431, down through the space 435 past the trap member 482 and out through ports 440 in the bottom of the bowl into the interior of the hollow spindle 402. It then flows down this spindle into the outlet passage 429 from which it is delivered to the bearings or other places of use.

While for ease of construction and of the subsequent periodical cleaning it is generally preferable to make the trap members separate from their associate wall members it would be possible to form the wall members and trap members integrally with each other. Thus they might be formed from a suitable metal, for example by casting, or they might be moulded from a plastic.

The trap members could also take a number of other forms, being made of any of a wide range of appropriate materials such as, for example, those disclosed in the specification of the copending British application No. 28,685 of 1947. Such trap members might be fitted in association with wall members, such as that shown at 31 in Figure 1 of the accompanying drawings, or they might be so constructed as to render such a wall member unnecessary. In other words a single part would fulfil the combined functions of a wall member and of a trap member.

I claim:

1. A centrifuge machine for removing matter from fluids comprising a hollow drive shaft, a centrifuge bowl mounted on and driven by said shaft, said bowl comprising a bottom, an outer circumferential wall, and a removable cover, means lo-

cated within said bowl and defining a plurality of concentric spaces through which the fluid to be centrifuged is passed, said means comprising a plurality of annular wall members arranged within said bowl and secured against displacement in the axial and transverse directions between the bottom of said bowl and said cover, said wall members being made of a liquid impervious material and having openings therein through which centrifuged liquid is passed to the adjacent concentric space, trap members arranged within at least two of said concentric spaces and in contact with the inner surfaces of said space defining wall members, said trap members cooperating with said wall members to retain matter separated from the fluid passed through said spaces, and means forming separate inlet and outlet passages coaxial with said bowl through which fluid to be centrifuged is supplied to and discharged from said spaces, said last mentioned means including said hollow drive shaft which communicates with the interior of said bowl and forms one of said passages.

2. A centrifuge machine for removing matter from fluids comprising a hollow drive shaft, means rotatably supporting said hollow drive shaft, a centrifuge bowl mounted on and driven by said shaft, said bowl comprising a bottom, an outer cylindrical wall, and a removable cover, means located within said bowl and defining a plurality of concentric spaces through which the fluid to be centrifuged is passed, said means comprising a plurality of cylindrical wall members arranged within said bowl and secured against displacement in the axial and transverse directions between the bottom of said bowl and said cover, cylindrical trap members arranged within at least two of said concentric spaces and in contact with the inner surfaces of said space defining wall members, said trap members being adapted to retain matter separated from the fluid passed through said spaces, means forming separate inlet and outlet passages coaxial with said bowl through which fluid to be centrifuged is supplied to and discharged from said spaces, said last mentioned means including said hollow drive shaft which communicates with the interior of said bowl and forms one of said passages, and separate inlet and outlet passageways formed in said supporting means and communicating, respectively, with said bowl inlet and outlet passages, said bowl passage forming means having a substantially liquid-tight seal with said supporting means at the points of communication with said passageways.

3. A centrifuge machine for removing matter from fluids comprising a hollow drive shaft, a centrifuge bowl mounted on and driven by said shaft, said bowl comprising a bottom, an outer circumferential wall, and a removable cover, means located within said bowl and defining a plurality of concentric spaces through which the fluid to be centrifuged is passed, said means comprising a plurality of annular wall members arranged within said bowl and secured against displacement in the axial and transverse directions between the bottom of said bowl and said cover, trap members arranged within at least two of said concentric spaces and in contact with the inner surfaces of said space defining wall members, said trap members being of honeycomb formation, comprising a plurality of intersecting ribs, and adapted to retain matter separated from the fluid passed through said spaces, and means forming separate inlet and outlet passages coaxial with said bowl through which fluid to be centrifuged is supplied to and discharged from said spaces, said last mentioned means including said hollow drive shaft which communicates with the interior of said bowl and forms one of said passages.

4. A centrifuge machine as claimed in claim 3 wherein the said ribs present sharpened edges directed radially inwardly and outwardly.

5. A centrifuge machine as claimed in claim 3 wherein all of said ribs of each trap member are formed integrally with each other.

6. A centrifuge machine for removing matter from fluids comprising a hollow drive shaft, means rotatably supporting said hollow drive shaft, a centrifuge bowl mounted on and driven by said shaft, said bowl comprising a bottom, an outer circumferential wall, and a removable cover, means located within said bowl and defining a plurality of concentric spaces through which the fluid to be centrifuged is passed, said means comprising a plurality of annular wall members arranged within said bowl and secured against displacement in the axial and transverse directions between the bottom of said bowl and said cover, trap members arranged within at least two of said concentric spaces and in contact with the inner surfaces of said space defining wall members, said trap members each comprising a plurality of annular elements assembled in axial juxtaposition with each other and forming between them spaces in which the matter separated from the fluid passed through said concentric spaces may be trapped, means forming separate inlet and outlet passages coaxial with said bowl through which fluid to be centrifuged is supplied to and discharged from said spaces, said last mentioned means including said hollow drive shaft which communicates with the interior of said bowl and forms one of said passages, and separate inlet and outlet passageways formed in said supporting means and communicating, respectively, with said bowl inlet and outlet passages, said bowl passage forming means having a substantially liquid-tight seal with said supporting means at the points of communication with said passageways.

CAMILLE CLARE SPRANKLING LE CLAIR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
631,680	Staahlgren	Aug. 22, 1899
632,338	Clark	Sept. 5, 1899
696,130	Berrigan	Mar. 25, 1902
1,148,771	Haskell	Aug. 3, 1915
1,619,652	Carter	May 1, 1927
1,998,359	Cowan	Apr. 16, 1935
2,045,116	Beskow	June 23, 1936
2,089,122	Jones	Aug. 3, 1937
2,268,534	Schutte	Dec. 30, 1941

FOREIGN PATENTS

Number	Country	Date
703,182	France	Apr. 25, 1931
79,480	Sweden	Feb. 20, 1932
184,364	Switzerland	Aug. 1, 1936