Oct. 5, 1948. B. C. RUNDQUIST 2,450,737

OIL CENTRIFUGE WITH PLURAL CONCENTRIC SEPARATING ZONES

Filed Feb. 12, 1943 3 Sheets-Sheet 1

Fig. 1.

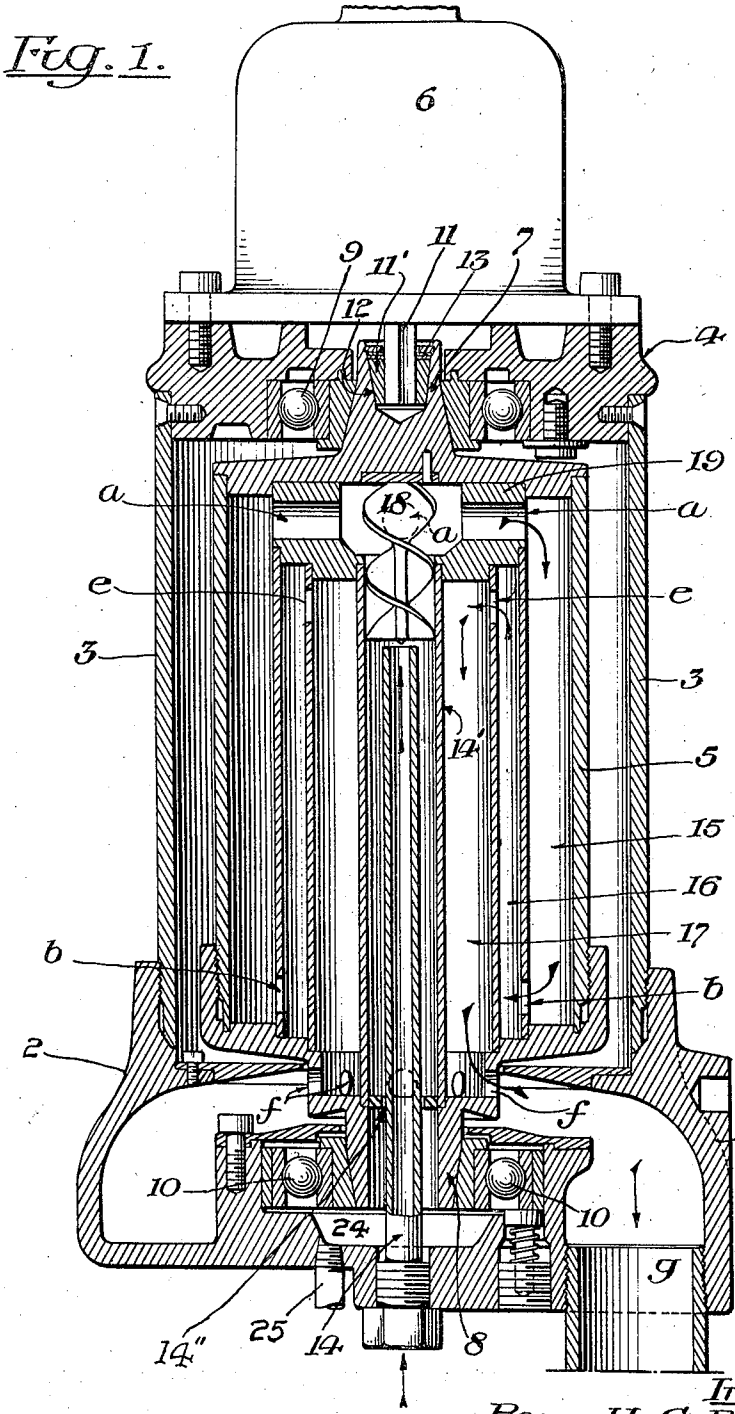

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Fig. 2.

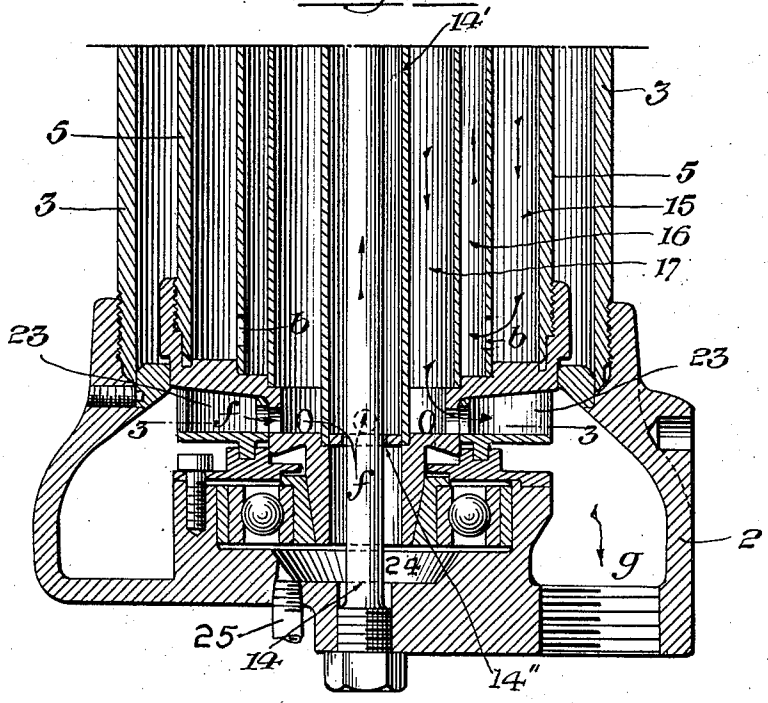
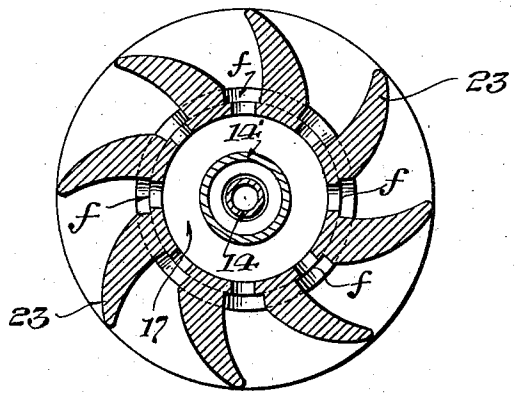


Fig. 3.



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Filed Feb. 12, 1943 3 Sheets-Sheet 3

Fig. 4.

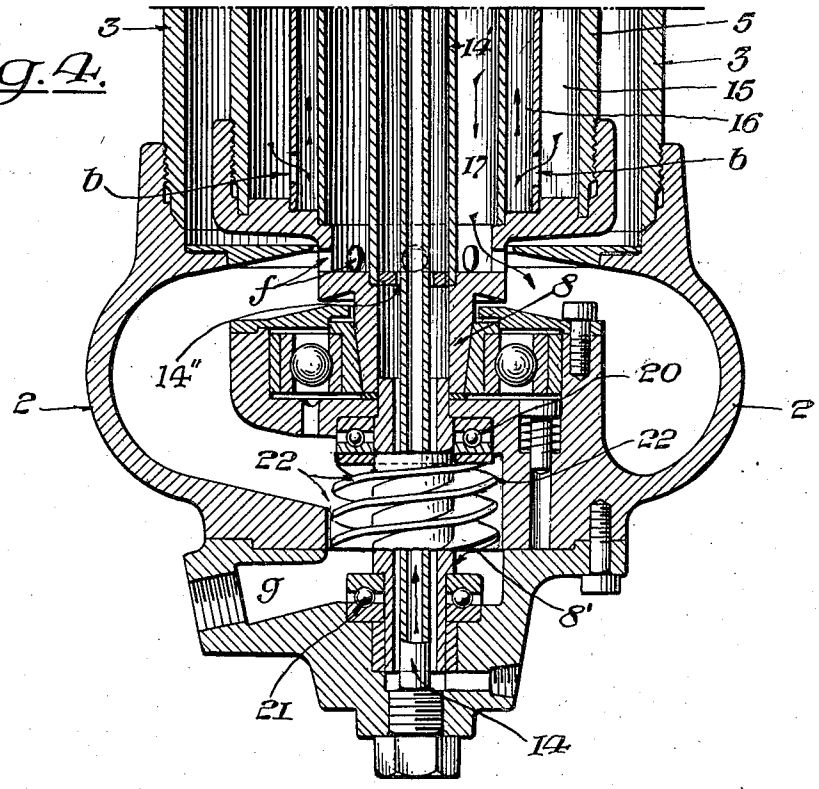
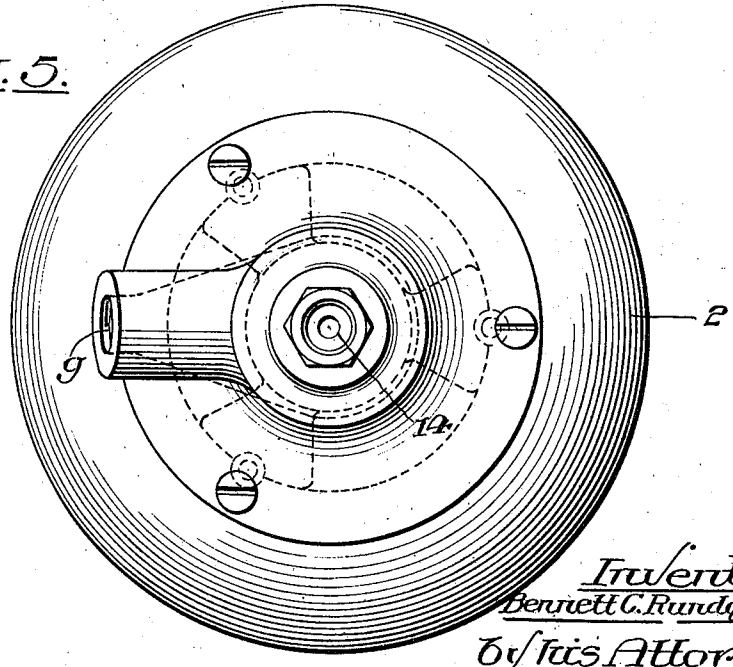


Fig. 5.



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2,450,737

OIL CENTRIFUGE WITH PLURAL CONCENTRIC SEPARATING ZONES

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Application February 12, 1943, Serial No. 475,639

20 Claims. (Cl. 233—31)

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This invention relates to centrifuges, the object being to provide an improved centrifuge particularly adapted for use with motors such as aeroplane, tank or Diesel motors and so compact that it can be used in a small space and by means of which the lubricating oil used in the motor will be cleaned after each circulating cycle in the motor thereby to eliminate from the oil all foreign particles.

As is well known, lubricating oil picks up dust and metal particles and forms carbon and sludge during its circulation in the motor so that its repeated use is very injurious to expensive bearings such as those used in high speed motors of aeroplanes, tanks, etc., and for the purpose of cleaning this oil it has heretofore been the practice to use filters but these filters quickly become clogged and have to be cleaned frequently.

Therefore, for the purpose of cleaning the oil and separating therefrom all foreign matter, this improved centrifuge is provided, it being so constructed that it can be readily connected or attached to the motor so that the oil, after it once passes through the motor, then passes through the centrifuge before it passes back into the motor. Consequently, any deleterious particles are removed and the efficiency of the motor increased and the life thereof prolonged.

The use of centrifuges as usually constructed would not be possible in view of the limited space available in an aeroplane or tank and, therefore, it is the object of this invention to provide a centrifuge that can be used in a practical way with aeroplanes and other motors in the limited space available for that purpose.

Furthermore, as the oil in the motor is usually pumped into the pipe lines under a pressure of 25 to 40 pounds, it follows that when this oil leaves the lines after its passage through the motor and enters the centrifuge for cleaning, this oil pressure is naturally reduced since it passes through the centrifuge at a gravity feed and it is essential, therefore, that when the oil passes back to the motor from the centrifuge, it pass thereinto under pressure.

Therefore, one of the objects of the present improvement is the provision of a centrifuge in which oil that passes from the motor to the centrifuge and from the centrifuge back to the motor will be transmitted to that motor under substantially the same pressure under which it was used while in the motor.

The present improvement therefore has to do with the provision of a simple, compact and efficient centrifuge particularly adapted for cleaning the oil used in the motor during its circulation cycle.

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In the drawings accompanying and forming a part of this specification,

Fig. 1 is a vertical sectional view of this improved centrifuge.

Fig. 2 is a vertical sectional view of the lower half of the centrifuge showing one means for pumping the oil back to the motor under pressure.

Fig. 3 is a horizontal sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a vertical sectional view of the lower half of the centrifuge illustrating a somewhat different arrangement for the pumping of the oil back to the motor, and

Fig. 5 is a bottom view of the centrifuge.

Similar reference characters indicate corresponding parts in the several views.

Before explaining in detail the present improvement and its mode of operation, I desire it understood that the invention is not limited to the details of construction and arrangement of parts illustrated in the accompanying drawings since the invention is capable of other embodiments, and that the phraseology employed is for the purpose of description and not of limitation.

This improved centrifuge comprises a suitable supporting base or base housing 2, a casing 3 and its cover 4.

In the casing 3 is located a rotatable bowl 5 and on the cover 4 is located a motor 6 for rotating the bowl. Thus the motor is above the bowl instead of below its bottom as is the usual practice, requiring that the bowl be supported in a more or less complicated way.

The bowl 5 is supported by two sets of ball bearings and for this purpose the bowl has its top and bottom provided with tapered spindles 7 and 8, each having a set of these ball bearings, one set 9 at the top and the other set 10 at the bottom.

The drive to the bowl from the motor shaft 11 is obtained by a tapered slip bushing 11' fitting a tapered seat 12 in the tapered spindle 7, a spring 13 being provided between the tapered bushing and the motor drive 11 to care for the friction between the parts.

As this drive from the motor to the bowl is through a tapered fitting or joint between the motor shaft and the bowl, the spring operates not only to keep these parts in contact but also acts as a safety for, with the bowl and motor running at extremely high speed between 7,000 and 10,000 R. P. M., this depending upon the amount

of separation desired, it follows that in case of accident to the motor or bowl, the spring would prevent its transmission from one to the other.

Extending upwardly into the bowl to near the top and at the center thereof is an inlet tube 14 for feeding the oil from the motor into the bowl. Thus, the inlet to the bowl is at the bottom instead of at the top as is the usual practice.

Surrounding this tube is a series of cylindrically formed ported chambers 15, 16 and 17 through which the oil passes from one to the other until it is finally discharged also at the bottom of the bowl back into the motor.

The inlet tube 14 is located within a larger tube 14' forming the inner wall of the chamber 17 and has at the top thereof and just above the upper or outlet end of the tube 14, an impeller or propeller 18 of screw or worm form, the rotation of which with the bowl assists in forcing the liquid from the tube 14 through the laterally extending ports *a* formed in a top cover disk 19 of the bowl into the top of the outer annular chamber 15 from which it passes at the bottom of this chamber 15 through the ports *b* into the bottom of an intermediate annular chamber 16 from which it passes at the top thereof through ports *e* into an inner annular chamber 17 from which it passes through ports *f* at the bottom thereof through the outlet ports *g* of the base housing of the centrifuge back to the motor.

It will thus be observed that as the oil passes from the motor into the tube 14 at the bottom of the centrifuge, it is circulated through the entire lengths of the various chambers, as indicated by the arrows on the drawings, and during this circulation and rotation, it is cleaned of all foreign particles which are thus removed therefrom before the passage of the oil back to the motor.

Thus, the dirty oil entering the centrifuge from the motor is cleaned and clarified and so passes back into the motor practically in the same condition as when it was first poured thereinto and, consequently, the bearings and other moving parts of the motor are not injured by the foreign matter which is picked up by the oil during its circulation through the motor as would be the case where this oil continued to circulate through the motor or even with filters which imperfectly clean it.

At the top of the tube 14 there is clearance between this tube 14 and the screw 18. This is to provide an overflow in case flow of oil becomes blocked in its passage at some place in the bowl. If this happens, the oil will then pass down the chamber or tube 14' formed between the tube 14 and this tube 14' past a clearance ring 14'' at the bottom of the tube 14' into a chamber 24 and out the vent 25.

Also, as the oil returns to the centrifuge from the motor, it has from fifty to seventy per cent air. This air must be removed. As the oil only is forced through the screw 18, the air entering the centrifuge with the oil is forced down the overflow chamber or tube 14' past the ring 14'' into the chamber 24 and out the vent 25, thus eliminating de-airing tanks now used with motors.

It will be observed that the several chambers and the bowl parts are readily assembled and separable for cleaning purposes and for the removal of the sludge that may accumulate in the bottom of any chamber.

The oil circulating in motors of the class described is usually pumped into the pipe lines under a considerable pressure, for instance, from

twenty-five to forty pounds. Consequently, since the oil pressure is naturally reduced when the oil passes from the motor into the centrifuge for cleaning as it passes through the centrifuge at gravity feed, when the oil passes back from the centrifuge to the motor, it is essential that it pass into the motor under pressure and, for this purpose, this improved centrifuge is provided with means for passing the oil from the centrifuge into the motor under the desired pressure and since the available space, as before stated, is very limited, especially in aeroplanes and tanks, this pressure means, in the form of a pump, is a part of the centrifuge and is located at the bottom of the bowl and in the housing supporting that bowl, the housing being constructed for that purpose.

In one form thereof (see Fig. 4) the bowl spindle 8 is extended as by means of a shaft or supplemental spindle 8' suitably connected to or integral with the spindle 8 and which, likewise, is carried by ball bearings 20 and 21.

The inlet tube 14 is likewise extended to pass therethrough and this shaft is provided with vanes or spiral leaves 22 which act as a pump so that during the rotation of the bowl and its shaft, when the oil flows from the various chambers through the outlet of the bowl bottom into the housing 2 and before its passage therefrom, it is picked up by the vanes and forced through the outlet *g* of the housing at substantially the same pressure as when it was originally passed into the bowl and, therefore, a perfect cycle of the oil and clarification thereof is obtained with no loss of pressure since the oil is forced back into the motor under substantially the same pressure as when it left the motor.

The vanes of this pump are formed like the threads of a screw and the pitch may vary to determine the amount of pressure.

In the form shown in Figs. 2 and 3 which is adapted especially for aeroplane motors where sufficient space is not available to take care of the extended shaft 8' of Fig. 4, the unit is provided with vanes 23 directly underneath the bottom of the bowl and rotate therewith.

These vanes may be formed as a part of the bottom disk of the bowl and pick the oil up immediately on its passage from the outlet *f* of the bowl and thus build up the pressure before it passes from the bowl and its housing back to the motor.

Thus, by this very simple, compact and efficient centrifuge, the oil of the motor may be readily cleansed of its various foreign particles as it circulates from the motor to and through the centrifuge and not only this, but is fed back to the motor under substantially the same pressure at which it is maintained during its passage in the motor.

It is to be understood that, by describing in detail herein any particular forms, structure or arrangement, it is not intended to limit the invention beyond the terms of the several claims or the requirements of the prior art.

Having thus explained the nature of my said invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I claim:

1. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation and having ball-supported tapered spindles, a motor supported by the casing at the top of the bowl for rotating said bowl, said bowl comprising a plurality of cylinder-formed chambers therein,

said chambers having communicating ports so located as to pass the fluid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the length of all the chambers, the bowl having centrally thereof an inlet at its bottom and also an outlet at its bottom communicating with the innermost chamber.

2. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed chambers therein, said chambers having communicating ports so located as to pass the liquid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the length of all the chambers, the bowl having centrally thereof an inlet at its bottom and also an outlet at its bottom communicating with the innermost chamber, said inlet extending to near the top of the bowl, and an impeller located at the top of said inlet.

3. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation and having ball-supported tapered spindles, a motor supported by the casing at the top of the bowl for rotating said bowl, said bowl comprising a plurality of cylinder-formed chambers therein, said chambers having communicating ports so located as to pass the fluid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the length of all the chambers, the bowl having centrally thereof an inlet at its bottom and also an outlet at its bottom communicating with the innermost chamber, said inlet extending to near the top of the bowl, and an impeller located at the top of said inlet.

4. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed chambers therein, said chambers having communicating ports so located as to pass the fluid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the length of all the chambers, the bowl having centrally thereof an inlet at its bottom and also an outlet at its bottom communicating with the innermost chamber, said inlet comprising a tube located within a larger tube forming the inner wall of the inner chamber of the bowl and having its outlet below the top of the bowl and in communication with laterally extending ports in a top cover disk of the bowl, and an impeller located between said tube outlet and said last ports.

5. A centrifuge comprising a housing-supported casing, a rotatable bowl, spindle supported at the top and bottom in such casing, a motor having a tapered cushioned slip joint connection with the bowl and supported by the casing at the top of the bowl for rotating said bowl, said bowl having a plurality of cylinder-formed nested chambers therein, said chambers having communicating ports alternately located at the top and bottom of the chambers so as to pass the fluid lengthwise through the chambers from the center of rotation to the outer chamber and from thence back toward the center of rotation through an adjacent chamber, the inlet to and outlet from the bowl being at the bottom thereof, and an impeller located at the top of the bowl and in communication with the inlet and outer chamber.

6. A centrifuge comprising a housing-supported casing, a rotatable bowl, spindle supported at the top and bottom in such casing, a motor having a tapered cushioned slip joint connection with the bowl and supported by a casing at the top of the bowl for rotating said bowl, said bowl having a plurality of cylinder-formed nested chambers therein, said chambers having communicating ports alternately located at the top and bottom of the chambers so as to pass the fluid lengthwise through the chambers from the center of rotation to the outer chamber and from thence back toward the center of rotation through an adjacent chamber, the inlet to and outlet from the bowl being at the bottom thereof, an impeller located at the top of the bowl and in communication with the inlet and outer chamber, and rotatable means for increasing the pressure of the fluid passing from the bowl and located below the bottom of the bowl and in communication with the outlet therefrom and rotable with the bowl.

7. A centrifuge comprising a housing-supported casing, a rotatable bowl, spindle supported at its top and bottom in such casing, a motor having a tapered cushioned slip joint connection with the bowl and supported by the casing at the top of the bowl for rotating said bowl, said bowl having a plurality of cylinder-formed nested chambers therein, said chambers having communicating ports alternately located at the top and bottom of the chambers so as to pass the fluid lengthwise through the chambers from the center of rotation to the outer chamber and from thence back toward the center of rotation through an adjacent chamber, the inlet to and outlet from the bowl being at the bottom thereof, the lower spindle of the bowl having a supplemental ball-supported spindle, said housing having an outlet, and means carried by said supplemental spindle for increasing the pressure of the fluid as it leaves the bowl and passes through the housing outlet of the centrifuge.

8. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed ported chambers therein and having an outlet at its bottom and an inlet centrally thereof also at its bottom and communicating with the top of the bowl, and an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl.

9. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed ported chambers therein and having an outlet at its bottom and an inlet centrally thereof also at its bottom and communicating with the top of the bowl, an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl, and means located below the bottom of the bowl and rotatable therewith for increasing the pressure of the fluid passing from the bowl.

10. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation and having a pair of taper-formed ball-bearing supported spindles, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed ported chambers therein and having an outlet at its bottom and an inlet centrally thereof also at its bot-

tom and communicating with the top of the bowl, and an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl.

11. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation and having a pair of taper-formed ball-bearing supported spindles, a motor supported above said bowl for rotating it and a tapered spring-cushioned connection between the motor and the upper tapered spindle of the bowl, said bowl comprising a plurality of cylinder-formed ported members therein and having an outlet at its bottom and an inlet centrally thereof also at its bottom and communicating with the top of the bowl, and an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl.

12. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation and having ball-supported tapered spindles, a motor supported by the casing at the top of the bowl for rotating said bowl, the upper tapered bowl spindle having a tapered seat and a tapered and spring-cushioned bushing connecting the shaft of the motor and bowl, said bowl comprising a plurality of cylinder-formed chambers therein, said chambers having communicating ports so located as to pass the fluid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the lengths of all the chambers, the bowl having centrally thereof an inlet at its bottom and also an outlet at its bottom communicating with the innermost chamber, the top of the bowl having laterally extending ports communicating with the inlet and with the outer chamber, a screw-formed impeller at the top of the inlet adjacent to the top of the bowl and in communication with the laterally extending ports leading to the outer chamber, and vane-formed means located below the bottom of the bowl and rotatable therewith and communicating with a housing outlet below the bottom of the bowl for increasing the pressure of the fluid passing from the bowl.

13. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed ported chambers therein and having an outlet at its bottom and an inlet centrally thereof also at its bottom and communicating with the top of the bowl, and an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl and outlet means below the impeller and around said central inlet for de-airing the fluid.

14. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed ported chambers therein and having an outlet at its bottom and an inlet centrally thereof also at its bottom and extended to communicate with the top of the bowl, and an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl and means below the impeller and adjacent to said central inlet for de-airing the fluid and comprising an overflow chamber around the centrally located inlet and having a clearance or port at its bottom for the passage of overflow fluid and the removal of air from the fluid and a vented chamber below said overflow chamber for the reception of said overflow fluid.

15. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed chambers therein, said chambers having communicating ports so located as to pass the liquid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the length of all the chambers, the bowl having centrally thereof an inlet at its bottom and also an outlet at its bottom communicating with the innermost chamber, said inlet extending to near the top of the bowl, and an impeller located at the top of said inlet and outlet means below the impeller and around said central inlet for de-airing the fluid.

16. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed chambers therein, said chambers having communicating ports so located as to pass the fluid from the center of the bowl to the outer chamber and from thence toward the center of rotation through adjacent chambers and throughout the length of all the chambers, the bowl having centrally thereof an inlet at its bottom and extending to communicate with the top of the bowl and also an outlet at its bottom communicating with the innermost chamber, said housing having an outlet below the bottom of the bowl, means located below the bottom of the bowl and in communication with the housing outlet for increasing the pressure of the fluid passing from the bowl, an impeller located at the top of said inlet, and means below the impeller and adjacent to said central inlet for de-airing the fluid and comprising an overflow chamber around the centrally located inlet and having a clearance or port at its bottom for the passage of overflow fluid and the removal of air from the fluid and a vented chamber below said overflow chamber for the reception of said overflow fluid.

17. A centrifuge comprising a housing-supported casing, a bowl supported in said casing for rotation, a motor supported above said bowl for rotating it, said bowl comprising a plurality of cylinder-formed ported chambers therein and having an outlet at its bottom and an inlet centrally thereof also at its bottom and communicating with the top of the bowl, an impeller at the top of the bowl communicating with said inlet and with a chamber of the bowl, means located below the bottom of the bowl and rotatable therewith for increasing the pressure of the fluid passing from the bowl, and outlet means below the impeller and around said central inlet for de-airing the fluid.

18. A centrifuge comprising a supporting base, a casing secured thereto, a cover for the casing, a rotary bowl in said casing and having tapered spindles at its top and bottom, ball bearings at the bottom of the bowl between one of said tapered spindles and base, ball bearings between the cover and the other of said tapered spindles, a motor on the cover and having spring-cushioned driving means to the top tapered spindle of the bowl, said bowl having an inlet and an outlet, both at the bottom of the bowl, the inlet located centrally of the bowl and in communication with ported chambers within the bowl for separating the fluid.

19. A centrifuge comprising a supporting base, a casing secured thereto, a cover for the casing, a rotary bowl in said casing and having tapered spindles at its top and bottom, ball bearings at the bottom of the bowl between one of said tapered spindles and base, ball bearings between the cover and the other of said tapered spindles, a motor on the cover and having spring-cushioned driving means to the top tapered spindle of the bowl, said bowl having an inlet and an outlet, both at the bottom of the bowl, the inlet located centrally of the bowl and in communication with ported chambers within the bowl for separating the fluid, and an impeller located at the top of the bowl and in communication with the inlet located centrally of the bowl.

20. A centrifuge comprising a supporting base, a casing secured thereto, a cover for the casing, a rotary bowl in said casing and having tapered spindles at its top and bottom, ball bearings at the bottom of the bowl between one of said tapered spindles and base, ball bearings between the cover and the other of said tapered spindles, a motor on the cover and having driving means to the top tapered spindle of the bowl, said motor having a diameter substantially no greater than the diameter of the supporting casing, said bowl having an inlet and outlet both at the bottom of the bowl, the inlet located centrally of the bowl and in communication with ported chambers within the bowl for separating the fluid.

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