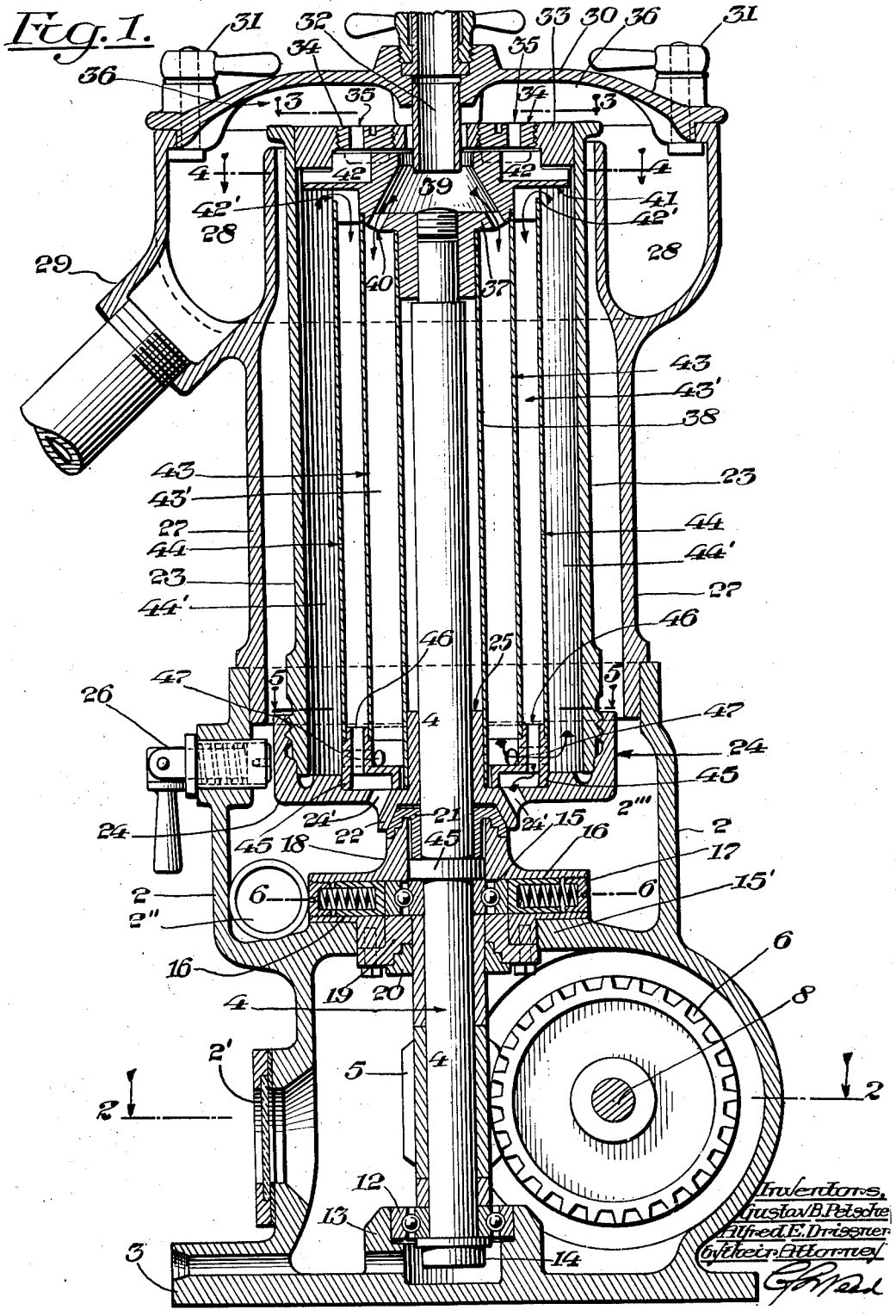
Dec. 2, 1930. G. B. PETSCHE ET AL 1,783,546

CENTRIFUGE

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Fig. 1.

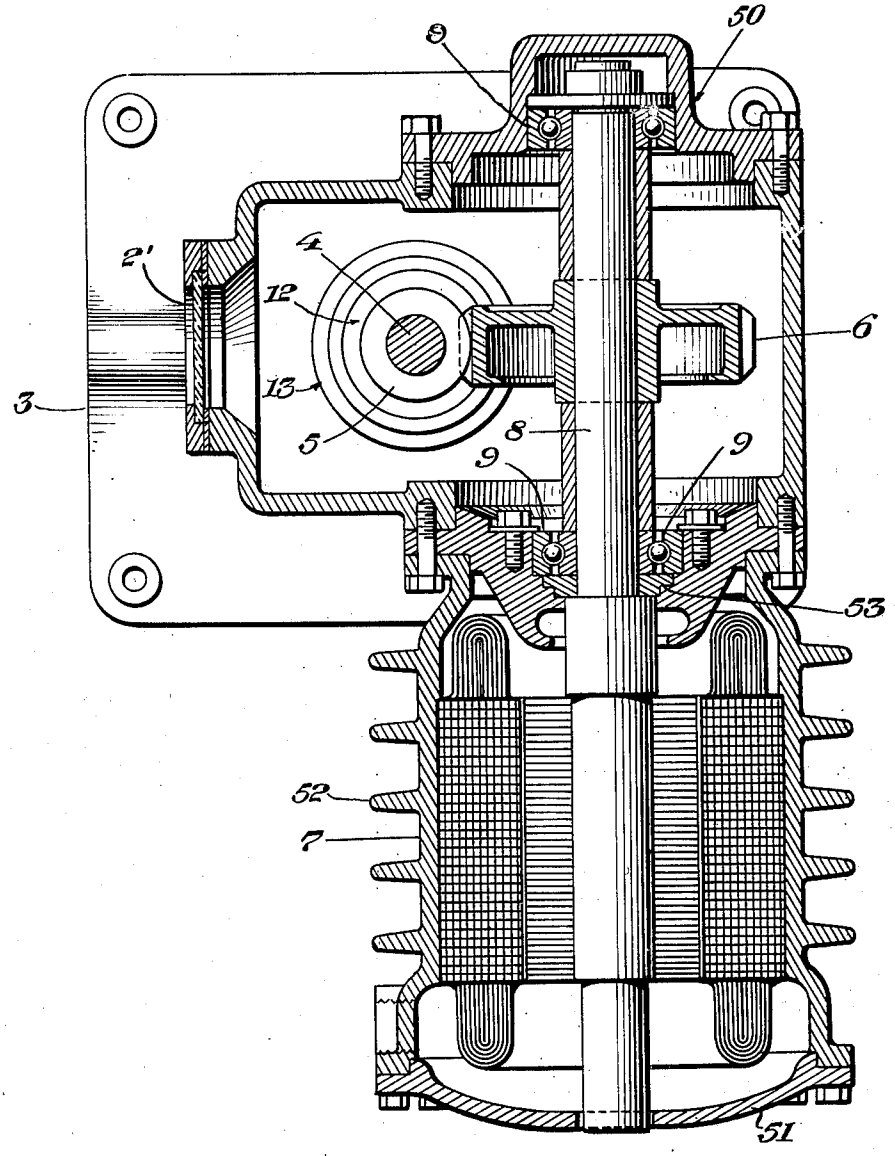


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CENTRIFUGE

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Fig. 2.



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CENTRIFUGE

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Fig. 3.

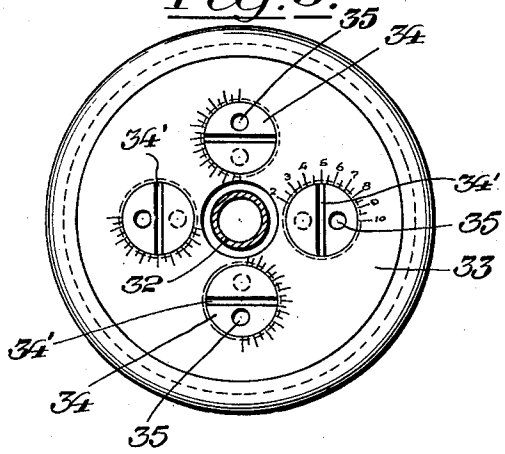


Fig. 4.

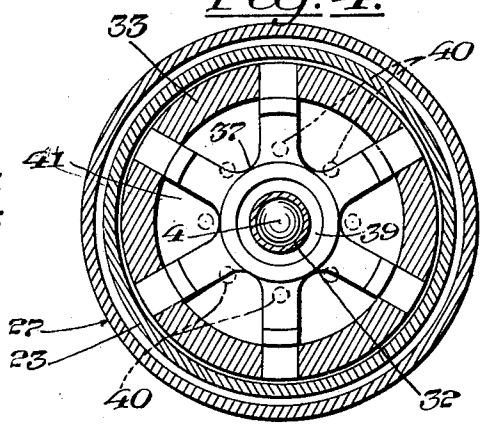


Fig. 6.

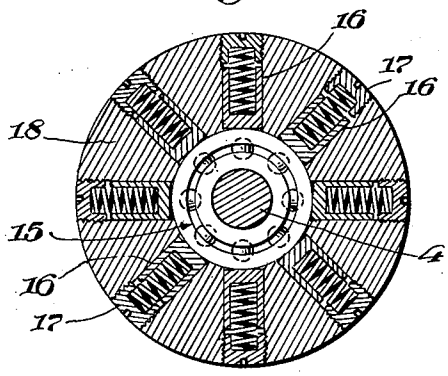


Fig. 5.

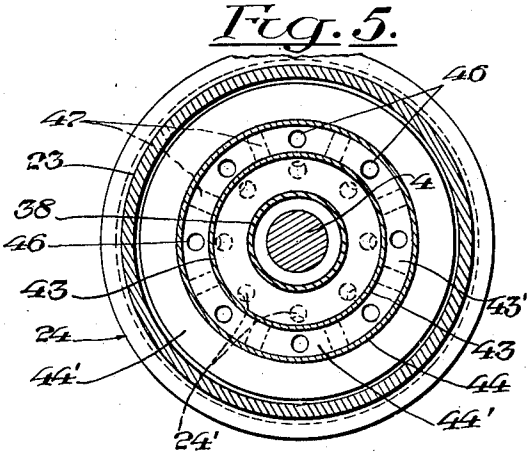


Fig. 7.

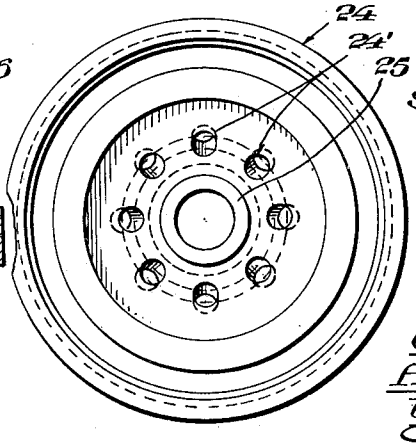


Fig. 8.

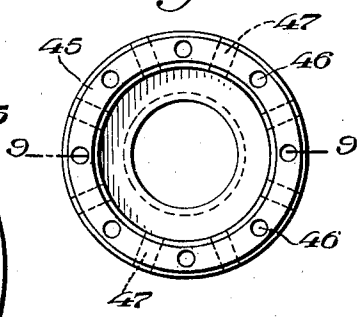
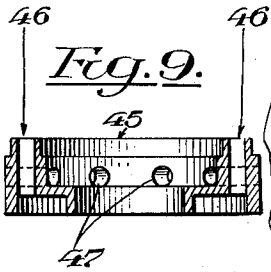


Fig. 9.



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CENTRIFUGE

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Fig. 10.

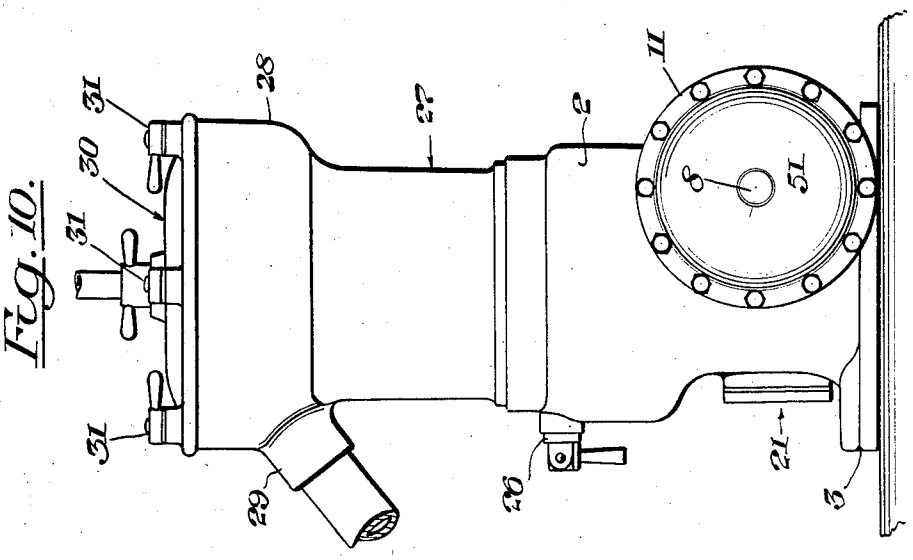
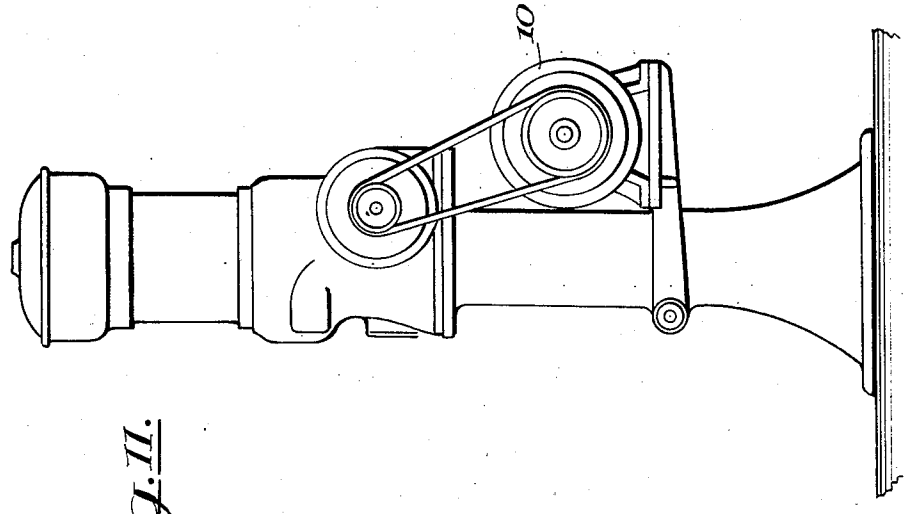


Fig. 11.



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Patented Dec. 2, 1930 1,783,546

UNITED STATES PATENT OFFICE

GUSTAV B. PETSCHE AND ALFRED E. DRISSNER, OF CLEVELAND, OHIO, ASSIGNORS TO THE NATIONAL ACME COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO

CENTRIFUGE

Application filed September 7, 1929. Serial No. 390,975.

This invention relates to centrifuges for separating liquids, the object of the present invention being to provide a small and compact centrifuge which can be used either as a separator or a clarifier, and therefore the primary object of the present invention is the provision of a combined centrifuge and clarifier quickly convertible from one into the other without the necessity of providing interchangeable parts and which is comparatively simple in construction.

A further object of the invention is the provision of a centrifuge in which the bowl comprises a plurality of cylinder-forming chambers, all the ports of which are below and above the cylinders and none through the walls thereof, whereby the fluid is given the longest possible travel and in which the fluid in one form of apparatus is required to travel in parallel paths three times the length of the cylinders, whereby superior results are obtained.

A still further object is the provision in a centrifuge of an improved bowl readily assembled and easily cleaned.

Another object is the provision of a bowl provided with adjustable ports whereby the condition of the fluid may not only be controlled, but the apparatus quickly converted from a separator to a clarifier or vice versa.

In the purifying of liquids by centrifuge force, the best efficiency is obtained by having the liquid travel through the revolving bowl in thin layers or strata and also have it remain in the bowl as long as possible, since impurities require time to settle out of the liquid and this time is reduced by reducing the thickness of the layers. This is also true of the separation of two liquids of different specific gravities. When purifying liquids from which solids only have to be removed, the centrifuge is set up as a clarifier and in that case the solids accumulate within the bowl and have to be removed from time to time, with the consequent interruption in the operation of the machine unless a carrier liquid is used to carry away the solids through special discharge ports to prevent accumulation.

In separators the location or distance of the discharge ports with reference to the axis of rotation is very important. These discharge ports correspond to and have to vary with the variation of the specific gravities. Otherwise, if water, for instance, is to be separated from oil and the distance of the overflow for the oil is too close toward the axis of rotation, an undue amount of oil will discharge with the water, and if too far away then part of the water discharges with the oil. It has heretofore been the usual practice to have one port stationary and the other adjustable by interchangeable rings of different size or bore. To interchange these rings is a time-taking and rather troublesome manipulation as sometimes several have to be tried out before the right one is found, and, of course, a great number of rings have to be on hand so as to be prepared for separating liquids of various kinds.

Therefore, the present improvement is intended to eliminate these difficulties and provide an apparatus useful either as a centrifuge or as a clarifier and convertible from one to the other without the necessity of using interchangeable parts and making certain adjustments. Other important advantages of this improvement will appear in the detailed description thereof.

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

Figure 1 is a vertical sectional view of this improved centrifuge and separator;

Fig. 2 is a horizontal sectional view taken on line 2—2, Fig. 1;

Fig. 3 is a top view of the bowl taken on line 3—3, Fig. 1;

Fig. 4 is a cross-sectional view taken on line 4—4, Fig. 1;

Fig. 5 is a cross-sectional view adjacent to the bottom of the bowl taken on line 5—5, Fig. 1;

Fig. 6 is a cross-sectional view of the upper spindle bearing taken on line 6—6, Fig. 1;

Fig. 7 is a top view of the bowl bottom;

Fig. 8 is a top view of the inner cylinder centering member or ring;

Fig. 9 is a cross-sectional view thereof taken on line 9—9, Fig. 8;

Fig. 10 is a front view of the machine mounted on a plate and driven by a motor also mounted thereon; and

Fig. 11 is a view of this machine mounted on a pedestal and driven by a somewhat differently arranged motor.

Similar characters of reference indicate corresponding parts in the several views.

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

By reason of the fact that the machine is small and compact, it may be directly driven, as shown in Fig. 1; or mounted on a pedestal, as shown in Fig. 11, and driven by a motor mounted in the manner therein shown; or it may be mounted on a plate driven by a motor mounted on the same plate, as shown in Fig. 10; or in other ways, as found desirable in practice.

This improved combined centrifuge and clarifier comprises a casing or housing 2 having an oil sight or window 2′ and a clean liquid discharge opening or pipe 2″ from an oil chamber 2‴. This housing 2 has a suitable supporting base 3 in which is located a rotating spindle 4 carrying a spiral pinion 5 in mesh with a spiral gear 6 within the casing. This spiral gear 6 is fixed to a shaft 8 which is driven by a suitable motor 7 (see Fig. 2). The shaft 8 is suitably mounted on ball bearings 9. In this manner the spindle 4 is directly driven. In the form shown in Fig. 11, the spindle is driven by a suitable motor 10 mounted on a shaft connected by a belt with a pulley which in turn is provided with the necessary means for rotating the spindle; while in Fig. 10 the motor 11 is located outside the casing for rotating the spindle.

The rotating spindle is supported at its lower end by suitable ball bearing 12 supported by an upturned ring or flange 13 at the bottom of the casing and is maintained against separation from its bearings by means of a nut or collar 14. This rotating spindle is also supported by an upper bearing 15 carried by an inturned flange 15′ of the casing, suitable spring-pressed plungers 16 being used to provide a yielding support of the spindle, the springs being maintained in position by suitable adjustable threaded caps 17. This upper bearing is carried by a suitable housing 18 and bearing cap 19, the latter carrying an oil sealing collar 20 for the bowl spindle. At the top of the bearing housing 18 and secured to the spindle is located a friction cone 21 for supporting the bottom of the bowl which is provided with a similarly-formed cone member 22, thus forming a friction clutch-like drive while facilitating a ready removal of the bowl by slipping it off the spindle for cleaning. The bowl shell 23 is thread-fitted into the bottom 24 thereof, and adjacent to the cone 22 this bottom is provided with discharge ports 24′. The bottom is also provided with an upwardly-extending sleeve or bearing member 25 for the rotating spindle. The spindle is preferably of an integral structure and the bowl can be readily removed therefrom, when desired—it being understood that the bowl rotates with the rotating spindle by means of the friction clutch members 21 and 22. For the purpose of braking the bowl, a suitable brake 26 is provided mounted in the housing 2 and in position to engage the upturned flange of the bottom 24 of the bowl, thereby to quickly stop the rotation of the bowl when the drive therefor is stopped.

Located around the bowl 23 is a bowl-protecting shell or housing 27 projecting into the housing 2 and suitably secured thereto, and this housing 27 is provided near its top with a waste-collecting chamber 28 having a discharge spout or pipe 29 and is closed by a cover 30 suitably secured to the housing 27 by clamps 31. Centrally of and carried by the cover is located a suitable inlet, including an inlet nozzle 32. The bowl 23 comprising the outer shell and the bottom 24 hereinbefore referred to, is also provided with a top plate 33 suitably secured thereto, in which is mounted a series of rotatable plugs or plates 34 (see Fig. 3) each provided with outlet ports 35 opening into a chamber 36 between the top of the bowl and the cover 30 and which chamber leads to the waste-collecting chamber 28.

By rotating the plugs 34 to carry the outlet ports 35 thereof into the positions shown in dotted lines in Fig. 3, the center of these holes will be much nearer to the center of the bowl, as are the ports 24′ in its bottom. Consequently, when the bowl is spinning, normally no fluid will discharge through the ports 35, only through the ports 24′, and thus the separator is converted into a clarifier in which the solids which accumulated inside of the bowl must be removed at intervals by the operator.

Carried by the upper end of the rotating spindle 4, which is reduced for the purpose, is a bowl spindle head 37, which is also supported by a supporting tube 38 encircling the flange 25 and supported by the bottom 24 of the bowl. This bowl spindle head 37 has a cone-shaped chamber 39 at the top in communication with the inlet nozzle 32, and this head is provided in the bottom thereof with impelling ports 40 opening into the inner or first cylinder 43 of the bowl hereinafter described. This head is provided with a hori-

zontally-located separating disk 41 and thereabove with ports 42 (which are designated herein as "heavy fluid ports") and at the underside thereof with ports 42′ (designated herein as "light fluid ports"). The ports 42 are in communication with the ports 35 of the convertible plugs 34. The top of the bowl around the convertible plugs is provided with indicating marks whereby all of the plugs may be adjusted to the same extent, for which purpose the plugs are provided with slots 34′.

Located within the bowl is a pair of tubes or cylinders 43 and 44 (the cylinder 43 being designated as the "inner cylinder" and the cylinder 44 as the "outer cylinder"), and the small inner cylinder or tube is supported at its top by the spindle head 37 and at its lower end by a centering ring 45, a part of which is located between the inner cylinder 43 and the outer cylinder 44. This centering ring is supported on the bottom of the bowl and is provided with vertically-located ports 46 (herein designated as "light fluid ports") and with horizontally-located ports 47 (herein designated as "heavy fluid" or "impeller ports"). This centering ring 45 holds the tubes or cylinders 43 and 44 in position and separates tube 43 from tube 44. The lower end of the tube 44 is likewise carried by this ring 45, while the top thereof is supported by the spindle head 37 and at the top of this outer cylinder the ports 42′ are located.

The machine is provided (see Fig. 2) with a rear cover 50 and a front cover 51 whereby access to the motor housing 52 and the related parts is obtained, a suitable oil-sealed collar 53 being provided.

In the form shown in Fig. 2, the direct motor drive results in greater compactness of the machine, since it reduces the number of bearings and other parts which would otherwise be necessary.

In operation the fluid enters through the nozzle 32 (see Fig. 1) into what is designated as the "impeller cavity" or cone chamber 39 and from thence passes through the exit ports 40 which are inclinedly-located and arranged at the extreme radius of this chamber so as to give the fluid when leaving the chamber 39 approximately the same speed as the inner cylinder 43. The inner radius of this bowl cylinder 43, wth reference to the distance of the exit ports 24′ in the bowl bottom from the axis of rotation, is such that only a film of fluid can remain on the surface of the cylinder 43 instead of being submerged by a heavy layer,—so that this cylinder may properly be termed a "dry" one, as compared with the outer or larger cylinder 44 which is submerged.

This construction facilitates the separation and clarification to a great extent, as it is a well-known fact that with a thin film under centrifugal force, water, oil and dirt separate almost instantly. The water within the oil may be distributed in atom size, but in a thin film under pressure forms drops. This takes place before the fluid under pressure leaves the inner cylinder 43. In this state the fluid enters through the horizontal impeller ports 47 at the bottom of the bowl and passes into what may be termed the "accumulating chamber" 44′ formed between the outer cylinder 44 and the bowl shell 23. Here the water, oil and residue form strata,—the oil nearest to the axis of rotation, the residue at the extreme radius, and the water between the two. Owing to the greatest centrifugal force in this part of the bowl, the most extensive separation and clarification take place, assisted by the long travel over the whole length of the bowl and the parallel flow from the bottom to the top. After this the water and residue discharge from the chamber 44′ around the separating disk 41 which extends nearly across the top thereof to the bowl shell 23 and through the horizontal ports 42 and ports 35 into the chamber or trough 28 and thence through the waste pipe 29; while the oil passes through ports 42′ into the intermediate chamber 43′ formed between the inner cylinder 43 and the outer cylinder 44, where the oil receives an additional purification before it leaves through the vertical ports 46 and 24′ at the bottom of the bowl, and thence it passes into the oil chamber 2‴ and from thence through the clean discharge opening or pipe 2″. Thus the oil has to travel three times the length of the bowl, continually exposed to centrifugal force, while going through the process of purification. Should it be found that it still contains some water or some oil discharges with the water, then a slight adjustment of the convertible plugs 34, thereby to change the radius of discharge, will correct this. As hereinbefore stated, when it is desired to remove the solids from a fluid without separating one from the other, these convertible plugs 34 are rotated into the position shown in dotted lines in Fig. 3, whereby the separator is converted into a clarifier in which the solids accumulate until they are removed at intervals by the operator.

The bowl is easily dismantled and can be operated without the cylinders 43 and 44 and the bottom centering ring 45 when purification of the material to be treated does not have to be of high grade.

From the foregoing it will be observed that the cylinders are not provided with any ports through their side walls at all and that the ports in communication with these cylinders or the chambers formed thereby are so located at the top and bottom of the bowl as to give highly efficient and superior results. Furthermore, the ports at the bottom are all carried by a centering ring readily inserted

and removed and by the detachable bottom of the bowl, and at the top of the bowl by a spindle head and rotatable plugs, all of which likewise can be readily removed and replaced, thereby permitting quick and easy assemblage of the bowl parts and the cleaning thereof; while the several chambers formed by the cylinders or tubes 43 and 44 are all properly spaced from each other by the same centering ring and spindle head,— thus providing, in conjunction with a simple form of bowl-protecting housing having a waste chamber therein and cover therefor a very simple and compact machine having the smallest number of parts and in which the bowl may be readily removed by slipping it from the spindle,—and the bowl-protecting housing may also be removed, if desired, from the housing carrying the driving mechanism for the rotating spindle, since it may be secured thereto in any suitable way. Furthermore, access to the driving mechanism housing is readily obtained by the removable covers located at the ends thereof (see Fig. 2). Thus it will be seen that for a machine as efficient as the present one has proved to be in practice, the parts are comparatively few and that without the necessity of removing any parts the machine may be readily converted from a clarifier into a separator.

One of the important features of the present improvement is the provision of the adjustable plugs 34 having the outlet ports 35 eccentrically located relatively to the stationary outlet ports 42, thus doing entirely away with the necessity of providing interchangeable removable rings, and which plugs 34 are rotatable to change the radius of discharge. The adjustment of these plugs does not change the size of the port or orifice but only the location thereof relatively to the center of rotation, thereby to adjust the radius of discharge.

It is to be understood that by describing in detail herein any particular form, 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 our 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, we claim:

1. In a centrifuge, the combination of a rotable spindle, means for rotating it, and a bowl carried by the spindle and having nesting cylinder-forming chambers, said bowl having an inlet nozzle and a chamber communicating therewith, said chamber having exit ports located at its extreme radius thereby to give the fluid when leaving the chamber approximately the same speed as the inner cylinder, said chambers having communicating ports so located as to pass the fluid from the innermost chamber to the outermost chamber and from there toward the center of rotation through an adjacent chamber.

2. In a centrifuge, the combination of a rotatable spindle, means for rotating it, and a bowl carried by the spindle and having nesting cylinder-forming chambers, said bowl having an inlet nozzle and a chamber communicating therewith, said chamber having inclined exit ports located at its extreme radius thereby to give the fluid when leaving the chamber approximately the same speed as the inner cylinder, said chambers having communicating ports so located as to pass the fluid from the innermost chamber to the outermost chamber and from there toward the center of rotation through an adjacent chamber.

3. In a centrifuge, the combination of a rotatable spindle, means for rotating it, and a bowl carried thereby having nesting cylinder-forming inner, outer and intermediate chambers, said bowl having inlet ports to the top of the inner chamber, outlet ports connecting the inner and outer chambers at the bottom thereof, and outlet ports communicating with the bottom of the intermediate chamber, the radius of the inner cylinder relatively to the distance of the exit of said last outlet ports from the axis of rotation being such that only a film of fluid can remain on the surface of the cylinder instead of being submerged by a heavy layer of fluid.

4. In a centrifuge, the combination of a rotatable spindle, means for rotating it, and a bowl having a plurality of cylinder-forming chambers therein, said chambers having communicating ports so located as to pass the fluid from the innermost chamber to the outermost chamber and from there toward the center of rotation through an adjacent chamber.

5. In a centrifuge, the combination of a rotatable spindle, means for rotating it, and a bowl having a plurality of cylinder-forming chambers therein, said bowl having ports so located as to pass the fluid alternately through each of said chambers throughout the entire length thereof, one of said chambers being so located and of such diameter with relation to the ports that only a film of fluid will remain on its surface instead of being submerged by a heavy layer while another of said chambers is submerged, whereby said first chamber is substantially a dry chamber as compared with the submerged chamber, thereby insuring almost instantaneous separation of the fluid.

6. In a centrifuge, the combination of a rotatable spindle, means for rotating it, a bowl carried by the spindle and having a bottom and a top, a pair of cylinder-forming

chambers in the bowl, and a centering ring carried by the bottom for spacing said cylinders and provided with vertical and horizontal ports.

7. In a centrifuge, the combination of a rotatable spindle, means for rotating it, a bowl carried by the spindle and having a bottom and a top, a pair of cylinder-forming chambers therein, a spindle head having vertical and horizontal ports, and a separating disk separating said ports.

8. In a centrifuge, the combination of a rotatable spindle, means for rotating it, a bowl carried by the spindle and having a bottom and a top, a pair of cylinder-forming chambers therein, a spindle head having vertical and horizontal ports, and a separating disk separating said ports, said disk projecting substantially to the bowl wall.

9. In a centrifuge, the combination of a rotatable spindle, means for rotating it, a bowl carried by the spindle and having a bottom and a top, a pair of cylinder-forming chambers therein, a centering ring carried by the bottom for spacing said cylinders and provided with vertical and horizontal ports, a spindle head having vertical and horizontal ports, and a separating disk separating said ports and projecting substantially to the bowl wall.

10. In a centrifuge, the combination of a housing having a waste chamber at the top thereof and having an outlet therefrom, a cover for said housing and provided with a centrally-located inlet nozzle, a rotating spindle in said housing, means for rotating it, a bowl carried by said spindle having a ported bottom and a top having adjustable ports communicating with the waste chamber, a plurality of cylinder-forming chambers within said bowl, means carried by the bowl bottom for centering said cylinders and having vertical and horizontal ports, the latter forming communication between a pair of spaced chambers and the former having communication with the intermediate chamber and the ports of the bowl bottom, and a spindle head having a chamber in communication with the inlet nozzle and having obliquely-located ports in communication with the inner cylinder chamber, said head also having ports in communication with the adjustable ports and with the outer cylinder chamber adjacent to the bowl wall, and ports forming communication between the outer chamber and an intermediate chamber.

11. In a centrifuge, the combination of a housing having a waste chamber at the top thereof and having an outlet therefrom, a cover for said housing and provided with a centrally-located inlet nozzle, a rotating spindle in said housing, means for rotating it and located within the housing, a bowl carried by said spindle having a ported bottom and a top having adjustable ports communicating with the waste chamber, a plurality of cylinder-forming chambers within said bowl, means carried by the bowl bottom for centering said cylinders and having vertical and horizontal ports, the latter forming communication between a pair of spaced chambers and the former having communication with the intermediate chamber and the ports of the bowl bottom, and a spindle head having a chamber in communication with the inlet nozzle and having obliquely-located ports in communication with the inner cylinder chamber, said head also having ports in communication with the adjustable ports and with the outer cylinder chamber adjacent to the bowl wall, and ports forming communication between the outer chamber and an intermediate chamber.

12. In a centrifuge, the combination of a housing having a waste chamber at the top thereof and having an outlet therefrom, a cover for said housing and provided with a centrally-located inlet nozzle, a rotating spindle in said housing, means for rotating it, a bowl carried by said spindle having a ported bottom and a top having adjustable ports communicating with the waste chamber, a plurality of cylinder-forming chambers within said bowl, means carried by the bowl bottom for centering said cylinders and having vertical and horizontal ports, the latter forming communication between a pair of spaced chambers and the former having communication with the intermediate chamber and the ports of the bowl bottom, and a spindle head having a chamber in communication with the inlet nozzle and having obliquely-located ports in communication with the inner cylinder chamber, said head also having ports in communication with the adjustable ports and with the outer cylinder chamber adjacent to the bowl wall, and ports forming communication between the outer chamber and an intermediate chamber, said housing having a chamber below and in communication with the bowl provided with a clear fluid outlet therefrom.

13. In a centrifuge, the combination of a housing having a waste chamber at the top thereof and having an outlet therefrom, a cover for said housing and provided with a centrally-located inlet nozzle, a rotating spindle in said housing, means for rotating it, a bowl carried by said spindle having a ported bottom and a top having adjustable ports communicating with the waste chamber, a plurality of cylinder-forming chambers within said bowl, means carried by the bowl bottom for centering said cylinders and having vertical and horizontal ports, the latter forming communication between a pair of spaced chambers and the former having communication with the intermediate chamber and the ports of the bowl bottom, a spin-

dle head having a chamber in communication with the inlet nozzle and having obliquely-located ports in communication with the inner cylinder chamber, said head also having ports in communication with the adjustable ports and with the outer cylinder chamber adjacent to the bowl wall, and ports forming communication between the outer chamber and an intermediate chamber, said housing having a chamber below and in communication with the bowl provided with a clear fluid outlet therefrom, braking means carried by the housing for engaging the bottom of the bowl, and upper and lower bearings for supporting the spindle within the housing, said upper bearing having means for automatically adjusting it.

14. In a centrifuge, the combination of a rotatable spindle, means for rotating it, a bowl carried by the spindle and having nesting cylinder forming chambers, said bowl having outlet ports above and below the cylinders whereby the fluid will alternately pass through the cylinder forming chambers the entire length of the cylinders before passing from the bowl, said ports located so as to pass the fluid from the innermost chamber to the outermost chamber and from there toward the center of rotation through an adjacent chamber, the outlet for the clean fluid being at the bottom and the outlet for the dirty or waste fluid at the top of the bowl, and a discharge pan around the top of the bowl for the dirty fluid.

15. In a centrifuge, the combination of a rotatable spindle, means for rotating it, a bowl carried by the spindle and having nesting cylinder forming chambers, said bowl having outlet ports above and below the cylinders whereby the fluid will alternately pass through the cylinder forming chambers the entire length of the cylinders before passing from the bowl, said ports located so as to pass the fluid from the innermost chamber to the outermost chamber and from there toward the center of rotation through an adjacent chamber, the outlet for the clean fluid being at the bottom and the outlet for the dirty or waste fluid at the top of the bowl, a housing for the spindle rotating means, a removable bowl protecting shell carried by said housing and having at its upper end a discharge pan around the top of the bowl for the dirty fluid, and a removable cover for said pan.

Signed at Cleveland, Ohio, this 30th day of August, 1929.

GUSTAV B. PETSCHE.
ALFRED E. DRISSNER.