May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 1

Fig. 1.

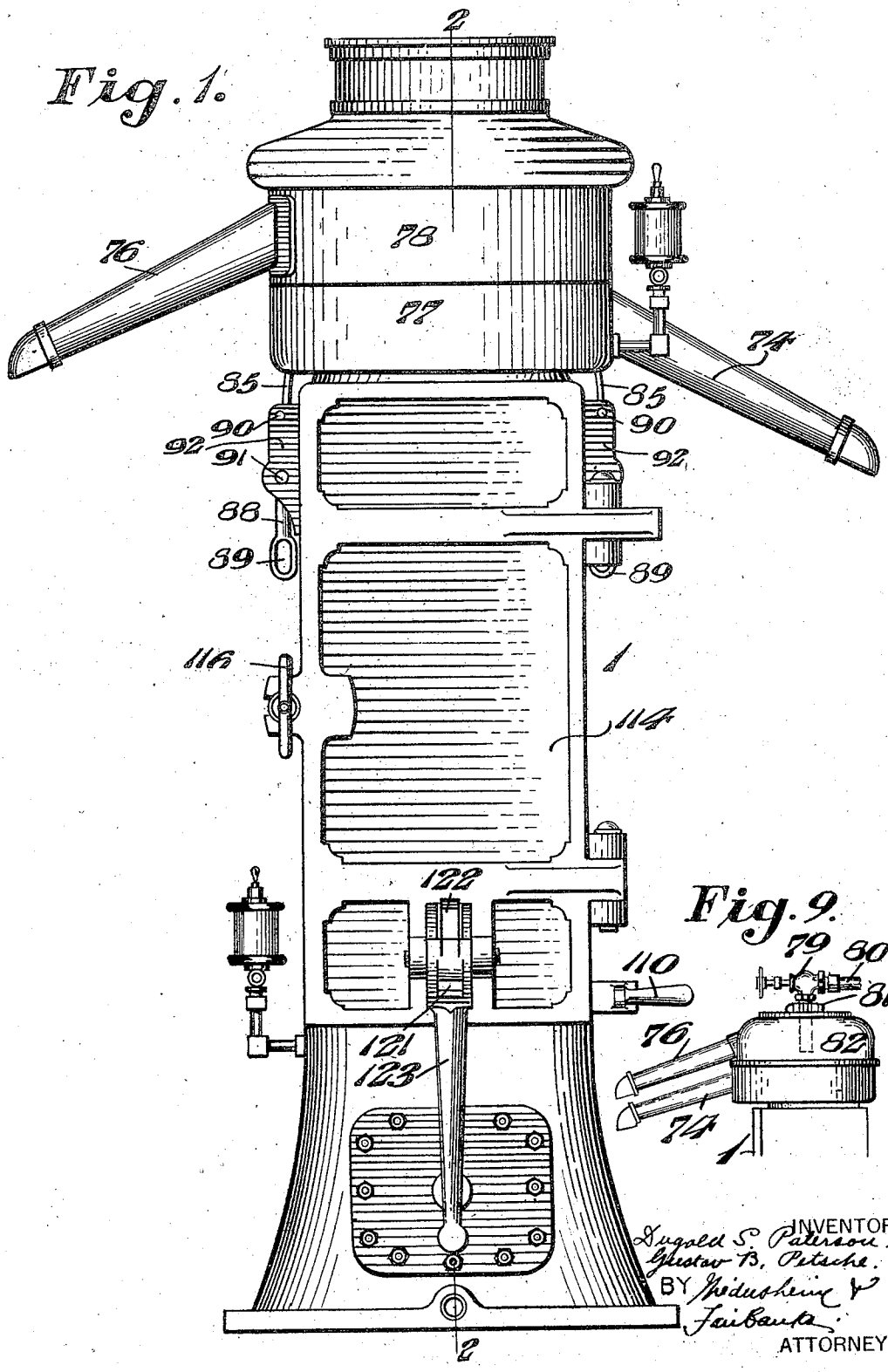


Fig. 9.

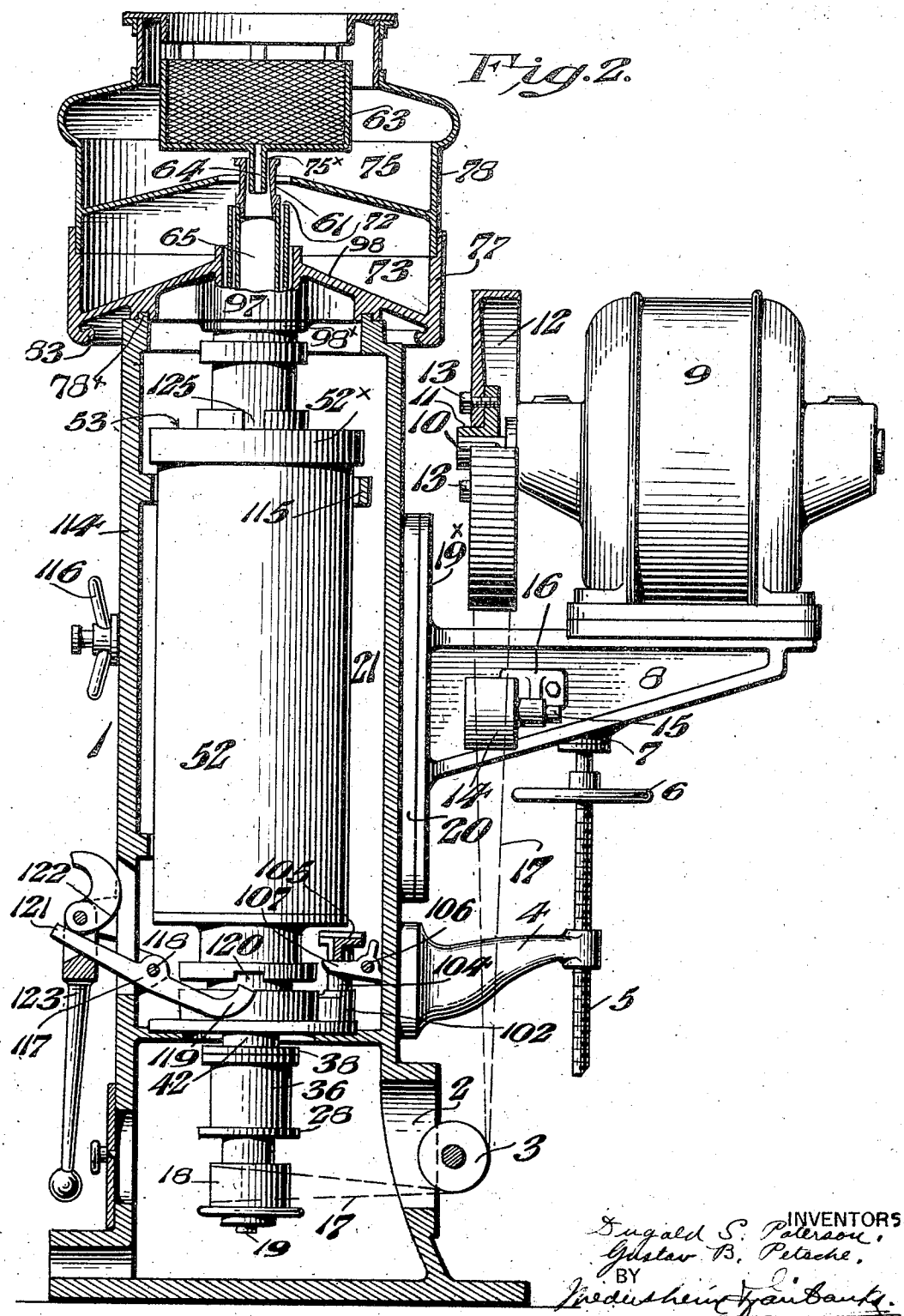
INVENTORS
Dugald S. Paterson.
Gustav B. Petsche.
BY Wiedenheim & Fairbanks.
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 2

Fig. 2.



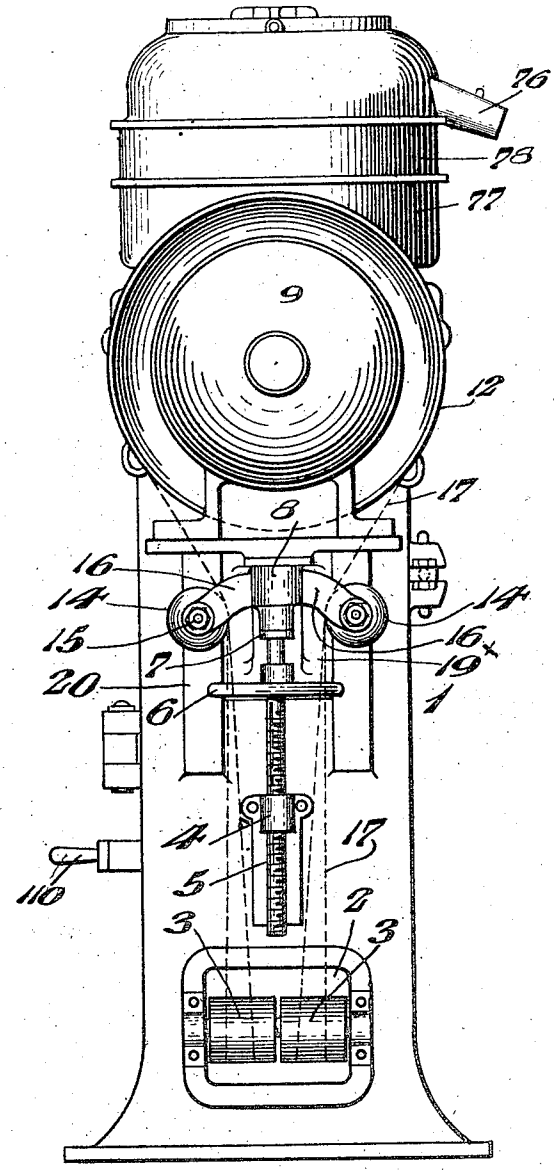
Ingvald S. Paterson,
Gustav B. Petsche.
INVENTORS
BY
Fredericks, Fairbanks & Haight
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 3

Fig. 3.



Sugald S. Paterson.
Gustav B. Petsche.
INVENTORS
BY
Frederik Leipziger
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 4

Fig. 4.

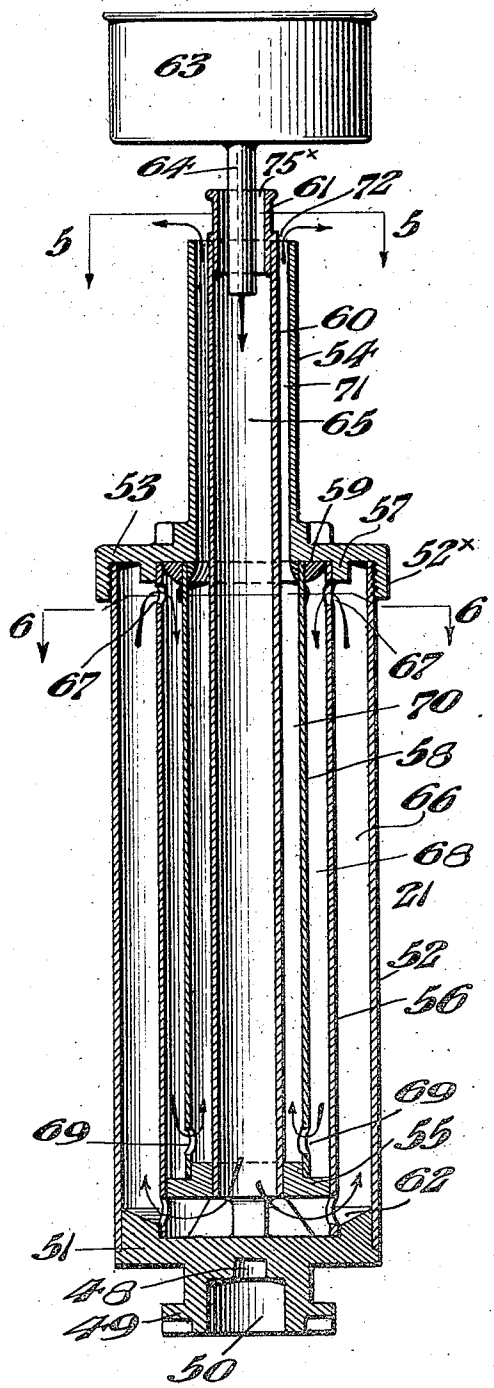


Fig. 5.

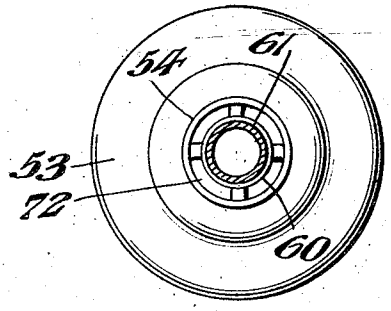
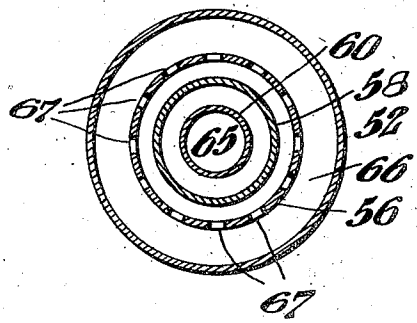


Fig. 6.



INVENTORS
Dugald S. Paterson.
Gustav B. Petsche.
BY
Middleton Lyon & Banks.
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL. 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 5

Fig. 7.

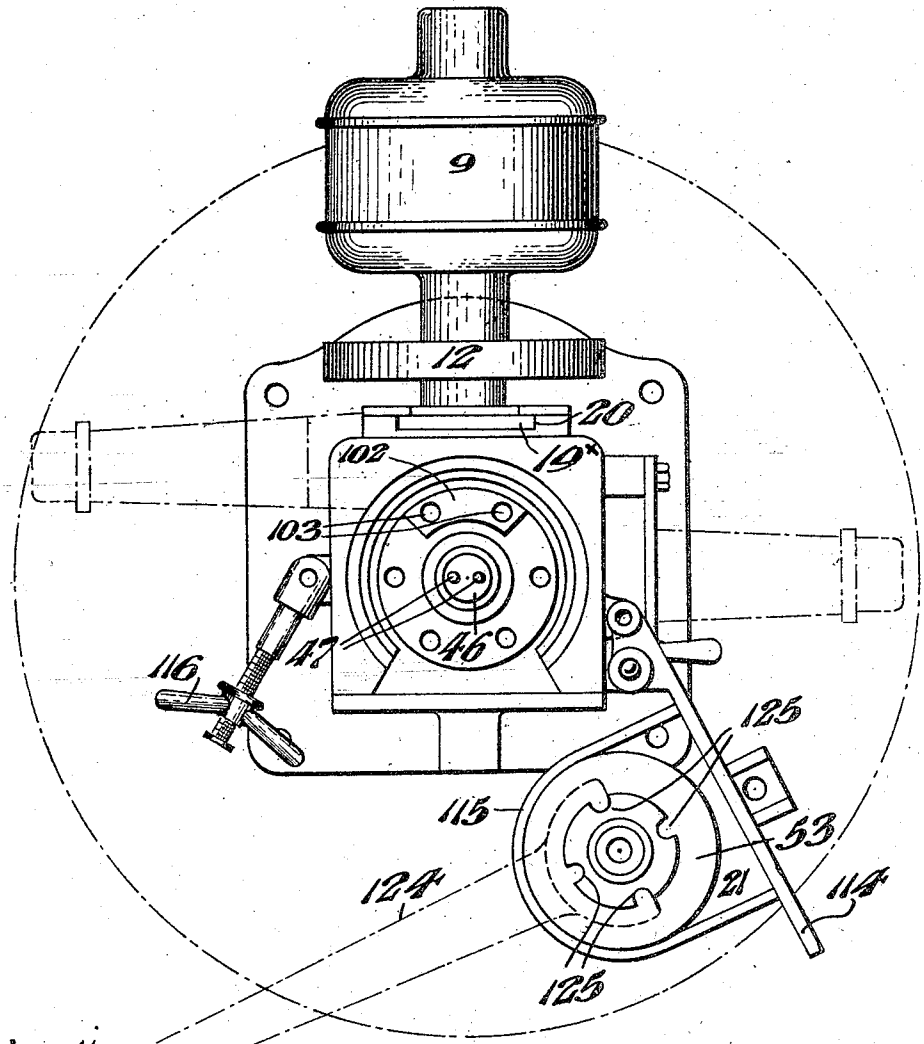


Fig. 11.

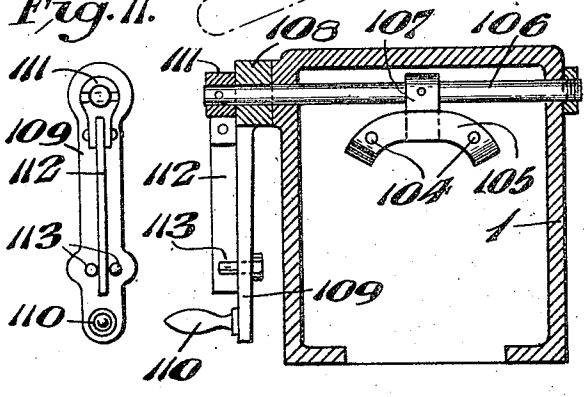


Fig. 10.

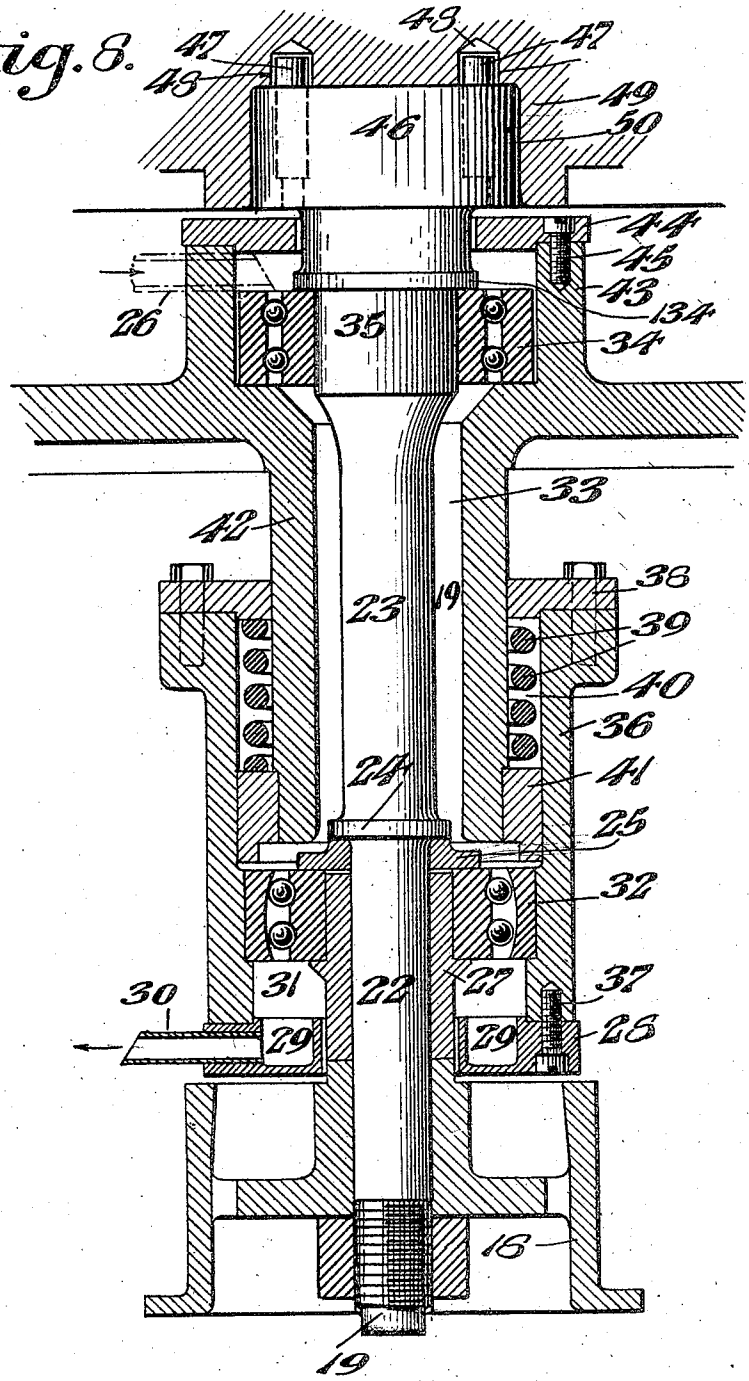
INVENTORS
Ingald S. Paterson.
Gustav B. Petsche.
BY
Meiderhein & Fairbanks.
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 6

Fig. 8.



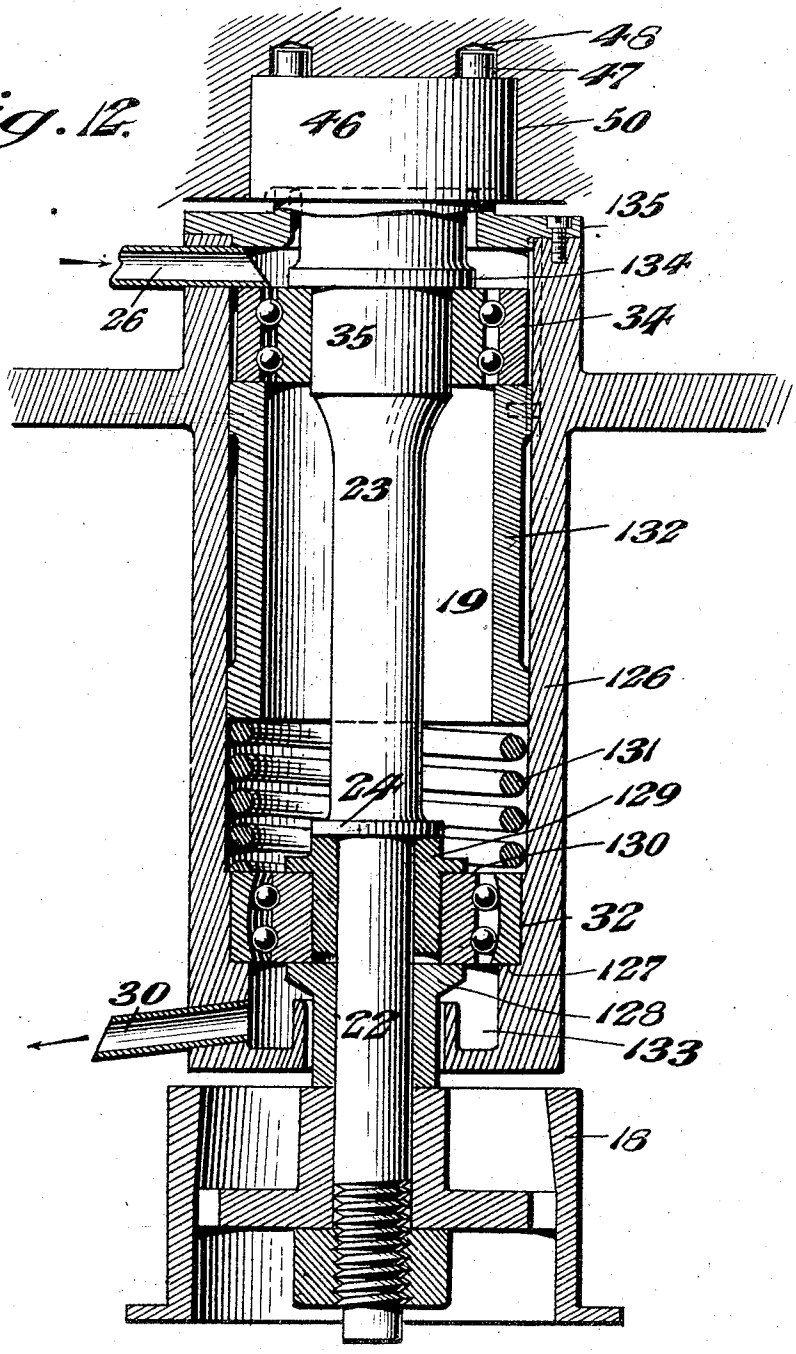
Dugald S. Paterson. INVENTORS
Gustav B. Petsche.
BY
Mederschein & Fairbanks
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 7

Fig. 12.



Dugald S. Paterson. INVENTORS
Gustav B. Petsche.
BY
Middleton Goldsmith
ATTORNEYS.

May 28, 1929. D. S. PATERSON ET AL 1,714,985

CENTRIFUGE

Filed July 25, 1927 8 Sheets-Sheet 8

Fig. 13.

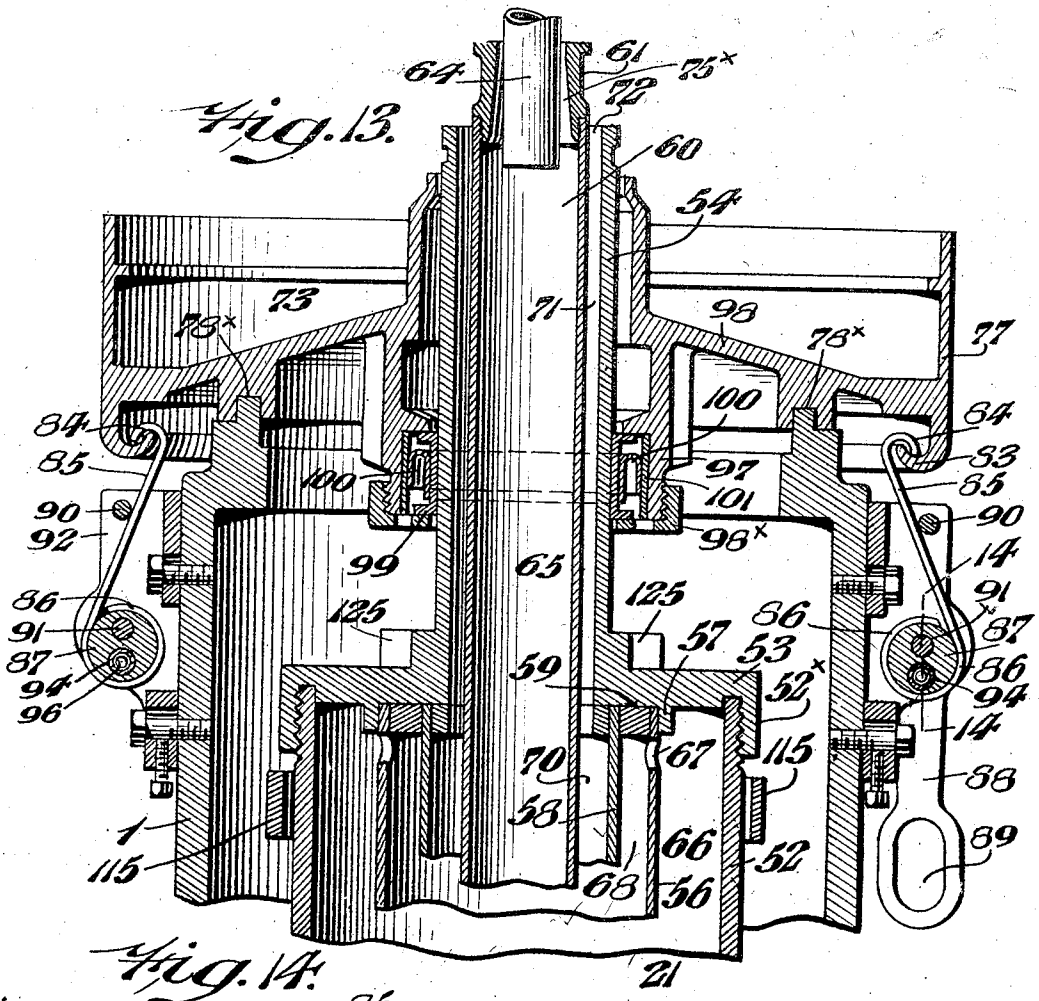


Fig. 14.

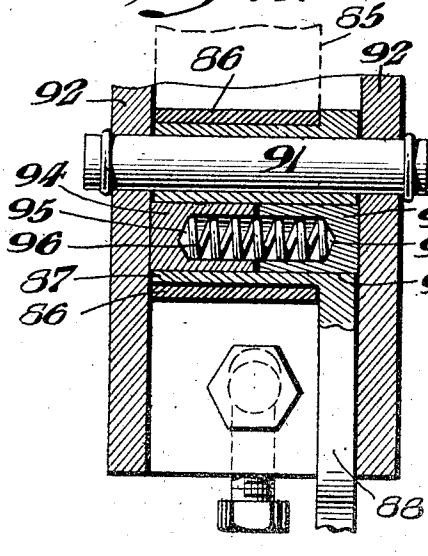
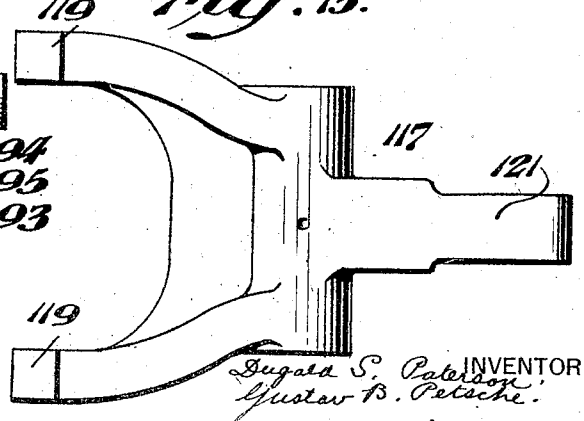


Fig. 15.



Dugald S. Paterson INVENTORS
Gustav B. Petsche.

BY Frederick Frankenberg

ATTORNEYS.

Patented May 28, 1929. 1,714,985

UNITED STATES PATENT OFFICE.

DUGALD S. PATERSON AND GUSTAV B. PETSCHE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO THE NATIONAL ACME COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

CENTRIFUGE.

Application filed July 25, 1927. Serial No. 208,208.

Our invention relates generally to a new and useful centrifuge whereby commingled liquids of different densities and specific gravities, as well as of different consistencies and viscosities may be effectively and accurately clarified.

In our novel construction of centrifuge, we employ a large volume bowl, which is equipped at its lower portion with novel manipulating devices which can be readily handled by a single operator without requiring extraneous lifting means for removing said bowl out of the machine for the purposes of inspection, replacement or cleaning, which ordinarily has to be done periodically.

Our invention further consists of novel means for reliably supporting and driving our novel bowl and bringing it to a stop on short notice by a novel and effective braking mechanism,—and it further consists in novel mechanism for readily changing the speed of rotation, when driven by a single speed motor.

By our novel construction, a bowl of maximum area or volume is provided, whereby we are enabled to provide elongated passageways therein of a maximum length, which cause the fluid to be clarified, to stay longer in the bowl before it passes therethrough or emerges therefrom, which in consequence accomplishes a greater degree of purification than heretofore, and provides also a larger space for the accumulation of impurities, thus reducing to a minimum, interruptions in operation which are necessary for cleaning. Since a bowl constructed so as to incorporate these advantages would weigh too much to be lifted or manipulated by hand when assembled, we have provided the novel means aforesaid for enabling the bowl to be taken apart conveniently at desired periods, so that only parts of moderate weight have to be handled, all of which can be readily done by a single operator.

Our invention further consists of a novel construction of a bowl adapted to be reliably rotated at great speeds, and which is substantially supported at both its upper and lower ends and driven by a spindle of novel construction adapted and designed effectively to take care of the great weight of the bowl and the side pull of the driving belt.

Our invention further consists of a novel construction of a spindle supported by two sets of ball races, one of which is spring supported to insure an equal distribution of load on each of the races.

Our invention further consists of a novel construction of a braking mechanism, which is arranged to act on the bottom face of the bowl since at this point the lateral vibrations of the bowl have no effect upon the operation of the brake, and to avoid the possibility of lifting the bowl off its driving spindle by an excessive pull on the brake lever, we have designed a novel construction of a yielding spring and its adjuncts which is provided between the lever rod-shaft so as to limit the lifting force, said lever being loose on the shaft to which the spring hub is pinned, said brake mechanism being provided with a novel cam control to be hereafter referred to.

Our invention further consists of novel means for changing the speed of the bowl, when a one speed motor is used, which comprises easily removable pulleys of different diameters, which are bolted to the driving shaft, a slide being provided for the motor on the housing, which slide can be conveniently adjusted, so as to tighten a belt of uniform length for different sized pulleys.

To the above ends our invention consists of a novel construction of a centrifuge which is of large capacity and accomplishes a greater degree of purification than heretofore, and has great flexibility in performance with reference to speed, our novel device being suitable for liquids of almost any viscosity, the bowl being of unusually large size to facilitate long runs without cleaning and by reason of our novel interior construction, there is an exceedingly long travel of the fluid from the inlet to the outlet, and a maximum area of surfaces upon which to deposit impurities is also provided.

For the purpose of illustrating our invention we have shown in the accompanying drawings one form thereof which is at present preferred by us, since the same has been

found in practice to give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which our invention consists can be variously arranged and organized and that our invention is not limited to the precise arrangement and organization of the instrumentalities as herein shown and described.

Figure 1 represents a front elevation of a novel centrifuge embodying our invention.

Figure 2 represents a vertical section on line 2—2 Fig. 1, certain of the parts being shown in elevation.

Figure 3 represents a side elevation of Fig. 2, showing the driving mechanism and adjusting devices therefor.

Figure 4 represents on an enlarged scale, a vertical sectional view of the bowl and its adjuncts seen in Figure 2.

Figure 5 represents a horizontal section on line 5—5 Fig. 4.

Figure 6 represents a horizontal section on line 6—6 Fig. 4.

Figure 7 represents a top plan view of certain parts of the bowl handling mechanism.

Figure 8 represents on an enlarged scale, a vertical sectional view of the driving spindle casing and its adjuncts, the spindle being shown in elevation.

Figure 9 represents on a reduced scale, a side elevation of a modification.

Figure 10 represents a plan view of the brake actuating mechanism, certain parts being shown in section.

Figure 11 represents a side elevation of the handle shown in Figure 10.

Figure 12 represents a side elevation of a spindle substantially the same as seen in Figure 8 but showing a different arrangement of the spring. Figure 13 represents on an enlarged scale, a sectional view of the upper portion of Figure 2 showing certain details omitted from Figure 2, for clearness of illustration. Figure 14 represents a vertical section on line 14—14, Fig. 13. Figure 15 represents a plan view of the bowl lifting fork seen in Figure 2.

In carrying out our invention, we employ a suitable housing 1, having an opening 2 at its lower portion, in which are journalled a pair of lower rollers 3, above which is the bracket 4 which is interiorly threaded and carries the feed screw 5 which is provided with the hand wheel 6, the upper end of said feed screw engaging a boss 7 on the underside of the arm or shelf 8 upon which is supported an electric or other motor 9 which drives the shaft 10 carrying the hub 11 which is permanently keyed to said motor shaft. The pulley 12 is secured to said hub by the bolts 13, so that it will be apparent that said pulley 12 and shaft 10 rotate as a unit, but that said pulley can be readily removed or replaced by removing nuts from said bolts 13. 14 designates idlers which are rotatably mounted on the shafts 15 carried by the brackets 16, as will be understood from Figures 2 and 3. The driving belt 17 is shown dotted as passing around the pulley 12 and thence around the inner juxtaposed peripheries of the idlers 14 and thence around the lower pairs of rollers 3 and thence around the pulley 18 which is fastened on the lower end of the spindle 19, as seen in Figs. 2 and 8. The shelf 8 projects laterally from the slide 19× which is vertically movable in the ways 20, as will be understood from Fig. 7, so that it will be apparent that by rotating the hand wheel 6, the feed screw 5 can be adjusted upwardly and downwardly, together with the shelf 8, motor 9 and pulley 12, so that the tension of the belt 17 can be readily adjusted according to requirements.

By our novel construction, we can remove the nuts on the bolts 13, seen in Fig. 2, and quickly replace the pulley 12 with a larger or smaller pulley in a very expeditious and convenient manner, and it will be apparent that one length of belt 17 will suit all requirements, since the motor is supported upon the vertically adjustable shelf 8, which has a sufficient range of vertical adjustments so as quickly to increase or decrease the tension on the belt 17 according to requirements. In practice, the power of the motor 9 and the strength of the belt 17 are such that the bowl 21 hereafter to be referred to in detail, is quickly brought up to the desired speed, and by our novel construction of braking mechanism, to be hereafter referred to, acting on the bottom surface of the bowl, where there is the least vibration, the bowl can be quickly brought to a stop.

Referring now to the lower portion of Figs. 2 and 8, it will be seen that the spindle 19 comprises the lower portion 22, and the upper portion 23, which latter is of larger diameter and terminates in the intermediate shoulder 24 which rests upon the collar 25, the lower portion 22 of the spindle passing through the sleeve 27. 28 designates a cup shaped receptacle which surrounds the lower portion of the sleeve 27 and is provided with the oil chamber 29, having the outlet pipe 30 leading therefrom, whereby lubricant is conveyed outwardly from said cup 29 and the chamber 31 above it. The lubricant enters through the pipe 26, flows past the ball bearings 34, surrounding the portion 35, and thence into the chamber 33, and downwardly past the ball bearings 32 which surround the sleeve 27. The member 28 is secured to the shell or casing 36 by screws or fastening devices 37 and the top of said casing 36 is closed by the cap 38, bolted thereto. 39 designates a spring contained in the chamber 40, the upper end of said spring bearing on the underside of the cap 38, and the lower end of said spring bearing upon the collar 41, into which the lower end of the casing mem-

ber 42 extends, the upper end of said casing 42 being enlarged to receive the ball bearing 34 and being provided with the cover 44 secured thereto by screws or fastening devices 45, as seen in Fig. 8. The upper end of the spindle 19 is provided with a head 46, which carries the pins 47, which engage the seats 48 in the bottom 49 of the bowl, 21, said upper spindle head 46 being positioned in the seat 50 of the lower head 49 of the bowl, as will be understood from Figs. 4 and 8. The bowl 21 will next be described in detail, said bowl appearing exteriorly, as seen in Fig. 2, and interiorly, as seen in Fig. 4.

Our novel bowl 21 is composed of a lower disk member 51 in the outer portion of which is seated the lower end of the bowl casing 52, the upper end of said casing being confined within the pendent annular flange 52× of the top disk 53, which is provided with the upper outer tubular extension 54. 55 designates a lower disk positioned above the disk 51 against the outer periphery of which disk 55 is secured the lower end of the inner concentric shell 56, the upper end of the latter being secured to the inner wall of the pendent annular ring 57, which is preferably integral with the disk 53.

58 designates an inner cylinder or shell, whose upper edge is suspended from or secured to the underside of the disk 53, as indicated at 59, in Fig. 4. 60 designates an inner elongated cylinder or tubular shell, whose upper end is secured to the nipple 61 and whose lower end is secured in the lower disk 55, said cylinder 60 being imperforate throughout. The disk 55 is supported above the lower disk 51 in such a way that well defined passages 62 are formed for the travel of the liquid which is to be treated. 63 designates an intake funnel which has a pendent outlet pipe 64, which discharges into the central chamber 65 of the inner cylinder 60, the liquid passing downwardly therein through the passages 62, and thence upwardly into and through the annular outer chamber 66, to the upper ports 67, after which the fluid passes downwardly into and through the chamber 68, into and through the ports 69, and thence upwardly through the chamber 70, through the elongated narrow chamber 71 out through the outlet passages 72, the heavier products passing into the chamber 73, seen in Fig. 2, and being conducted therefrom by the spout 74, while the lighter products pass into the chamber 75 and are conducted therefrom by the spout 76. For convenient handling of the top covers in the cleaning of the spouts, the covers are made in sections, the chamber 73 and its spout 74 being carried by the casing member 77, which is seated at the point 78× upon the top of the outer casing 1. The upper chamber 75 and its spout 76 are carried by the casing member 78, whose bottom periphery fits within and is seated upon the top of the casing member 77, as will be understood from Fig. 2. The top covers or members 77 and 78 are made of maximum size with spouts in proportion to suit fluids with very high viscosity. In cases where a vapor-proof connection between the cover and the tank is desired, the top cover may be completely closed, or in one piece, as seen at 82, in Fig. 9, and provided with a regulating valve 79 having a metal hose conduit 80 leading thereto and a wing nut 81 positioned below said valve to facilitate convenient disconnection of the parts.

It will be apparent that in our novel construction of bowl, as seen in Fig. 4, the basic principle thereof embodies the provision of a maximum or exceedingly long travel of the fluid from the inlet pipe 64 to the outlet points 72, which in practice is about 100″ and we further provide unusually large surfaces, upon which the impurities are deposited. The construction seen in Figures 4 to 6 is especially applicable for handling varnishes and similar compositions of matter.

It will be apparent that the upper portion of the bowl and its adjuncts as well as the covers therefor may be supported and packed and the lower bowl section detachably secured or mounted upon the top of the housing 1 in any suitable manner and that various devices may be employed for holding the lower cover in assembled position with respect to the housing. In Figures 13 and 14, we have shown a preferred form of these mechanisms which will function satisfactorily in practice, wherein we have shown in detail certain mechanisms which have been omitted from the other views for the sake of clearness and illustration.

Referring now to the upper portion of Figure 13, 83 designates an inturned, bottom, peripheral, lip or annular hook on the lower cover section 77 which is engaged by the upper hooked end 84 of the spring or strip 85, whose lower end as 86 is secured to the lateral hub or head 87, which has the pendent integral handle 88 seen in Figures 13 and 14 which terminates in the slotted portion 89 whereby said handle can be readily manipulated. The strip 85 bears against the inner periphery of the stop or pin 90, so that when the handle portion 89 is lifted to the right of the position seen at the right of Figure 13, the hook 84 will tend to disengage from or ride out of the annular lip or hook 83, so that the cover section 77 can be readily lifted from its seat 78×, there being a plurality of said hooked springs 85 employed. The hub member 87 is eccentrically mounted on the pin 91, whose ends are positioned in the plates 92 as seen in Figure 14 so that it will be apparent that when the hub member 87 is rotated by the handle 89, an eccentric movement will be imparted thereto as will be understood from

Figures 13 and 14, which will effect the ready disengagement and the quick interlocking of the parts 83 and 84 according to requirements. In order that the spring or strip 85 and the hub 87 may be frictionally retained in the various extreme or intermediate positions, the handle 88 may assume, we locate in the bore 93 of the hub 87 the spring pressed braking members 94, having the juxtaposed chambers 95 therein, within which is contained a spring 96, whose function is to press the braking members 94 away from each other or outwardly against the contiguous surfaces of the plates 92, so that the hub 87 will be frictionally retained at all times in the desired position when the handle 88 is released, as will be apparent from Figure 14.

From the foregoing construction it will be apparent that we have provided an efficient and conveniently manipulated means for retaining the lower cover section 77 in locked or assembled position upon the top of the housing 1 and that by a short or quick movement of the handle 88, the locking hooks 84 can be readily detached from the annular, bottom peripheral lip or flange 83. In order efficiently to pack the upper portion of the extension 54 and to provide a suitable bearing for steadying the upper portion of the bowl, we employ the pendent ring member 97, which depends from the bottom wall 98 of the cover member 77, to the lower portion of which is screwed the nut 98×, which retains the gland 99 in position, there being an inverted U shaped packing 100 interposed between the cylindrical portion of said gland and the sleeve or ring member 101. It will of course be apparent that other packing and guiding devices for steadying the upper portion of the bowl may be employed, but the construction seen in Figure 13 will be found to operate with great efficiency.

By this construction it will be further seen that the intermediate portion of the extension 54 or the upper portion of the bowl 21, seen in Figures 2 and 13 is effectively guided and steadied during its rotation.

The braking mechanism will next be described, reference being had to Figures 2, 7, 10 and 11. Referring first to Figure 7, 102 designates an arc shaped plate best seen in Figures 2 and 7, having holes 103 therein, which are engaged by pins 104, which carry the brake shoe 105. 106 designates a rock shaft which extends transversely through the lower portion of the housing 1 and having its ends mounted therein as will be understood from Figure 10, said shaft carrying the rock arm 107, which bears on the under side of the brake shoe 105. On the outer end of the shaft 106 is loosely mounted the hub 108 of the brake lever 109, which has a handle 110 at the extremity thereof. 111 designates a hub pinned to the shaft 106 and carrying the spring 112, whose outer end is confined between the pins 113. It will be apparent from the foregoing, that by our novel construction, we avoid the possibility of lifting the bowl 21 off its driving spindle by pulling too hard on the brake lever 109 since the yielding spring 112 limits the lifting force, the lever 109 being loose on the shaft, while the spring hub 11 is pinned thereto.

It will be further apparent that our novel brake is arranged to act on the bottom face of the bowl, since at that point any lateral vibration of the bowl will have no effect upon the brake and by our novel construction all liability of lifting the bowl off its driving spindle is obviated. The mechanism for lifting the bowl from its driving spindle will next be described, reference being had to Figures 2, 7 and 15. 114 designates a door at the front of the centrifuge, whose extent will be understood from Figure 1, which is provided at its upper portion with the strap 115, which encircles the bowl 21 and is positioned just below the flange 52× thereof, said door being provided with any suitable locking or fastening device 116. 117 designates a forked lever fulcrumed at 118, and provided with the arms 119, which are adapted to engage the oppositely disposed notches 120, seen in Figure 2, the outer end 121 of said lever being engaged by the bottom face of the cam 122, which is integral with the cam lever 123, so that when the latter is raised from the position seen in Figure 2, said cam face will depress the outer end 121 of said lever and elevate the inner ends 119 of the lever 117, so that said ends will engage the notches 120 and lift the bowl 21 out of engagement with its driving spindle 19. Since the forked lever 117 and the cam lever 123 all move or can be swung outwardly as a unit with the door, it will be apparent that when the bowl is raised out of engagement with the driving spindle, the door, bowl and levers can be swung outwardly or laterally, so that the parts now appear as seen in the lower right hand portion of Figure 7. In this position a spanner wrench 124, as indicated in dotted lines in Figure 7 can be readily applied to the notches 125 of the disc or cover 53 so that the latter can be readily unscrewed from the position seen in Figure 13. It will of course be understood that the top covers 77 and 78 are first removed prior to the operation of the front cam lever 123 to lift the bowl after which the door 114 can be readily opened with the bowl securely supported on the forked lever 117, whereby the bowl is prevented from turning when the spanner wrench 124 is applied to unscrew the top disk or cover 53 of the bowl. It will be understood that our novel bowl is too heavy to be lifted by hand when assembled upon its spindle and we consequently by our novel arrangement of forked lever 117 and cam lever 123 carried by or upon the door 114

provide a novel and efficient means, whereby upon the removal of the covers 77 and 78, the bowl can be instantly lifted or disengaged from its driving spindle and then swung to one side into an accessible position for cleaning, as seen in Figure 7. It is also a feature of great importance in the practical operation of the device to retain the bowl when in open and accessible position from rotation by locking the same so that the wrench 124 can be applied to the upper notches 125 to unscrew the cover 53, which is effected by the engagement of the arms 119 with the notches 120, as will be understood from Figure 2.

It will be apparent that the components of our novel bowl can be assembled and correlated in various ways, but we preferably cause the bottom ends of the outer bowl casing 52 and the inner cylinders, which compose the annular compartments to be welded or similarly secured to their bottom supports, while the top cover 53 is preferably in threaded engagement with the top of the casing and when tightened in place, serves to center and secure in position certain of the upper ends of the cylinders, so that a symmetrical and balanced bowl structure is produced, and further by our novel construction, upon the removal of said top cover, all the compartments within the bowl are instantly accessible for cleaning.

In Figure 12 we have shown an alternative manner of mounting the driving spindle 19, wherein substantially the same constructions of driving spindle and upper and lower ball races are shown, as were described in reference to Figure 8; in Figure 12, the arrangement and allocation of said ball races, the spring and their adjuncts being slightly different from the arrangement and construction seen in Figure 8. In Figure 12, 126 designates a spindle housing which is provided in its lower portion with a shoulder 127 upon which the outer portion of the ball race 32 rests, the inner portion thereof resting upon the sleeve 128 above which is the collar 129 provided with the flange 130 bearing on said ball race 32. The shoulder or flange 24 of the spindle 19 bears upon the top of said collar 129. The lower end of the spring 131 bears on the top of the ball race 32 and on its upper portion is supported the sleeve 132 upon the upper end of which is supported the upper ball race 34. The lubricant is introduced to the spindle bearing in the construction shown in Figure 12 through the upper pipe 26 and after flowing downwardly leaves the oil pocket 133 through the pipe 30 as already described. The upper shoulder 134 of the spindle 19 contacts with the top of the ball race 34 in both the constructions seen in Figures 8 and 12. The top of the housing 126 is closed by the cover plate 135. The construction seen in Figure 12 is composed of somewhat fewer parts than the construction seen in Figure 8 and under certain conditions may be preferable to the construction seen in Figure 8. It will be evident that the spindle 19 seen in Figure 12 is supported by two sets of ball races and that the weight of the spindle in the upper ball race 34 is effectively cushioned by the spring 131 so as to assure a predetermined distribution of load on each of the ball races 34 and 32.

The operation is as follows:

The parts in assembled position are substantially as seen in Figures 2 and 13. By the rotation of the pulley 12, power is transmitted to the pulley 18 of the driving spindle and by manipulating the hand wheel 6 the shelf or support 8 can be quickly raised or lowered so that the belt 17 can be tightened to the requisite extent. By removing the nuts 13 the pulley 12 can be interchanged with a larger or smaller pulley according to requirements and the same length of belt can be used with varying sizes of pulleys by means of the provision of the adjusting feed screw 5, the adjustment of the belt 17 being quickly and readily effected, as is evident. Since the upper end of the spindle 19 is interlocked with the lower end of the bowl 21, it will be apparent that said bowl and its adjuncts can be rotated with great rapidity and the fluids to be clarified will travel through the bowl in the direction indicated by the arrows in Figure 4. The liquid which is being clarified will have its exit through the opening 72 and will pass into the lower cover section 77 and flows therefrom through the spout 74 and any overflow will flow through the opening 75× into the pan or chamber 75 and out through the spout 76 to the desired point. After a run has been completed the operator actuates the brake handle 110, whereby the rock shaft 106 is actuated and the brake shoe 105 is raised by the rock arm 107 into contact with the bottom of the bowl 21 and the rotation thereof is stopped in a short period of time. When it is desired to have access to the interior of the bowl the cam lever 123 seen in Figure 2, is lifted, thereby elevating the inner ends 119 of the forked lever 117 into the notches 120, whereupon the bowl is lifted or elevated out of engagement with the top end of the driving spindle 19. The door 114 is then swung from the position seen in Figure 2 to the position seen in Figure 7, and as will be apparent, the bowl is then readily accessible. The arms 119 of the lever 117, engaging the notches 120 in the bottom of the bowl thereof prevent any rotary movement while the cover 53 is being unscrewed by the application of a spanner wrench, or the like, thereto, as indicated in dotted lines in Figure 7. The hooks 84 seen in Figure 13 normally hold the lower cover section 77 in position upon the top of the housing but upon the actuation of the handles 88 seen in Fig-

ures 1 and 13, the hooks 84 are readily disengaged from the annular rim 83, as is evident, whereupon the cover section 77 can be lifted upwardly from the position seen in Figures 2 and 13. It will of course be understood that the cover sections are elevated from the position seen in Figures 2 and 13, prior to the lifting of the bowl from its spindle and the swinging of said bowl with the door 114 laterally.

Having thus described our invention what we claim as new and desire to secure by Letters Patent, is:—

1. In a centrifuge, a housing, a bowl therein, a driving spindle for supporting and rotating said bowl, a door for closing an opening in said housing, and means carried by said door for disconnecting said bowl from said driving spindle.

2. In a centrifuge, a housing, a bowl therein, a driving spindle detachably connected to said bowl and interlocked therewith for rotating the latter, a door for closing an opening in said housing, and means carried by said door for lifting said bowl from said driving spindle and for sustaining said bowl in elevated position during the opening of said door.

3. In a centrifuge, a housing, a bowl therein, a driving spindle detachably connected to said bowl and interlocked therewith for rotating the latter, a door for closing an opening in said housing, means carried by said door for lifting said bowl from said driving spindle and for sustaining said bowl in elevated position during the opening of said door, and means for holding said bowl from rotation during its suspension from said door.

4. In a centrifuge, a housing, a vertically disposed bowl therein, a driving spindle for supporting and actuating said bowl, a door for closing an opening in said housing, and a plurality of levers carried by said door for lifting said bowl from said spindle, one of said levers serving to lock said bowl from rotation by its engagement therewith.

5. In a centrifuge, a housing, a bowl therein, a plurality of covers supported on said housing, spouts leading from each of said covers, a driving spindle upon which said bowl is supported and actuated, interlocking devices common to the lower end of said bowl and the upper end of said spindle, whereby said bowl and spindle are rotatable as a unit, and means carried by the housing and shiftable into position to engage and elevate the bowl thereby to separate the same from the spindle

6. In a centrifuge, a housing, a door closing an opening therein, a bowl rotatably supported in said housing, and means carried by said door for elevating said bowl and for locking said bowl from rotation while in elevated position.

7. In a centrifuge, a housing, a rotatable spindle in the lower portion thereof, a vertically disposed bowl detachably supported on and actuated by said spindle, a door closing an opening in said housing, means carried by said door for elevating said bowl from said spindle, and a removable upper bearing to steady the upper end of said bowl.

8. In a centrifuge, a housing, a rotatable spindle in the lower portion thereof, a vertically disposed bowl supported on and actuated by said spindle, a pulley on said spindle, a slide adjustably mounted on said housing, a motor, motor shaft and pulley supported by said slide, a belt common to said pulleys, and means also carried by the housing for vertically adjusting said slide to vary the tension on said belt.

9. In a centrifuge, a housing, a rotatable spindle in the lower portion thereof, a vertically disposed bowl supported on and actuated by said spindle, a pulley on said spindle, a slide adjustably mounted on said housing, a motor, motor shaft and pulley supported by said slide, a belt common to said pulleys, idlers for said belt, and means also carried by the housing for vertically adjusting said slide to vary the tension on said belt.

10. In a centrifuge, a housing, a rotatable spindle in the lower portion thereof, a vertically disposed bowl supported on and actuated by said spindle, a pulley on said spindle, a slide adjustably mounted on said housing, a motor, motor shaft and pulley supported by said slide, means for detaching said pulley from said motor shaft, rollers journalled in the lower portion of said housing in proximity to said spindle pulley, idlers carried by said slide, a belt common to said pulleys and passing over said idlers and rollers, and a manually operated feed screw also supported by the housing for vertically adjusting said slide and its adjuncts to vary the tension on said belt.

11. In a centrifuge, a vertically disposed bowl, a driving spindle engaging the lower end of the bowl, a housing for the bowl and spindle, an upper and lower set of ball races for the spindle, and a spring support positioned within said housing for one of said races to ensure a predetermined distribution of load on each of said races.

12. In a centrifuge, a vertically disposed bowl, a driving spindle therefor, interlocking devices for the bottom of said bowl and the top of said spindle, an upper and lower set of ball races for said spindle, and a spring support for one of said ball races to ensure a predetermined distribution of load on each of said races.

13. In a centrifuge, a housing, a bowl having oppositely disposed notches on its lower portion, a forked lever adapted to engage said notches for lifting said bowl, a door for said housing on which said lever is mounted,

a cam lever also carried by said door for actuating said forked lever, and a removable cover for the top of said bowl in threaded engagement therewith.

14. In a centrifuge, a housing, a bowl therein, a door for said housing, a driving spindle for said bowl, and means pivotally mounted on said door for lifting said bowl from said driving spindle.

15. In a centrifuge, a housing, a bowl therein, means for rotating said bowl, a brake shoe in proximity to the bottom of said bowl for directly engaging said bowl, guiding means for said brake shoe, and a manually operated lever carried by the housing for actuating said brake shoe.

16. In a centrifuge, a housing, a bowl therein, means for rotating said bowl, a brake shoe in proximity to the bottom of said bowl for directly engaging said bowl, a rock shaft mounted in the lower portion of said housing, means on said rock shaft for actuating said brake shoe, a brake lever loosely mounted on said shaft, projections on the end of said lever, and a spring having one end positioned between said projections and its other end fast to said shaft whereby the lifting force of said lever is limited.

17. In a centrifuge, a housing, a cover therefor, having a lower, annular inwardly deflected, peripheral rim, oppositely located strips having hooks at their upper ends adapted to engage said rim, rotatable hubs to which the lower ends of said strips are attached, handles for said hubs, and supports for the latter carried by said housing.

18. In a centrifuge, a housing, a bowl therein, means for rotating said bowl, a brake shoe in proximity to the bottom of said bowl, a rock shaft mounted in the lower portion of said housing, means on said rock shaft for actuating said brake shoe, a brake lever loosely mounted on said shaft, projections on the end of said lever, and a spring having one end positioned between said projections and its other end fast to said shaft whereby the lifting force of said lever is yielding and thus limited, said braking devices being adapted for directly engaging and frictionally retarding the rotation of the bowl.

19. In a centrifuge, a housing, a bowl therein, comprising an outer casing containing concentric chambers, means for causing the material to be clarified to pass longitudinally through said chambers in opposite directions, a lower disc for said bowl having oppositely positioned notches for engagement with a lifting mechanism, means co-operating with the housing and bowl for lifting said bowl and locking it against rotation, an upper removable cover for said bowl and means on said cover for enabling the bowl to be rotated.

20. In a centrifuge, a housing, a rotatable bowl therein, having annular compartments therein, means for causing the material to be clarified to traverse said compartments in opposite directions, means co-operating with the housing and bowl for lifting said bowl and for moving it laterally, a cover for said bowl and means for holding said bowl from rotation, during the removal of said cover.

21. In a centrifuge, a housing, a driving spindle in said housing, spaced bearings for supporting said spindle in the housing, means for insuring a predetermined distribution of the load on each of said bearings, means for rotating said spindle, a vertically disposed rotatable bowl supported by and interlocked with said spindle for rotation thereby and comprising a plurality of longitudinally extending intercommunicating chambers, the inlet of one of the chambers being above the top of the bowl and the outlet therefrom adjacent to the bottom of the bowl and the outlet from the bowl being adjacent to the top of the bowl, a plurality of superimposed chambered and spouted covers for said housing one in communication with the outlet from the bowl and in communication with a companion cover, means carried by the housing for elevating the bowl relatively to the spindle and for supporting it against rotation for lateral movement, and means co-operating with the bottom of the bowl for braking it without displacing the same relatively to its rotating means.

22. In a centrifuge, a housing, a driving spindle in said housing, spaced bearings for supporting said spindle in the housing, means for insuring a predetermined distribution of the load on each of said bearings, means for rotating said spindle, and comprising a motor, and means carried by the housing for supporting it, a vertically disposed rotatable bowl supported by and interlocked with said spindle for rotation thereby and comprising a plurality of longitudinally extending intercommunicating chambers, the inlet of one of the chambers being above the top of the bowl and the outlet therefrom adjacent to the bottom of the bowl and the outlet from the bowl being adjacent to the top of the bowl, a plurality of superimposed chambered and spouted covers for said housing one in communication with the outlet from the bowl and in communication with a companion cover, means carried by the housing for elevating the bowl relatively to the spindle and for supporting it against rotation for lateral movement, and means co-operating with the bottom of the bowl for braking it without displacing the same relatively to its rotating means.

23. In a centrifuge, a housing having a swinging door, a driving spindle in said housing, spaced bearings for supporting said spindle in the housing, means for insuring a predetermined distribution of the load on each of said bearings, means for rotating said spin-

dle and including a motor, means supported by and shiftable relatively to the housing for supporting said motor, means for shifting said shiftable means, a vertically disposed rotatable bowl supported by and interlocked with said spindle for rotation thereby and comprising a plurality of longitudinally extending intercommunicating chambers, the inlet of one of the chambers being above the top of the bowl and the outlet therefrom adjacent to the bottom of the bowl and the outlet from the bowl being adjacent to the top of the bowl, a plurality of superimposed chambered and spouted covers for said housing one in communication with the outlet from the bowl and in communication with a companion cover, means for securing said covers to the housing, means carried by the housing for elevating the bowl relatively to the spindle and for supporting it against rotation for lateral movement with the door, and means co-operating with the bottom of the bowl for braking it without displacing the same relatively to its rotating means.

24. In a centrifuge, a housing, a rotatable bowl in the housing, means for supporting it, means for rotating it, and means co-operating with the housing for separating the bowl from its supporting means and shifting it laterally out of the housing.

25. In a centrifuge, a housing, a rotatable bowl in the housing, means for supporting it, means for rotating it, means carried by the housing for separating the bowl from its supporting means and shifting it laterally out of the housing, and means also carried by the housing for locking the bowl against rotation when separated from its supporting means.

26. In a centrifuge, a housing, a rotatable bowl in the housing, means for supporting it, means for rotating it, means within the housing for separating the bowl from its supporting means, and means located exteriorly of the housing for operating said separating means.

27. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl, and means carried by the housing for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing.

28. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle interconnected with the lower end of the bowl, and means carried by the housing for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing.

29. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl, means carried by the housing for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing, and means also carried by the housing for locking the bowl against rotation when separated from its supporting means.

30. In a centrifuge, a housing having a door provided with bowl-supporting means, a rotatable bowl in said housing, means for supporting the bowl in the housing, means for rotating it, manually operative supporting means for the bowl and effective to separate the bowl from its housing supporting means thereby to permit it to be supported by the door for movement with the door.

31. In a centrifuge, a housing having an opening, a rotatable bowl in said housing, means for supporting the bowl in the housing, means for rotating it, and means carried by the housing for separating the bowl from its housing supporting means and supporting it for swinging movement through said opening.

32. In a centrifuge, a housing having an opening, a rotatable bowl in said housing, means for supporting the bowl in the housing, means for rotating it, means carried by the housing for separating the bowl from its housing supporting means and supporting it for swinging movement through said opening, and means also carried by the housing for locking the bowl against rotation when separated from its housing supporting means.

33. In a centrifuge, a housing having a door, a bowl in said housing, means for supporting and rotating said bowl in the housing, and means carried by the door for separating the bowl from its supporting and rotating means whereby the bowl is shiftable with the door.

34. In a centrifuge, a housing having a door, a bowl in said housing, means for supporting and rotating said bowl in the housing, means carried by the door for separating the bowl from its supporting and rotating means whereby the bowl is shiftable with the door, and means also carried by the door for locking said bowl against rotation when separated from its supporting and housing means.

35. In a centrifuge, a housing having a swinging door, a rotatable bowl within the housing, means connected with the bowl for supporting and rotating it, means for separating the bowl from its supporting and rotating means and for supporting it in position to be shifted with the door, and means carried by the door for positioning the upper end of the bowl.

36. In a centrifuge, a housing, a bowl supported and rotatable therein, a lever adapted to engage and interlock with said bowl for lifting the bowl, swinging means carried by the housing on which said lever is mounted and a cam lever also carried by said swinging means for actuating said first lever.

37. In a centrifuge, a housing, a bowl, means for supporting the bowl, means for

rotating it, means adapted to engage and separate said bowl from its supporting means, and swinging means carried by the housing on which said bowl separating means is mounted.

38. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl for supporting it, means for rotating the bowl, means carried by the housing for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing, spaced bearings for said spindle, and means for admitting oil to and from the outside of the housing to said bearings.

39. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl for supporting it, means for rotating the bowl, means for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing, spaced bearings for said spindle and a spring for cushioning the spindle thereby to insure a predetermined distribution of the load on each of the bearings.

40. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl, means for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing, and means shiftable with the bowl for braking the bowl.

41. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl, means for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing, and means for engaging the bottom of the bowl and shiftable therewith for braking it.

42. In a centrifuge, a housing, a rotatable bowl in the housing, a rotatable spindle connected with the bowl, means carried by the housing for separating the bowl from the spindle and supporting it separated therefrom for movement into and out of the housing, means for rotating the spindle and comprising a motor, a sliding support therefor carried by the housing, and means for adjusting said support relatively to the housing.

43. In a centrifuge, a housing, a rotatable spindle, a vertically disposed bowl detachably supported and actuated by said spindle, means for separating the bowl from the spindle, and an upper bearing for steadying the upper end of the bowl.

44. In a centrifuge, a housing, a rotatable spindle, a vertically disposed bowl detachably supported and actuated by said spindle, said bowl having an upwardly extending tubular extension, and an upper bearing co-operating with said extension for steadying the upper end of the bowl.

45. In a centrifuge, a housing, a rotatable spindle, a vertical bowl detachably supported and actuated by said spindle, said bowl having an upward tubular extension, a removable chambered and spouted cover for said bowl, and means carried thereby and co-operating with the tubular extension for steadying the bowl.

46. In a centrifuge, a housing, a rotatable bowl supported therein and having a plurality of longitudinal chambers, a plurality of superimposed chambered and spouted covers for the housing, and means for clamping said covers to the housing.

47. In a centrifuge, a housing, a plurality of superimposed chambered and spouted covers for the housing, means for clamping the lower of said covers to the housing, and comprising an inturned annular hooked lip on the lower cover, a series of hook members pivotally supported around the housing, and means for swinging said hook members into and out of engagement with the hooked lip.

48. In a centrifuge, a housing, a plurality of superimposed chambered and spouted covers for the housing, means for clamping the lower of said covers to the housing and comprising an inturned annular hooked lip on the lower cover, a series of spring formed hook members pivotally and eccentrically supported around the housing, and means for swinging said hook members into and out of engagement with the hooked lip.

49. In a centrifuge, a housing, a plurality of superimposed chambered and spouted covers for the housing, means for clamping the lower of said covers to the housing and comprising and inturned annular hooked lip on the lower cover, a series of spring-formed hook members pivotally and eccentrically supported around the housing, handles for swinging said hook members into and out of engagement with the hooked lip, and means for maintaining the handles in any desired position.

50. In a centrifuge, a housing, a rotatable bowl therein comprising a lower disk and a top disk having an upward tubular extension, an outer bowl casing carried by said disks, a disk spaced above said lower disk, an inner tubular shell supported by said spaced lower disk and opening therethrough and extending into and spaced from the tubular extension of the top disk, and a shell between said bowl casing and inner tubular shell and having ports therein, and means for directing liquid into the inner tubular shell.

51. In a centrifuge, a housing, a rotatable bowl therein comprising a lower disk and a top disk having an upward tubular extension, an outer bowl casing carried by said disks, a disk spaced above said lower disk, an inner tubular shell supported by said spaced lower disk and opening therethrough and extending into and spaced from the tubular extension of the top disk, and a plurality of shells between said outer bowl casing and said inner tubular shell, one of said shells having

ports adjacent to its upper and lower ends and another of said shells having ports adjacent to its lower end, and means for directing a liquid into the inner tubular shell.

52. In a centrifuge, a housing, a rotatable bowl therein comprising a lower disk and a top disk having an upward tubular extension, an outer bowl casing carried by said disks, a disk spaced above said lower disk, an inner tubular shell supported by said spaced lower disk and opening therethrough and extending into and spaced from the tubular extension of the top disk, and a plurality of shells between said outer bowl casing and said inner tubular shell, one of said shells having ports adjacent to its upper and lower ends and another of said shells having ports adjacent to its lower end, means for directing a liquid into the inner tubular shell, and a plurality of superimposed chambered and spouted covers for said housing, one communicating with the top of the tubular extension and the other communicating with a lower disk.

53. In a centrifuge, a housing, a bowl therein, means for supporting said bowl for rotation, and means carried by the housing for engaging the bottom portion of the bowl for elevating the bowl thereby to separate it from its supporting means.

54. In a centrifuge, a housing, a bowl therein, means for supporting said bowl for rotation, means carried by the housing for elevating the bowl thereby to separate it from its supporting means, and shiftable means also carried by the housing for supporting said elevating means whereby on the shifting of said shiftable means the bowl is shiftable laterally relatively to the housing.

55. In a centrifuge, a bowl comprising an inlet tube, an outer compartment in communication therewith at the bottom of said tube, an intermediate compartment in communication at the top thereof with the outer compartment, and another intermediate compartment in communication at the bottom thereof with said last compartment and in communication with the top of the bowl at the side of said inlet tube.

56. In a centrifuge, a bowl comprising an inlet tube, an outer compartment in communication therewith at the bottom of said tube, an intermediate compartment in communication at the top thereof with the outer compartment, another intermediate compartment in communication at the bottom thereof with said last compartment and in communication with the top of the bowl at the side of said inlet tube, means for rotating said bowl, and means for elevating the bowl from its rotating means.

57. In a centrifuge, a bowl comprising an inlet tube, an outer compartment in communication therewith at the bottom of said tube, an intermediate compartment in communication at the top thereof with the outer compartment, another intermediate compartment in communication at the bottom thereof with the top of the bowl at the side of said inlet tube, means for rotating said bowl, and means for releasing said bowl from its rotating means and positioning it to be shifted laterally away from its rotating means.

58. In a centrifuge, a bowl comprising an inlet tube, an outer compartment in communication therewith at the bottom of said tube, an intermediate compartment in communication at the top thereof with the outer compartment, another intermediate compartment in communication at the bottom thereof with said last compartment and in communication with the top of the bowl at the side of said inlet tube, means for rotating said bowl, means for releasing said bowl from its rotating means and positioning it to be shifted laterally away from its rotating means, and means connected with one of said compartments at the top of the bowl for carrying off the separated fluids.

59. In a centrifuge, a bowl comprising an inlet tube, an outer compartment in communication therewith at the bottom of said tube, an intermediate compartment in communication at the top thereof with the outer compartment, another intermediate compartment in communication at the bottom thereof with said last compartment and in communication with the top of the bowl at the side of said inlet tube, means for rotating said bowl, means for releasing said bowl from its rotating means and positioning it to be shifted laterally away from its rotating means, means connected with one of said compartments at the top of the bowl for carrying off the separated fluids, means effective to change the speed of rotation of the bowl, and means for braking the bowl without the separation thereof from its rotating means.

60. In a centrifuge, a housing, a bowl therein, a plurality of chambered covers supported on said housing, a driving spindle upon which said bowl is supported and actuated, interlocking devices common to the lower end of said bowl and the upper end of said spindle whereby said bowl and spindle are rotatable as a unit, and means carried by the housing for elevating the bowl thereby to separate the same from the spindle.

61. In a centrifuge, a housing, a rotatable spindle, a vertically-disposed bowl detachably supported and actuated by said spindle, a removable pan-formed cover for the housing, and an upper bearing carried at the under side of the pan-formed cover for steadying the upper end of the bowl.

62. In a centrifuge, a housing, a rotatable spindle, a vertically-disposed bowl detachably supported and actuated by said spindle, said bowl having an upwardly-extending tubular extension, a removable cover for said

housing, and an upper bearing carried by and at the under side of said cover and cooperating with said bowl extension for steadying the upper end of the bowl.

63. In a centrifuge, a housing, a rotatable spindle, a vertically-disposed bowl detachably supported and actuated by said spindle, a removable cover for the housing, and an upper bearing carried by the cover at the under side thereof and co-operating with the upper end of the bowl for steadying said bowl.

DUGALD S. PATERSON.
GUSTAV B. PETSCHE.