S. H. HALL.

CENTRIFUGAL MACHINE.

APPLICATION FILED AUG. 6 1921.

1,422,852.

Patented July 18, 1922.

3 SHEETS—SHEET 1.

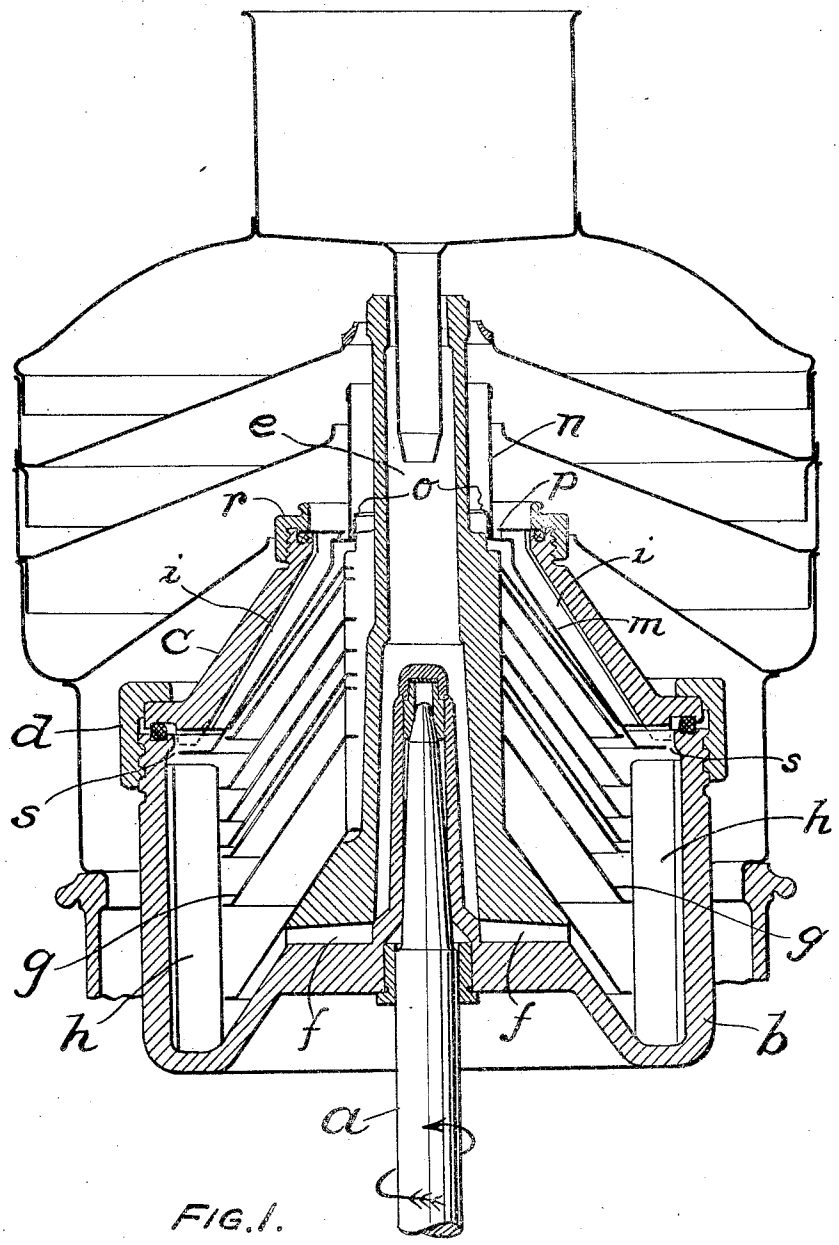



FIG. 1.

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WITNESS:

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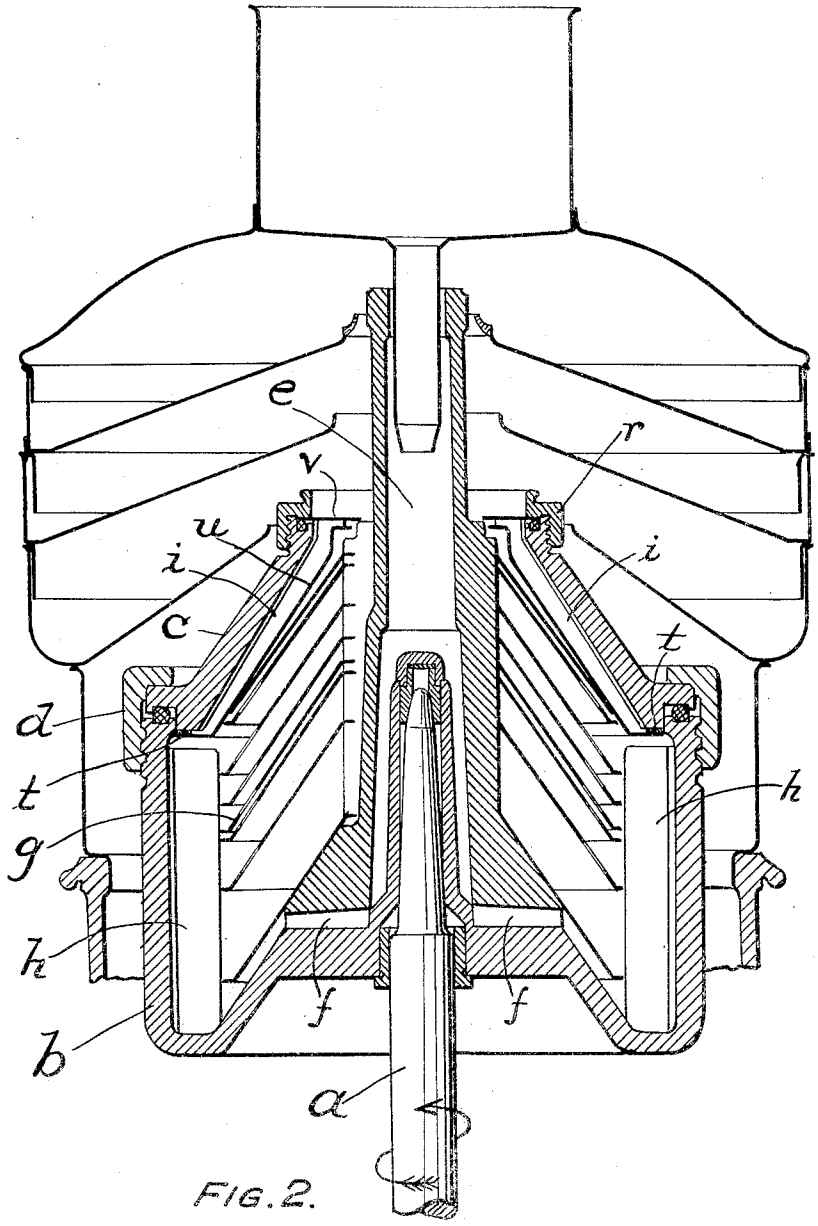



FIG. 2.

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CENTRIFUGAL MACHINE.

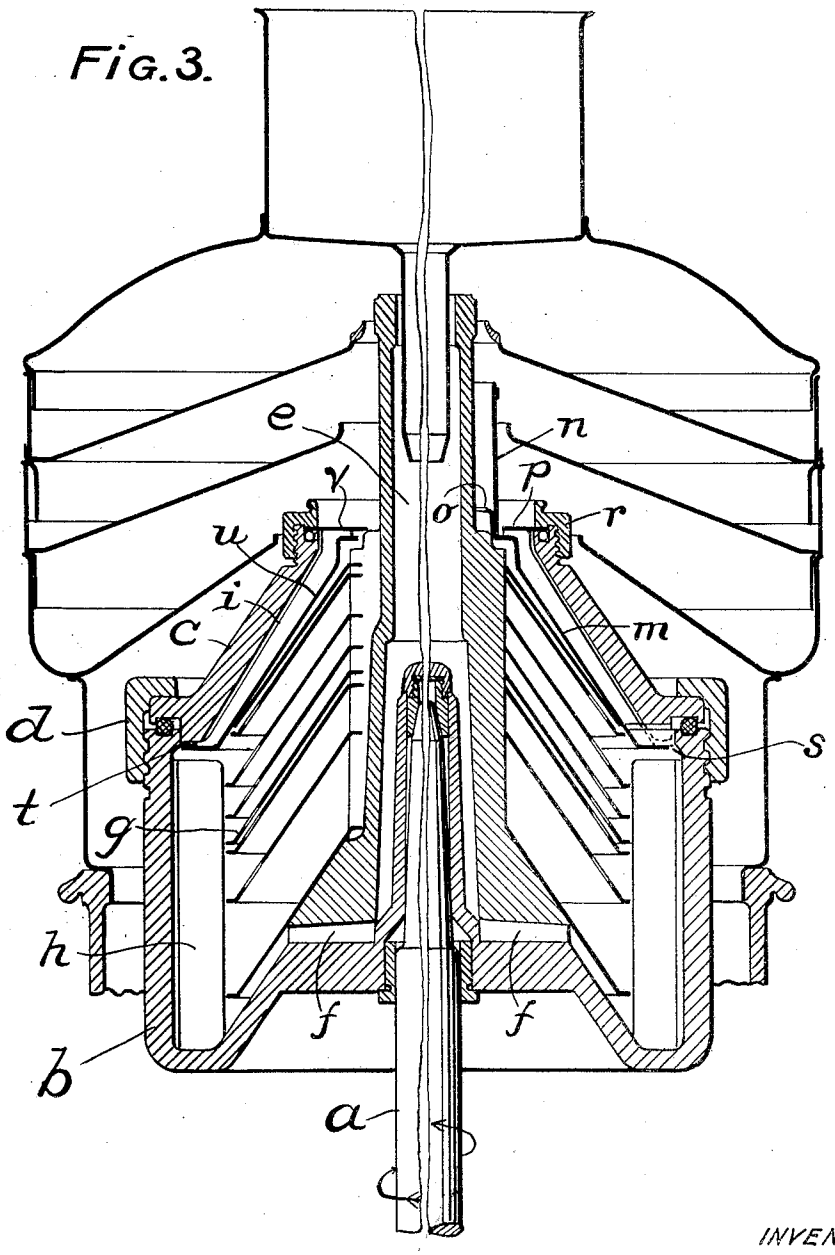
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3 SHEETS—SHEET 3.

Fig. 3.




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# UNITED STATES PATENT OFFICE.

SELDEN H. HALL, OF POUGHKEEPSIE, NEW YORK, ASSIGNOR TO THE DE LAVAL SEPARATOR COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

## CENTRIFUGAL MACHINE.

1,422,852. Specification of Letters Patent. Patented July 18, 1922.

Application filed August 6, 1921. Serial No. 490,376.

*To all whom it may concern:*

Be it known that I, SELDEN H. HALL, a citizen of the United States, residing at Poughkeepsie, county of Dutchess, and State of New York, have invented a new and useful Improvement in Centrifugal Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

The object of my invention is to provide a centrifuge which can be used as a separator for separating two liquids of different specific gravities or as a purifier for separating one liquid from another liquid and a solid, and which can be readily altered to adapt it for use as a clarifier for separating from a liquid a solid or a heavier liquid admixed therewith in very small proportions.

The uses to which my improved convertible centrifuge may be put are of such varied character that it is impossible to specify them all even in general terms. In certain cases the centrifuge may be used for carrying out wholly dissimilar processes that have heretofore been carried out in differently constructed machines. In other cases the centrifuge may be used for carrying out, in the same process, dissimilar steps that have required, or would require, differently constructed machines. One of the uses to which the centrifuge may be put is to carry out a process which comprises subjecting a mixture of a relatively light liquid and a relatively heavy liquid to centrifugal force to separate them, continuously inflowing the fresh mixture while continuously separately drawing off the lighter liquid and the heavier liquid, thereby recovering most of the lighter liquid (which, even in the most efficient separator, will contain a small proportion of the heavier liquid as an impurity), and then subjecting the thus imperfectly purified lighter liquid to centrifugal force, to separate out the remaining fraction of the heavier liquid while continuously inflowing fresh quantities of the partially purified lighter liquid and confining or restricting the heavier liquid from escape so as to build up a surrounding and gradually thickening envelope of the heavier liquid.

While the execution of this process would normally require the use of two bowls—a separator or purifier bowl and a clarifier bowl, I have herein provided means whereby, without substitution of another bowl shell, the centrifuge may be easily converted from one type of bowl to the other. Thereby the foregoing process, as well as other processes, may be carried out in the same centrifuge.

As an example of another process that can be carried out in my improved centrifuge may be mentioned the dehydration of used switch oil, wherein a saponifying agent is added to the oil, the mixture of oil, soap, carbon, dirt and water is subjected to centrifugal force to separate out the oil largely freed of impurities, and the thus separated oil again subjected to centrifugal force to effect its complete dehydration and purification. Such process forms the subject-matter of a pending application filed May 3, 1921 by Cyrus Howard Hapgood, Serial No. 466,496.

In either of the foregoing processes it would be impracticable to carry out the second step of the process in a centrifugal separator (the term "separator" being used in the art to designate that type of centrifuge wherein both the heavier liquid and the lighter liquid are continuously drawn off as they are separated), because a separator is not efficient if the heavier liquid is present in the mixture in a very small proportion. In other words, it is necessary to carry out the second step of each of said processes in a clarifier. By providing means whereby a single bowl is readily transformable, it is clear that one machine may be made to do the work which would otherwise require two machines.

While I have particularly specified two processes, each comprising two steps, as examples of the use to which my improved machine can be put, it is clear that it may also be used in carrying out two separate processes, one of which involves separation or purification and the other of which involves clarification. In industries wherein any two such independent processes are carried out, it is a material economic advantage to be able to carry out both of them by the use of a single machine.

While in order to secure the convertibility desired, it is only necessary to provide readily insertable and removable means whereby the outlet of heavier fluid from the bowl may substantially be prevented (such a

convertible bowl is set forth in the application filed by Cyrus Howard Hapgood May 5, 1921, Serial No. 466,962), it is often desirable, and usually necessary, in order to secure the highest degree of efficiency, to provide a different arrangement of discharge weirs for the lighter liquid in the respective processes of separation or purification and clarification. It is also desirable, when the machine is adjusted for clarification, to take care of possible leakage past the point at which it is intended to block the outflow of heavier liquid and even in some cases purposely arrange for a very restricted outflow of liquid at this point. In my improvement, I provide removable means whereby the discharge weirs will be properly arranged whether the machine be adjusted for one operation or the other and whereby leakage or seepage past the obstruction to outflow of liquid from the periphery will not affect the thoroughness of clarification. I insure the latter result first by providing for thorough separation of any such escaping liquid and either the subsequent return of the separated lighter liquid to the main body of liquid in the bowl or its discharge in a perfectly purified condition.

The nature of my invention will be understood by reference to the accompanying drawings, wherein:

Fig. 1 is a sectional view through one form of bowl when used as a separator.

Fig. 2 shows the bowl when adapted for use as a clarifier; and

Fig. 3 is a comparative view in which the right half shows the bowl adapted for use as a separator, while the left half shows the bowl adapted for use as a clarifier.

In all figures $a$ is the supporting rotary spindle, $b$ the bowl body, $c$ the bowl top, $d$ the ring by which the bowl top is secured to the bowl body, $e$ the central feed tube, $f$ radial channels leading from the central feed tube to the separating space of the bowl, $g$ the liner composed, as usual, of a number of superposed "discs," and $h$ and $i$ vanes or wings for compelling the liquid near the periphery to rotate with the bowl.

In each bowl, there is a top disc above the liner, affording a space between it and the bowl top or cover. In the separator or purifier (Fig. 1) the top disc $m$ is provided with a neck $n$ having an internal discharge weir $o$, while a weir $p$ having a diameter slightly greater than the outside diameter of the neck is secured, by means of the flanged ring $r$, to the upper end of the bowl top. The lower end of the top disc extends substantially outside the liner $g$, overhanging the free space between the liner and the bowl periphery, and terminates a relatively short distance from the bowl's periphery, leaving a space $s$ outside and above its edge around which the heavier liquid escapes into the conduit between the top disc and the bowl top.

To convert the centrifuge into a clarifier, the top disc $m$ and weir $p$ are removed and a top disc $u$ and weir $v$ are substituted, as shown in Fig. 2 and the left hand side of Fig. 3. The weir $v$ is of a diameter not greater than, and preferably the same as, the diameter of the weir $o$ of the neck $n$ of top disc $m$. The top disc $u$ is unprovided with a neck and its central opening is of somewhat greater diameter than that of weir $v$. The lower end of the top disc is provided with a ring or enlargement $t$ which rests against, or closely approximates, the cover of the bowl, thereby blocking or obstructing the outflow of liquid from the peripheral part of the bowl into the space above the top disc.

When the bowl operates as a separator or purifier, the heavier liquid (carrying with it any solids of intermediate specific gravity, if such solids be present in the mixture) flows around the outer edge of the top disc $m$, fills the conduit above the top disc and discharges over the edge of weir $p$ and thence over the neck of the bowl. The lighter liquid is displaced inwardly, flows upward inside the neck $n$ of the top disc $m$ and is discharged over the neck.

When the bowl operates as a clarifier, the relatively small proportion of heavier liquid (with any solids of intermediate specific gravity), or the solids alone if no relatively heavy liquid is present as an impurity, are thrown to the periphery, where they accumulate and form an envelope of gradually increasing thickness. The lighter liquid is discharged over the weir $v$.

If the weir $v$ were omitted from the clarifier, there would be a difference in pressure between the lighter liquid below the top disc and that above it of about thirty-five pounds per square inch. The central hole in the top disc $u$ is purposely cut somewhat larger than the diameter of the weir $v$ so that after the space between the top disc and the bowl top is filled, the flow of the lighter liquid is controlled entirely by the weir $v$ and the pressures on the two sides of the top disc are equal. Any leak of liquid past the outer rim of the top disc $u$ and the ring $t$ will not be, therefore, more than the quantity which can be clarified in the space between the top disc and the bowl top.

If the ring $t$ were omitted, the natural flow through the wide space between the bowl top and the top disc would be more than could be properly clarified. By providing the ring $t$ or some other equivalent means by which the flow from the bowl periphery into the top disc is limited, the flow is reduced to that which can be clarified. When, therefore, I speak of obstructing the flow of liquid around the rim of the top, I mean to include

a case where the flow is restricted as well as a case where the flow is stopped.

As an example of a specific process which may be carried out effectively in my convertible bowl may be mentioned the resolution of an emulsion of oil and water. The emulsion is first run through the machine adjusted for separation, the water being discharged from the periphery and the oil (with a small proportion of water) being displaced toward the center and discharging through the neck of the top disc. The incompletely purified oil is then run through the bowl adjusted for clarification and the water entirely eliminated. The effectiveness of the bowl will be the same whether or not dirt is present in the emulsion.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. A convertible centrifuge comprising a bowl shell, a top disc above the separating space of the bowl, and alternative means one affording a free flow for heavy liquid from the peripheral part of said separating space to the space above the top disc and the other obstructing the flow to said space above the top disc.

2. A convertible centrifuge comprising a bowl shell and two exchangeable top discs each of which spaces the separating chamber of the bowl from the bowl top and within which the relatively light liquid is adapted to flow upward to its discharge, one of said top discs affording a free escape around its outer rim for relatively heavy liquid and the other obstructing said escape, thereby permitting the bowl to operate respectively as a separator or purifier and as a clarifier.

3. A convertible centrifuge comprising two exchangeable top discs one having a neck, and two exchangeable weirs one of which is of larger diameter than the neck of the necked disc and is adapted to be associated therewith to adapt the centrifuge to act as a separator or purifier, while the second weir is of smaller diameter than the first weir and is adapted to be associated with the second top disc to adapt the centrifuge to act as a clarifier.

4. A convertible centrifuge comprising a bowl shell, two exchangeable top discs one having a neck, two exchangeable weirs of different diameters, the weir of larger diameter adapted to be associated with the necked disc and the weir of smaller diameter adapted to be associated with the second top disc, and means adapted to be associated with the second top disc and second weir and acting to obstruct the flow of liquid from the peripheral part of the bowl into the space above the top disc.

5. A convertible centrifuge comprising two exchangeable top discs one having a neck and an interior weir, and two exchangeable weirs one of which is of greater diameter than the neck of the necked disc and is adapted to be associated therewith and the other of a diameter not greater than that of the disc weir and adapted to be associated with the second disc.

6. A convertible centrifuge comprising a bowl shell, two interchangeable top discs, one having a neck and an interior weir, and two exchangeable weirs one of which is of greater diameter than the neck of the necked disc and is adapted to be associated therewith and the other of which is of a diameter not greater than that of the disc weir and is adapted to be associated with the second disc, and means adapted to be associated with the second disc and second weir to obstruct the flow of liquid from the peripheral part of the bowl into the space above the top disc.

7. A convertible centrifuge comprising two exchangeable top discs one having a neck and an interior weir and the other having a central hole, and two exchangeable weirs one of which is of greater diameter than the neck of the necked disc and is adapted to be associated therewith and the other of which is of a diameter not greater than that of the disc weir and less than that of the hole in the second disc and adapted to be associated therewith.

8. A convertible centrifuge comprising a bowl shell, two interchangeable top discs, one having a neck and an interior weir and the other having no neck and a central hole, two exchangeable weirs one of which is of greater internal diameter than the outside diameter of the neck of the first disc and is adapted to be associated therewith and the other of which is of an internal diameter not greater than that of the disc weir and less than that of the hole in the second disc and adapted to be associated therewith, and means adapted to be associated with the second disc and second weir to obstruct the flow of liquid from the peripheral part of the bowl into the space above the top disc.

9. In a centrifugal bowl, the combination with a bowl shell, a central feeding tube and a set of liner discs, of means to adapt said bowl to act as a separator or a clarifier, said means including two interchangeable top discs, one with a neck and one without a neck, a larger diameter discharge ring for use coincident with the disc having a neck and, for use coincident with the disc having no neck, a discharge ring with the same diameter as the discharge weir of the necked disc.

In testimony of which invention, I have hereunto set my hand, at Poughkeepsie, N. Y., on this 28th day of July, 1921.

SELDEN H. HALL.