

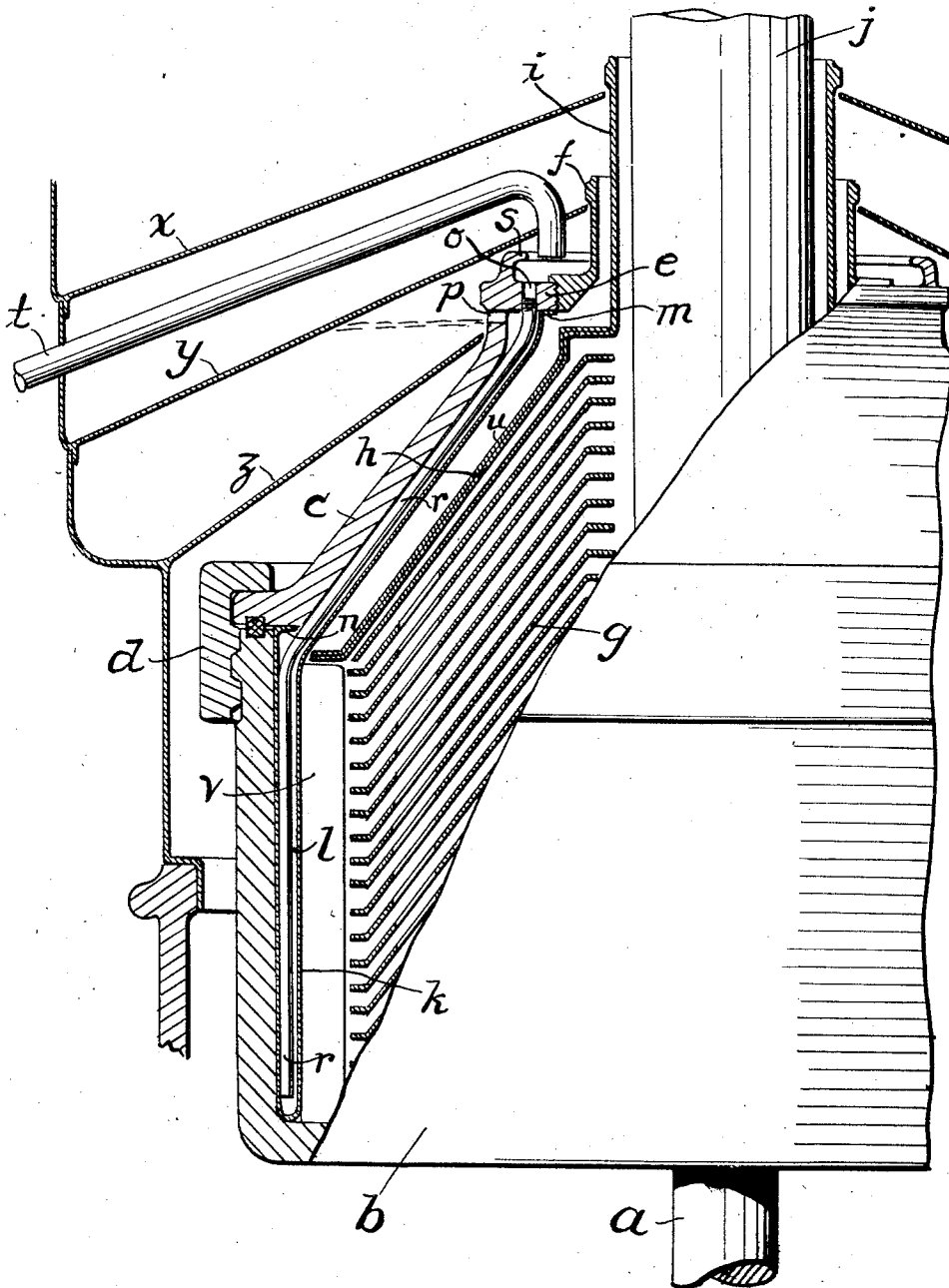
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C. H. HAPGOOD

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MACHINE FOR SEPARATING SOLIDS FROM LIQUIDS

Filed March 25, 1922



INVENTOR

WITNESS:

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MACHINE FOR SEPARATING SOLIDS FROM LIQUIDS.

Application filed March 25, 1922. Serial No. 546,810.

To all whom it may concern:

Be it known that I, CYRUS HOWARD HAPGOOD, a citizen of the United States, residing at Nutley, county of Essex, and State of New Jersey, have invented a new and useful Improvement in Machines for Separating Solids from Liquids, 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.

It is known to effect the separation of two ingredients in solution by reducing the temperature until one ingredient is so far solidified as to throw it out of solution and then to separate the ingredients by filtration, settlement or centrifugal force. Examples of such processes are the separation of amorphous wax (petrolatum) from cylinder oil stock, the separation of crystalline wax (paraffine) from wax distillates, and the separation of stearin from oleo.

The most rapid, efficient, and economical method of separation is by centrifugation, but in certain processes the solidified ingredient does not readily discharge from the bowl but builds up more or less on the periphery of the bowl. Little difficulty in this respect is encountered in the separation of petrolatum from cylinder stock; but in the separation of paraffine wax from wax distillates, it is necessary to blend naphtha with the distillate. The wax will then discharge from the bowl, but each separated ingredient carries out with it a large proportion of naphtha and both ingredients must be distilled to drive off the naphtha. This deleteriously affects the color of the treated material, which must be subsequently filtered to decolorize.

In the separation of stearin from oleo, if the solution is subjected to a temperature sufficiently low to throw the stearin, in a crystallized condition, out of solution, the stearin can be made to discharge from the bowl if there is also introduced into the bowl a heavy cushioning liquid (e. g., water) which, in its discharge, carries with it the crystallized stearin.

In a joint application filed September 8, 1921, by Selden H. Hall and the present inventor, Serial No. 499,325, is set forth a process of centrifuging refrigerated mixtures of the above character, which comprises feeding a liquid heavier than either

of the ingredients to the periphery of the bowl so as to form a surrounding envelope of heavy liquid, and maintaining such heavy liquid at a temperature sufficient to melt the outer layer of solids while not sufficient to melt the inner layer of solids, thereby allowing the melted portion of the heavier ingredient to readily discharge from the bowl. This process I deem a substantial advance in the art, as it is not only operative but efficient; but the specific manner of execution of the process set forth in said application requires the exercise of a fairly high degree of care and skill, the necessity for which is a factor obstructing the commercial success of the process.

The object of the present invention is to provide an improved construction, adapted to carry out an improvement in the Hall and Hapgood process, whereby the liquefaction of the solids adjacent the periphery of the mass of ingredients undergoing centrifugal separation and the discharge of the so liquefied heavier ingredient may be effected without the exercise on the part of the operator of any substantial degree of skill or more than ordinary care.

In the accompanying drawing, the figure is a view of a part of a centrifugal bowl shown partly in elevation and broken away to show the remainder in vertical section: said bowl embodying the present invention.

The bowl shell *b* is driven from the driving and supporting spindle *a*. The bowl top *c* is removably secured to the shell by the flanged ring *d*. The bowl top *c* has an inwardly extending annular flange *e* at its upper end. This flange is threaded to receive a removable necked weir *f*.

Within the bowl is a "liner" *g* comprising a series of frusto-conical "discs." Above the liner is a top disc *h*, which at its upper end, has a neck *i* forming a weir within, spaced from, and concentric to, and extending above, the weir *f*, and without, and concentric to, and spaced from, the feed tube *j*.

Within the bowl and adjacent its inner wall is a heat radiator having a smooth inner surface concentric with the axis of the bowl. The radiator is preferably an annular chamber within which a heating fluid is adapted to circulate. As shown, this chamber is formed from an annulus of sheet metal *k*, the upper part of which is coneshaped to correspond to the taper of the

bowl top and the lower part of which is bent outward and upward. The upper edge of the sheet *k* is flanged at *m* and secured to the inwardly extending annular flange *e* of the bowl top. The opposite edge of the sheet *k* is flanged at *n* and secured to the lower part of the bowl top. Thereby is formed an enclosed chamber or compartment *l* extending entirely around the inside wall of the bowl.

The flange *e* of the bowl top is provided with an orifice *o* for admission of a heating liquid. The bowl top, just beneath the flange *e*, is provided with another orifice *p* for discharge of said liquid. Any suitable means may be provided to insure a circulation of the liquid through the chamber from the inlet *o* to the outlet *p*, as, for example, a pipe *r* extending from the orifice *o* downward to near the bottom of the chamber.

Any desired number of orifices *o* and pipes *r* may be provided.

The inwardly flanged part *e* of the bowl top is provided on its top with a circular ledge *s*, forming a receptacle to receive the heating liquid and convey it through orifice *o* to the heating chamber. A stationary feed pipe *t* for heating liquid discharges into this receptacle.

The top disc *h* is insulated, as, for example, by a layer of "bakelite" *u*, to prevent radiation of heat from the passage above it to the bowl space below it.

The heating chamber preferably carries radial wings or blades *v*, which facilitate rotation with the bowl of its contents.

It is not imperative that the heating chamber shall extend down to the bottom of the bowl. The dimensions of the heating chamber may be varied in accordance with variations in bowl structure and variations in material to be heated; although if it be arranged as shown in the drawings, it will be adapted to practically all materials by regulating the temperature and rate of flow of the heating liquid.

Surrounding the upper part of the bowl are the usual receiving pans down which the separated ingredients flow to spouts or troughs (not shown) leading to portable receiving vessels. In the present construction, there is a set of three pans, *x*, *y* and *z*, the top one being arranged to receive the lighter separated ingredient, the middle one the heavier separated ingredient and the lower one the heating liquid discharged from the heating chamber. It will be observed that this heating liquid will discharge against the floor of the middle pan and therefore somewhat heat the separated heavier ingredient flowing down such floor, thereby still further increasing its fluidity and expediting its discharge through the spouts above mentioned.

Assume that a refrigerated mixture of oil

and crystalline wax is fed through the feed tube *j* into the interior of the bowl and is thence distributed throughout the spaces between the liner discs. Centrifugal force operates to throw the wax outwardly while the oil is displaced inwardly.

It is desirable, if not necessary, to delay admission of heating fluid (say hot water) to the heating chamber until after the bowl has been filled and the materials have been divided, by centrifugal force, into an outer zone of wax and an inner zone of oil. Heat exchange between the hot water and the cold wax melts that part of the wax nearest the wall of the heating chamber so as to render it sufficiently fluid to readily flow out of the bowl through the passage above and outside the top disc *h*, the fluidity of the wax being maintained in this passage by reason of the extension of the radiator thereinto. The oil will flow out through the passage within the neck of the top disc.

By the above means and method of heating the outer zone of the solidified or crystallized heavy ingredient, the temperature of such outer zone may be more easily regulated, the heat will penetrate to a more uniform depth, and the starting of the centrifugal operation is much easier, than if the hot liquid were introduced directly into the bowl space. The present invention also has the advantage that the heavier ingredient is discharged separately and therefore does not have to be subjected to any distilling or other dehydrating process.

If the invention is used in the separation of stearin from oleo, the mixture should be at a temperature of about ninety degrees F. in order to crystallize the stearin. The heating liquid, which may be water, should be at a temperature sufficient to melt the outer layer of stearin but of course not sufficient to melt the inner layer. Stearin melts at a temperature of 122 degrees F. The temperature of the water as it flows into the heating chamber should be about 150 degrees F.

In the case of wax distillates, the melting points of the various waxes vary from 100 degrees to 160 degrees F. The water should be hot enough to melt the wax having the highest melting point and should, therefore, enter the heating chamber at from 160 degrees to 180 degrees F.

It is apparent that the invention is not limited in its application to the separation of wax from mineral oil wax distillates, nor to the separation of stearin from oleo; these two substances of widely different characteristics being cited merely as examples of useful applications of the process. It is clear that the process is applicable to the separation of any solid from a liquid when the solid is capable of being melted.

I am aware that the terms "solid" or "liquid" do not indicate absolute conditions,

but only relative conditions, and that there is an intermediate stage of semi-solidity or semi-liquidity. In speaking, however, of "solids" undergoing separation in the bowl, I mean to imply a condition that is not free-flowing, as otherwise the use of my invention would be unnecessary.

It will be understood that while it is advisable, if not necessary, to maintain the surface opposed to the bowl contents at a substantially constant temperature during any desired operation, it may be necessary, in certain processes, to provide one temperature for one operation and another temperature for another operation, which successive operations may or may not take place without stoppage of the machine. By providing (for example) heating fluids of different temperatures, the surface of the radiator may be maintained at correspondingly different predetermined temperatures.

I do not claim herein the process herein described, as the same forms the subject-matter of a divisional application filed August 3, 1923, Serial No. 655,388.

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

1. The combination with a centrifugal bowl provided with an outlet for the heavier separated ingredient, of a heat radiator extending around the inside of the bowl adjacent its inner wall, said radiator having a smooth inner surface concentric with the axis of the bowl, and means to maintain said radiator at a substantially constant temperature.

2. The combination with a centrifugal bowl provided with an outlet for the heavier separated ingredient, of an annular chamber extending around the inside of the bowl adjacent its inner wall, and means to circulate a heating fluid within said chamber.

3. The combination with a centrifugal bowl comprising a shell and a removable top, of a heat radiator extending around the inside of the bowl and removable, with the top, from the bowl.

4. The combination with a centrifugal bowl comprising a shell and a removable top, of a peripheral heating compartment comprising an annular sheet of material, the upper end of which is secured to the upper part of the bowl top while the lower part of which is bent outwardly and upwardly upon itself and secured at its opposite end to the lower part of the bowl top, thereby forming a closed compartment adjacent the periphery of the bowl.

5. The combination with a centrifugal bowl provided with a discharge for the heavier separated ingredient, the bowl top being provided with an inlet and an outlet at different distances from the bowl axis, of a fluid circulating heating chamber adjacent

the inner wall of the bowl having a flow passage one end of which communicates with said inlet and the other end of which communicates with said outlet.

6. The combination with a centrifugal bowl, of a top disc therein having a neck at its upper end within which the lighter separated ingredient outflows, the bowl top having at its upper end a neck within which the heavier separated ingredient outflows and having also two orifices at different distances from the bowl axis, a fluid circulating chamber adjacent the inner wall of the bowl and having a flow passage communicating at opposite ends with said orifices, and means to feed a heating fluid through the inner of said orifices to said chamber.

7. The combination with a centrifugal bowl provided with a discharge for the heavier separated ingredient, of a chamber adjacent the inner wall of the bowl and having an inlet and an outlet for a heating fluid, a stationary receiving pan having an inclined floor and adapted to receive the discharged heavier ingredient, and means to direct the outflowing heating fluid against the bottom of the floor of said pan so as to impart heat to the downflowing stream of heavier ingredient after it has been discharged from the bowl.

8. The combination with a centrifugal bowl comprising a shell enclosing a separating chamber and a removable top, of heating means stationary relative to the bowl and positioned therein to heat only the outermost zone of material undergoing separation in the separating chamber and carried by, and removable with, the top of the bowl.

9. The combination with a centrifugal bowl comprising a shell enclosing a separating chamber, a removable top, and outlets for the separated ingredients, there being a passage within the removable top for discharging the heavier of the separated ingredients from said compartment to the outlet for such ingredient, of heating means, stationary relative to the bowl, positioned to heat the wall of the separating chamber and the said passage and carried by, and removable with, said top.

10. The combination with a centrifugal bowl comprising a shell enclosing a separating chamber, a removable top, and outlets for the separated ingredients, there being a passage within the removable top for discharging the heavier of the separated ingredients from said compartment to the outlet for such ingredient, of heating means, stationary relative to the bowl, positioned to heat said passage and thereby maintain the fluidity of the heavier ingredient after it is separated and during its travel toward said outlet, said heating means being carried by, and removable with, said top.

11. A centrifuge adapted to the separation of ingredients the heavier of which has been thrown out of solution with the lighter ingredient by refrigeration, the same comprising a bowl provided with a separating compartment, a discharge passage for the heavier ingredient communicating with said compartment adjacent its outer wall, and an outlet for the lighter liquid connecting with said compartment relatively near the axis of the bowl, and heating means, stationary relative to the bowl, positioned at the peripheral part of said compartment and adapted to substantially surround the whole body of liquid and to be maintained at the temperature required to render the outer zone of the heavier ingredient free flowing without reducing the temperature of its inner zone to the degree required to cause it to redissolve in the lighter ingredient.

12. A centrifuge adapted to the separation of ingredients the heavier of which has been thrown out of solution with the lighter ingredient by refrigeration, the same comprising a bowl provided with a separating compartment, a discharge passage for the heavier ingredient communicating with the said compartment adjacent its outer wall, an outlet communicating with said passage, and an outlet for the lighter liquid communicating with said compartment relatively near the axis of the bowl, and heating means, stationary relative to the bowl, positioned at the peripheral part of said compartment and along said discharge passage

and adapted to be maintained at the temperature required to render the outer zone of the heavier ingredient free flowing to facilitate its discharge from the bowl and maintain it free flowing during its travel through said passage to the outlet communicating therewith.

13. A centrifuge adapted to the separation of ingredients the heavier of which has been thrown out of solution with the lighter ingredient by refrigeration, the same comprising a bowl provided with a separating compartment, a discharge passage for the heavier ingredient communicating with the said compartment adjacent its outer wall, an outlet communicating with said passage, and an outlet for the lighter liquid communicating with said compartment relatively near the axis of the bowl, and heating means, stationary relative to the bowl, positioned along said discharge passage and adapted to locally heat said passage so that the heavier ingredient entering therein will be maintained at a sufficiently high temperature to render it capable of flowing freely through the passage and discharging at the outlet communicating therewith without clogging.

In testimony of which invention I have hereunto set my hand, at New York, on this 17th day of March, 1922.

CYRUS HOWARD HAPGOOD.

Witnesses:

R. R. WARREN,
G. D. TALLMAN.