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CENTRIFUGAL SEPARATOR

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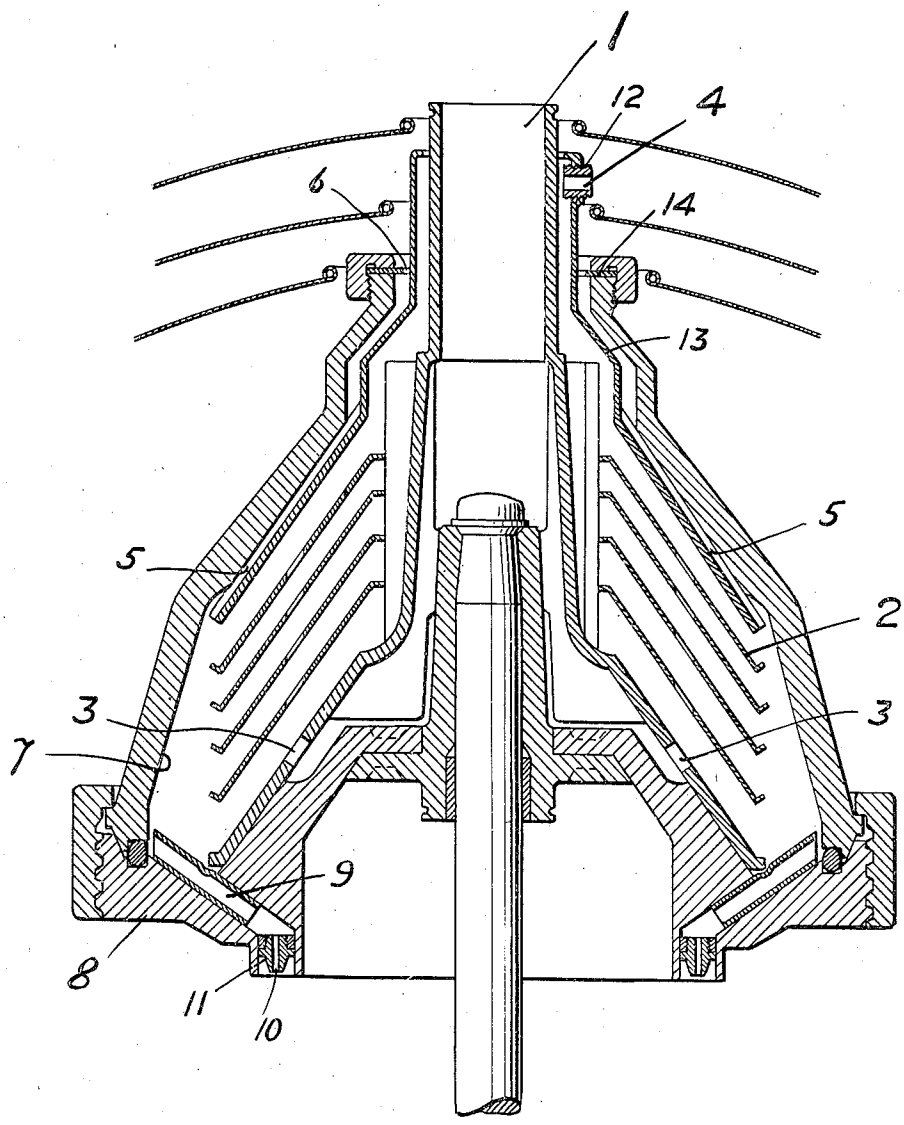

INVENTOR

Hans Olof Lindgren

BY

Bussey and Harding

ATTORNEYS.

WITNESS:

Robt. W. Mitchell.

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UNITED STATES PATENT OFFICE

HANS OLOF LINDGREN, OF APPELVIKEN, SWEDEN, ASSIGNOR TO THE DE LAVAL SEPARATOR COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY

CENTRIFUGAL SEPARATOR

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When centrifugating mixtures of two liquids of different specific gravities in order to separate them and continuously discharge them from the centrifugal bowl, there often accumulates at the bowl wall a layer of solids with higher specific gravity than that of the heavier liquid. With the object of preventing a reduction of the separating efficiency of the bowl resulting from such a deposit of solids, bowls provided with discs are generally provided with an annular space between the bowl wall and the discs, this space being sometimes designated a sludge space. It is necessary to stop the bowl and disassemble it in order to remove the sludge before said space is totally filled, so that the thickening layer of sludge deposits will be prevented from building up in between the discs, which would reduce the separating efficiency of the bowl in a high degree. When liquids containing large amounts of solids are to be treated in such separators, it is generally necessary first to submit the liquids to a pre-cleaning. Usually gravity settling tanks are employed for the purpose, in which tanks the solids deposit under influence of gravity as a bottom layer. It has also been proposed, and to a certain extent practically tried, to remove the coarse impurities by means of slowly rotating centrifuges of great diameter and provided with a large sludge space, and then to feed the liquid pre-cleaned in this way to a centrifuge revolving at a higher speed, in which the impurities which are more difficult to separate are removed.

Wash water from wool washeries may be specified as a specimen of such liquids. Said water contains, besides solid impurities (mainly finely divided sand and clay), waxy and fatty substances, "wool grease", in suspension, of lower specific gravity than the water. By centrifugating in separators similar to cream separators, it is possible to take out from this water, through the inner outlet of the bowl, a liquid mainly consisting of wax and fat. The wash water, more or less freed from fat, is led out through an outlet at a greater distance from the center of rotation. Experience has taught that, even after a gravity settling during a considerable length of time, such wash water contains so large quantities of solid impurities that, after a relatively short run, the bowl must be disassembled for cleaning. It has long been desired to be able to purify the wash water, to which soda and soap are added in order to facilitate the washing, from solid impurities and wax, so that the water, after such a purification, could again be used for washing. At the tests two centrifuges with the necessary pumps have been used in series with the wash apparatus. The wash water from the washer is fed into a slowly rotating centrifuge in which the coarse solid impurities are removed. The wash water, precleaned in this way, is thereupon treated in a separator of the cream separator type with the object of removing the wool grease. Experience teaches, however, that in this way it is not possible to obtain satisfactory results. The installation cost, as well as the working costs, become very high; and, furthermore, the wool grease is split up into such fine particles when the liquid streams out of the first separator that their separation in the second centrifuge is rendered highly difficult.

The object of the present invention is to provide a separator bowl which can be efficiently and economically used for treating a liquid, such as wash water from wool washeries, which is to be freed from lighter as well as from heavier components. The separator bowl is characterized by the fact that it is provided with two series of outlets at suitable distances from the center of rotation, which outlets permit a continuous discharge of two liquids of different specific gravity (in the illustrative case wool grease and wash water), and a third series of outlets communicating with a zone in the neighborhood of the bowl wall. The solid impurities, together with a suitable quantity of wash water, are continuously discharged through the last mentioned outlets. I am aware that it is not new to provide, in a centrifugal bowl, three outlets communicating with the separating space of the bowl at points at different distances from the bowl's axis in order to discharge components of different specific gravities. Such bowls are usually intended to pre-

vent the accumulation on the bowl wall of a more or less viscous relatively heavy constituent, such as wax, which it is desired to separate from a lighter and more freely flowing constituent, such as oil, for which purpose there is introduced a still heavier carrier liquid, such as brine; the three substances being discharged from the bowl through outlets located at progressively greater distances from the center. The more especial object of my invention is to provide a bowl adapted to separate three materials of different specific gravities, the heaviest of which, ordinarily a mixture of solids, tends to accumulate in the bowl wall, and to utilize a part of the material of intermediate specific gravity, ordinarily a free flowing liquid, to wash out the heavier solids. The novel structural combination hereinafter described is more especially adapted to the separation of mixtures of this character, although it is capable of other uses, and it is intended to claim the novel construction irrespective of the uses to which it may be found adapted.

In the drawing, which shows a preferred embodiment of the invention, the figure is a vertical section through the centrifugal bowl.

1 indicates a central distributor into which the mixture to be treated is fed and from which it is led into the pile of discs 2 through distributing holes 3 at a suitable distance from the center of rotation. The liquid constituents divide into two parts between the discs; the lighter one that streams towards the centre of the bowl and is discharged through the outlets 4, and the heavier one that moves towards the periphery of the bowl and is discharged through the channels 5 from the above mentioned sludge space, which channels suitably have the openings 6 at the centre. While the heavy liquid streams outwards, a separation of the lighter components, as well as of the heavier solid impurities, takes place. Most of the solid impurities pass through the liquid layer in the sludge space and hit the bowl wall 7. The bowl wall is shown as conical in the illustration, a wall so shaped facilitating the sliding of the solid impurities down to the bottom of the bowl. In the bowl body 8 are channels 9 leading from the neighborhood of the bowl wall to outlets 10 suitably placed in exchangeable nozzles 11. The openings 10 should be so dimensioned as to prevent an unnecessarily large amount of liquid streaming out with the solid impurities. The solid impurities can be discharged through openings other than the channels 9 shown in the figure. The last mentioned device, is, however, preferred, as it is thereby possible to make the outlet openings for a certain quantity of liquid larger, thus reducing the danger of clogging.

In certain instances it has been found that the separated solid impurities have such a consistency that it is necessary to have transport devices in the bowl to transport the impurities to the zone from where they are discharged from the sludge space; or to transport such impurities, by means of scrapers and other devices, from the sludge space to that part of the bowl from where they are discharged. Such transport devices are known in the art and require no description.

To make it possible to treat, in one and the same separator bowl, different mixtures comprising liquids of various specific gravities and having different proportions of light and heavy components, the bowl should be provided with regulating devices, by which the distance of the outlets from the axis of rotation can be altered. The figure shows a bored regulating screw 12 placed in the top disc 13. By adjusting this screw the distance of the outlet zone from the axis of rotation can be altered, and, with it, also, the proportion of liquid streaming out through this opening. The outer outlet is provided with exchangeable discs 14, each provided with a central opening. An alteration of the proportion between the liquids streaming out through the different outlets can be obtained by using discs with holes of different diameters, and it is thus possible to adjust the bowl to adapt it to the different characteristics of different mixtures.

The regulating devices described are to be considered only as examples. Many such regulating devices are already in use on separators for milk and oil, and they can generally be adapted to bowls embodying my invention.

It is also advisable to provide the outlets for the solid impurities with regulating devices, it generally being necessary to discharge a certain quantity of liquid together with said impurities. If the content of solid impurities is increased in the liquid to be separated, it is, in general, also necessary to increase the quantity of liquid which is discharged with the solid impurities.

While the construction just described is intended and adapted for the continuous discharge of solid impurities, the invention is not limited to a continuously discharging sludge outlet. With the use of special sludge outlets there may be combined special intermittently operable valves or special devices for forcing the solids out of the bowl. These being known in the art (see, for example, Patent 1,304,621 to Sturgeon), a description is unnecessary.

What I claim and desire to protect by Letters Patent is:

1. The combination with a revoluble separator bowl provided with an inlet for a mixture of centrifugally separable materials, of a series of superposed conical discs adapted to divide the separating space of the bowl

into strata and afford an open annular sludge space between the outer edges of said discs and the wall of the bowl, the top disc providing outside and above it an outlet channel whose inlet end is in direct communication with the space adjacent the outer edge of the top disc, an outlet affording direct communication with the inner ends of the spaces between the discs and an outlet communicating with said sludge space at a distance substantially greater than the edge of said top disc from the center of rotation.

2. The combination with a revoluble separator bowl provided with an inlet for a mixture of centrifugally separable materials, of a series of superposed conical discs adapted to divide the separating space of the bowl into strata and afford an open annular sludge space between the outer edges of said discs and the wall of the bowl, the wall of the bowl being shaped to provide a sludge space of varying width, the outer edge of the top disc adjoining a narrower part of said sludge space, the top disc providing outside and above it an outlet channel whose inlet end is in direct communication with the space adjacent the outer edge of the top disc, an outlet affording direct communication with the inner ends of the spaces between the discs and an outlet communicating with a wider part of said sludge space.

3. The combination with a revoluble separator bowl provided with an inlet for a mixture of centrifugally separable materials, of a series of superposed conical discs adapted to divide the separating space of the bowl into strata and afford an open annular sludge space between the outer edges of said discs and the wall of the bowl, the wall of said bowl being so inclined as to diverge from the axis of rotation from about opposite the top disc to about opposite the bottom disc, the bowl having an outlet affording direct communication with the space above the top disc, an outlet affording direct communication with the space below the top disc, and an outlet communicating with the part of the sludge space adjacent that part of the bowl wall farthest from the axis of rotation.

4. A revoluble centrifugal separator bowl having a circumferential wall bounding its separating space and inclined at an angle to the bowl's axis of rotation, there being an outlet communicating with the separating space of the bowl nearest its axis of rotation, means, including a top disc inclined to the axis of rotation of the bowl, providing an outlet channel whose inlet end adjoins that part of said bowl wall which is nearest the bowl's axis of rotation, there being a third outlet communicating with the space adjacent that part of said bowl wall which is furthest from the bowl's axis of rotation.

5. A revoluble centrifugal separator bowl having a lower circumferential wall bounding its separating space and inclined at a relatively narrow angle to the axis of rotation of the bowl, and an upper circumferential wall extending above the lower circumferential wall at a relatively wide angle to the axis of rotation, discs in the bowl whose outer edges are about in line with the inner upper end of said lower circumferential wall, said discs including a top disc spaced from said upper circumferential wall and affording an outlet channel whose inlet end adjoins the inner upper end of said lower circumferential wall, there being a second outlet communicating with the inner ends of the spaces between discs, and a third outlet communicating with the space adjoining the outer lower end of said lower circumferential wall.

In testimony of which invention, I have hereunto set my hand, at Stockholm, Sweden, on this 7th day of August, 1928.

HANS OLOF LINDGREN.