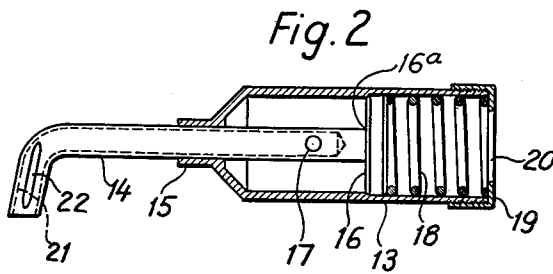
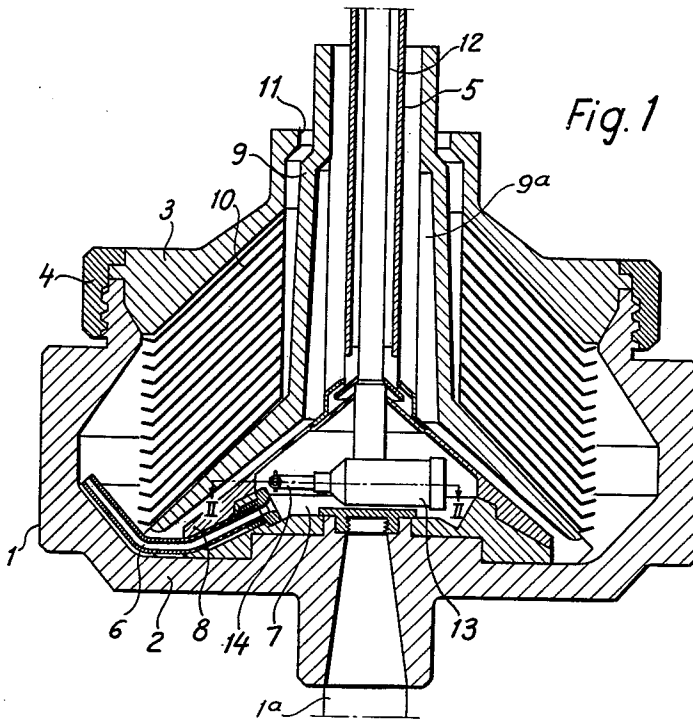


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H. W. THYLEFORS
CENTRIFUGAL SEPARATOR

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INVENTOR.
Henric W. Thylefors
BY
Davis, Horie, Faithfull &
Hapgood,
Attorneys.

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CENTRIFUGAL SEPARATOR

Henric W. Thylefors, Stockholm, Sweden, assignor to Aktiebolaget Separator, Stockholm, Sweden, a corporation of Sweden

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This invention relates to centrifugal separators of the type in which one of the separated components of the feed mixture is discharged from a paring chamber of the centrifugal bowl by means of a paring device having a paring edge which is adjustable radially, that is, toward and away from the rotation axis of the bowl. More particularly, the invention has reference to an improved separator of this type in which the paring edge is so adjusted automatically to counteract disturbances in the centrifugal separating operation.

In the centrifugal separation of a suspension or an emulsion in a separator of the above-noted type, one of the separated components of the feed material passes from the separating chamber of the centrifugal bowl to a paring chamber where it forms a rotating annular liquid body into which the non-rotating paring device extends, so that this component is pared from the rotating liquid body into a discharge passage. Examples of such feed material are a yeast suspension from which it is desired to pare out a yeast concentrate, and glue-water derived from whale or herring and from which it is desired to pare out oil-free water. The lighter separated component in these two cases, that is, water in the first case and oil in the second case, is discharged from a separate outlet of the centrifugal bowl. In practice, disturbances often occur during the separating operation which require radial adjustment of the paring edge of the paring device in one direction or the other in order to maintain the desired separating result. In many cases, this requires that an operator be assigned exclusively to the task of watching the separator and, when necessary, adjusting the radial position of the paring device.

The principal object of the present invention is to provide a separator of the type described in which the afore-mentioned adjustments of the paring device are effected automatically.

A separator made according to the invention includes actuating means subjected to the pressure of the component pared by the paring device and movable in response to a variation in this pressure, and an operative connection between the actuating means and the paring device for moving the latter radially in a direction to counteract such variation in pressure. With this arrangement, when separating a yeast suspension, for example, the strength of the pared-out yeast concentrate can automatically be kept substantially constant; and when separating glue-water, for example, the pared-out water component can automatically be kept free from oil. In the case of the yeast suspension, for example, if the strength and thus the specific gravity of the yeast concentrate in the paring chamber should decrease due to a disturbance in the separating operation, this causes the liquid level in the paring chamber to increase toward the bowl axis, as is well understood by those skilled in the centrifugal art, whereby the depth of immersion of the paring device in the yeast concentrate is increased. Due to this increased immersion depth, the pressure of the pared concentrate in the discharge passage of the paring device also increases. According to the invention, this pressure increase acts through the actuating means to move the paring device radially inward toward the rotation axis of the bowl, with the result that the strength of the yeast

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concentrate in the paring chamber increases. In glue-water separation, the pared-out water component can be kept free from oil in a similar way. By regulating a throttle valve in the outlet pipe of the paring device, it is possible to adjust the strength of the yeast concentrate or the degree in which the water component is freed from oil.

According to an embodiment of the present invention, the actuating means for the paring device comprises a diaphragm, a piston, or the like, which is subjected to the pressure of the pared-out liquid in a chamber provided in the discharge passage for the pared-out liquid. The piston or diaphragm thus forms a movable wall of this chamber which displaces the paring device in response to variations in the pressure of the pared-out liquid. The paring device may be a paring tube which opens into the chamber and has a close sliding fit in a wall of the chamber. The piston or diaphragm must, of course, be acted upon by a force balancing the variable pressure of the pared-out liquid. This balancing force may be a spring load or it may be a force produced by the paring-out operation. The latter force may be obtained by providing the paring device at its outer portion with a surface, or with vanes, ribs or the like, immersed in the rotating body of liquid in the paring chamber and inclined in such a way in relation to the surface of the liquid to be pared out that the liquid tends to urge the paring device radially inward or outward.

The invention is described in more detail below, reference being made to the accompanying drawing in which—

FIG. 1 is a vertical sectional view of a centrifugal bowl embodying a preferred form of the invention, and

FIG. 2 is an enlarged sectional view on the line II—II in FIG. 1, showing the interior of the closed chamber into which the discharge passage of the paring device leads.

The centrifugal bowl as illustrated comprises a hollow rotor body 1 having a bottom 2. A rotor cover 3 is held on the body 1 by a locking ring 4 screwed to the body 1, which is mounted on a vertical driving spindle 1a. A stationary feed tube 5 extends into the centrifugal bowl from above and is coaxial therewith. The liquid mixture to be separated, which enters the bowl from the bottom of feed tube 5, is picked up by radial vanes 9a on a distributor 9 forming part of the bowl and passes outwardly under centrifugal force through passages between the bottom of distributor 9 and the top of a hood 8 seated in the lower portion of the bowl. From these passages, the feed mixture enters the separating chamber of the bowl, which chamber contains a set of conical discs 10.

The separated heavy component of the feed mixture collects at the outer peripheral portion of the bowl (outside the disc set 10) from where it is conveyed inwardly through tubes, one of which is shown at 6, to a centrally located paring chamber 7. The tubes 6 extend generally radially of the bowl axis, about which they are spaced evenly, and they are held in place on the bowl bottom by the overlying hood 8. By unscrewing the locking ring 4, the hood 8 can be lifted freely from the bowl, together with distributor 9, disc set 10 and cover 3. The light component separated between the discs 10 is displaced inwardly toward distributor 9 and discharges over an overflow outlet 11.

Within the feed tube 5 and concentric thereto is a stationary discharge pipe 12 for the separated heavy component. The pipe 12 extends upwardly from the paring chamber 7, where this pipe carries a horizontal cylinder 13 which is hollow. The discharge pipe 12 opens at its lower end into the upper part of cylinder 13. A paring device in the form of a tube 14 has a sealed sliding fit in one end of cylinder 13, as shown at 15, and is adapted to slide lengthwise of the cylinder, that is, radially of

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the bowl axis. As shown in FIG. 2, the outer end portion of paring tube 14 is bent to form a paring surface 21 which is normally immersed in the rotating annular body of heavy component in paring chamber 7, it being understood that such body rotates clockwise as viewed in FIG. 2 so that liquid is pared from this body into the outer end of paring tube 14. At its inner end, the paring tube is connected to a piston 16 in cylinder 13 by an operative connection 16a, which may be a welded or brazed connection. The hollow interior of tube 14, which forms a discharge passage for the pared liquid, opens into the chamber of cylinder 13 through an opening 17. It will be apparent that the cylinder 13, supported by discharge pipe 12, forms a means mounting the paring device 14 for radial movements in paring chamber 7.

As shown in FIG. 2, the piston 16 is biased by means of a spring 18, which engages one side of the piston and urges it to the left against the pressure of the pared-out liquid on the other side of the piston, an internal shoulder of the cylinder acting to limit movement of the piston by the spring 18. A cap 19 screwed on the right-hand end of the cylinder 13 retains the spring 18 and has an opening 20 through which the space to the right of the piston 16 is in communication with the atmosphere in the surrounding paring chamber. The paring surface 21 at the outer end of the paring tube is so inclined in relation to the surface of the liquid to be pared that the tube during the paring-out operation tends to dig itself deeper into the liquid, that is, move to the left in FIG. 2. The outer end portion of the paring tube is provided with two vanes 22 which likewise are inclined in relation to the liquid surface and have the same moving effect. In the embodiment shown, the forces exerted by the rotating liquid body on the outer end portion of the paring tube, as well as the force exerted by spring 18, tend to move the paring tube to the left, while the liquid pressure acting upon the left-hand side of the piston 16 tends to displace the piston and thus the paring tube to the right. When there is balance between the various counter-acting forces, the piston 16 takes a position of equilibrium.

When separating a yeast suspension, for example, a separated yeast concentrate flows from the peripheral part of the rotor 1 through the tubes 6 to the paring chamber 7, while yeast-free water discharges over the overflow outlet 11. In the paring chamber 7, a certain liquid level is obtained, depending in part on the flow resistance in the discharge pipe 12. By inserting a throttle valve (not shown) in this pipe and increasing the throttling of this valve, the pressure in the paring tube outlet rises and the piston 16 is displaced to the right to a new position of equilibrium, so that the liquid level in the paring chamber 7 rises. In the new position of equilibrium, a yeast concentrate of increased strength is pared out, the concentration then being kept substantially constant in the manner previously explained, that is, through automatic adjustment of paring tube 14 to counteract any change in the concentration.

As will be apparent from the foregoing, the actuating means for the paring device 14 include piston 16 which forms a movable wall of the closed chamber in cylinder 13, this chamber having an outlet formed by discharge pipe 12. If the liquid level in paring chamber 7 increases (moves toward the bowl axis), as due to a decrease in the concentration or specific gravity of the heavy separated component, the resulting increased pressure of the pared-out liquid in cylinder 13 causes piston 16 to move the paring tube 14 to the right in FIG. 2, thereby moving the paring edge of the tube closer to the bowl axis and increasing the concentration of the heavy separated component. Conversely, if the concentration of this component becomes too high and there is a decrease of the liquid level in paring chamber 7, the reverse action is obtained so as to restore the desired concentration.

In principle, the illustrated arrangement can be re-

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versed so that the pressure of the pared-out liquid exerted on piston 16 urges the paring tube 14 radially outward against the balancing force of a spring or other biasing element, as when the liquid to be pared out is a lighter separated component of the feed material.

I claim:

1. A centrifugal separator comprising a rotatable centrifugal bowl having a separating chamber for receiving a mixture to be separated and in which said mixture is separated into relatively light and heavy components, the bowl also having an outlet for one of the separated components and a paring chamber communicating with the separating chamber for receiving the other separated component, a paring device, means mounting said paring device in the paring chamber for radial movement toward and away from the rotation axis of the bowl, said device having a discharge passage and a paring edge for paring said other component into said discharge passage, actuating means subjected to the pressure of the component pared by said device and movable in response to a variation in said pressure, and an operative connection between said actuating means and the paring device and through which said device is movable radially by the actuating means in response to said pressure variation to counteract said variation.

2. A centrifugal separator according to claim 1, in which said actuating means includes a closed chamber into which said discharge passage leads, said closed chamber having an outlet for the pared component and also having a movable wall connected to the paring device through said operative connection.

3. A centrifugal separator according to claim 1, in which said actuating means include a cylinder into which said discharge passage leads, the cylinder having an outlet for the pared component, and a piston in the cylinder connected to the paring device through said operative connection.

4. A centrifugal separator according to claim 1, in which said actuating means include a closed chamber into which said discharge passage leads, said closed chamber having an outlet for the pared component and also having a movable wall connected to the paring device through said operative connection, the paring device comprising a tube extending into said closed chamber and slidable radially in a wall of the closed chamber.

5. A centrifugal separator according to claim 1, in which said actuating means include a closed member into which said discharge passage leads, said closed chamber having an outlet for the pared component and also having a movable wall connected to the paring device through said operative connection, and a biasing element acting on said movable wall in opposition to said pressure of the pared component.

6. A centrifugal separator according to claim 1, in which said actuating means include a closed chamber into which said discharge passage leads, said closed chamber having an outlet for the pared component and also having a movable wall connected to the paring device through said operative connection, the paring device having an inclined surface on which a rotating body of said other component in the paring chamber is operable to urge the paring device radially in opposition to the action of said pressure on the actuating means.

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