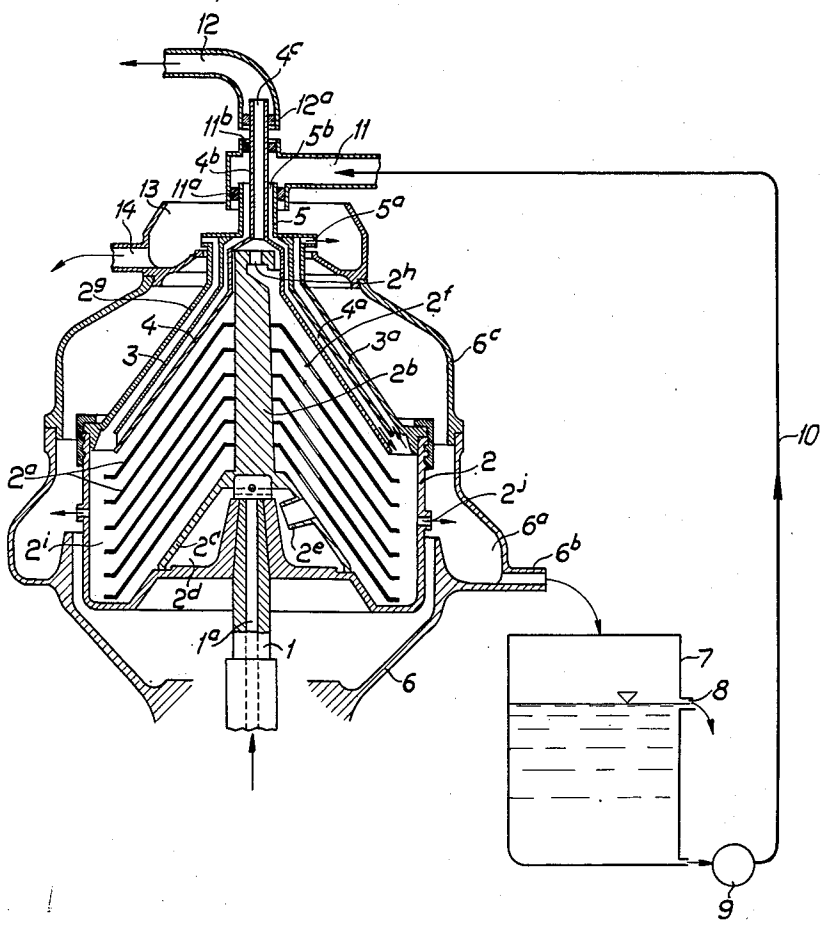
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CENTRIFUGE WITH AUXILIARY FEED ARRANGEMENT

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CENTRIFUGE WITH AUXILIARY FEED ARRANGEMENT

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9 Claims. (Cl. 233—14)

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This invention relates to centrifuges and more particularly to an improved centrifugal separator of the type having provision for feeding an auxiliary liquid into the outer peripheral portion of the centrifugal bowl, independently of the original feed, to assist in the operation of the centrifuge.

This application is a division of my co-pending application Serial No. 91,128, filed May 3, 1949; now Patent No. 2,526,292.

Centrifuges of the above-mentioned type are well-known and have been used to advantage under certain conditions. For example, when the material to be separated includes a sludge component which tends to clog the sludge outlets in the outer periphery of the bowl, this tendency can be overcome by enlarging the sludge outlets and recirculating some of the discharged sludge component to the bowl at the region of these outlets, whereby a relatively high rate of flow can be maintained in the sludge outlets without discharging a lighter component or components in excessive amounts through such outlets. Also, when recirculated sludge-containing liquid is thus used as the auxiliary liquid, it is possible to regulate the concentration of the sludge component discharging through the peripheral outlets by simply adjusting the rate of recirculation. In some cases, the auxiliary liquid consists of water for effecting a washing operation in the outer part of the bowl concurrently with the separation, or it may consist of some other liquid or a mixture of the sludge component and another liquid.

In centrifuges of the auxiliary feed type, various arrangements have been used heretofore to feed the auxiliary liquid to the outer part of the bowl. However, these prior arrangements, for the most part, have not been entirely satisfactory, due to the resulting complexity of the bowl structure (particularly when it is necessary to provide separate outlets for three separated components), or to impairment of the separating operation, or to leakage of the auxiliary liquid from its supply path, or to a combination of these reasons.

The present invention has for its principal object the provision of a centrifugal separator of the character described, which overcomes the above-mentioned objections.

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Another object is to provide a centrifuge of the auxiliary feed type adapted for the separate discharge of three separated components.

A further object is to provide an improved centrifuge of the type which is particularly adapted for concentrating cream, or the like, containing a substantial portion of sludge to be removed in the concentrating operation.

A centrifugal bowl made according to the invention comprises a bowl shell having a separating chamber provided with an inlet for the original feed material and peripheral outlets for a separated sludge component constituting the heaviest of three components into which the feed is separated in the chamber. A light component outlet, which is preferably located on the bowl axis, leads from within a conical disc in the upper part of the bowl. Above this conical disc is a similar disc, and above the latter is another conical member, which may be the bowl top. These three conical members are spaced from each other to define a pair of conical interspaces separated by the intermediate member, the interspaces being subdivided, if desired, by ribs. One of the conical interspaces, preferably the upper one, leads from the outer part of the separating chamber to an outlet through which the intermediate component is discharged from the bowl, while the other leads to the peripheral part of the chamber from an auxiliary feed port of the bowl communicating with a stationary feed pipe for an auxiliary liquid. Thus, the auxiliary liquid is delivered to the outer region of the separating chamber in a relatively thin annular layer adjacent to but separated from similar layers of the intermediate and light components, which discharge separately along the conical members countercurrently to the flow of the auxiliary liquid. The conical interspace for feeding the auxiliary liquid allows the latter to be distributed uniformly around the outer region of the separating chamber.

The preferred construction of the new centrifuge is as follows: The lowermost of the three conical members tapers upward to a neck or tube projecting axially from the bowl into a seal through which it communicates with a stationary discharge pipe for the light component. In this way, the light component is discharged through a closed path out of contact with atmosphere,

which I find to be particularly advantageous in concentrating sour cream for the production of butter, as disclosed in my previously mentioned co-pending application. The stationary feed pipe for the auxiliary liquid is sealed around the axial neck or tube and also around an extension of the intermediate conical member, thereby forming a closed path through which the auxiliary liquid is fed into the interspace between the intermediate and the lower conical member.

For a better inderstanding of the invention, reference may be had to the accompanying drawing in which the single illustration is a vertical sectional view of a preferred form of the new centrifuge, showing diagrammatically a system for recirculating separated sludge to the centrifugal bowl as the auxiliary liquid.

Referring to the drawing, the centrifuge comprises a hollow spindle 1 which supports and rotates a centrifugal bowl 2. Within the separating chamber of the bowl 2 is a stack of conical discs 2*a*, the discs being spaced from each other in the usual manner. The discs are provided with axial openings through which a center-post 2*b* extends upwardly from the lower portion of the bowl, whereby the discs are centered in the separating chamber. The center-post 2*b* has an expanded lower portion 2*c* resting upon the bottom of the bowl and forming an inlet chamber 2*d* into which the original feed material is delivered by way of a central passage 1*a* in the spindle 1. A hollow tube 2*e* projects inwardly toward the rotation axis of the bowl from the wall of the expanded portion 2*c*, so as to afford communication between the inlet chamber 2*d* and the main separating chamber containing the discs 2*a*. Thus, the spindle passage 1*a*, feed chamber 2*d* and tube 2*e* form an inlet for delivering to the main separating chamber the material to be separated. In the passage of the material through the feed chamber 2*d*, some of the heavier fraction, such as impurities or sludge, is collected in the outer part of the feed chamber under the action of centrifugal force, the remainder of the material being delivered through the tube 2*e* to distributing holes 2*f* in the conical discs in the main separating chamber. Preferably, the expanded portion 2*c* is provided with at least three tubes 2*e* spaced equidistantly about the rotation axis and each leading to a set of distributing holes 2*f* in the discs.

At the upper portion of the bowl 2 is a pair of superimposed conical members 2*g* and 3, the member 2*g* forming the bowl top. These conical members are located above a conical top disc 4 supported on the center-post 2*b* and forming the upper confine of the separating chamber. The conical members 2*g*—3 and the top disc 4 are spaced from each other to form a pair of superimposed conical interspaces 3*a* and 4*a* separated by the conical member 3. At its upper or reduced portion, the conical top disc 4 terminates in a hollow tube 4*b* projecting axially from the bowl and forming a light component outlet 4*c*. This outlet leads from within the conical top disc 4 by way of a recess 2*h* in the upper portion of the center-post 2*b*.

A neck extension 5 is secured on top of the conical members 2*g* and 3 and forms with the member 2*g* a series of radial outlets 5*a* for an intermediate component separated in the bowl. The upper conical interspace 3*a* leads inward and upward with a taper to the intermediate component outlets 5*a* from the outer part 2*i* of the separating chamber, that is, the outer zone of the chamber beyond the discs 2*a*. The neck extension 5 has a cylindrical portion surrounding the hollow tube 4*b* in spaced relation thereto and forming therewith an axial feed port 5*b*. From this feed port 5*b*, which is of annular form surrounding the tube 4*b*, the lower conical interspace 4*a* leads outward and downward with a flare to the outer portion 2*i* of the separating chamber.

The hollow spindle 1 is rotatably mounted in any suitable manner in a stationary structure including a hollow frame 6 having a collecting chamber 6*a*. The latter receives the sludge or heavy component separated in the bowl 2, this component being discharged from the outer portion 2*i* of the bowl chamber through peripheral outlets 2*j* into the stationary chamber 6*a*. From chamber 6, the heavy component is led through an outlet 6*b* into a receptacle 7, where the sludge is allowed to settle toward the bottom of the container. Part of the sludge-containing liquid is withdrawn from the system over a level outlet 8. By means of a pump 9 and a duct 10, the remaining part of the sludge-containing liquid is recirculated to the bowl through a stationary auxiliary feed pipe 11.

The feed pipe 11 has a sealed connection affording communication between this pipe and the auxiliary feed port 5*b* of the bowl. As illustrated, an annular seal 11*a* is located between the wall of the feed pipe 11 and the neck extension 5, and a second annular seal 11*b* is located between the wall of pipe 11 and the auxiliary tube 4*b*. In other words, the feed pipe 11 terminates in a cylindrical portion surrounding the tube 4*b* and the upper part of the neck extension 5, and the ring 11*a* forms a seal between the extension 5 and the lower part of this cylindrical portion, while the ring 11*b* forms a seal between the auxiliary tube and the upper part of this cylindrical portion. Accordingly, the auxiliary liquid is delivered in a closed path from the stationary pipe 11 to the auxiliary feed port 5*b* and thence through the conical interspace 4*a* to the outer part 2*i* of the separating chamber. In its passage through the conical interspace 4*a*, the auxiliary liquid flows countercurrently to the intermediate component discharging through the conical interspace 3*a* and to the light component moving toward the central outlet 4*c*.

When the centrifuge is to be used for concentrating sour cream which has been neutralized, as in the production of butter, I find that it is advantageous to provide a closed discharge path for the light component or cream separated in the bowl. Thus, the cream discharging through the central passage 4*c* is delivered to a stationary discharge pipe 12 containing an annular seal 12*a* through which the tube 4*b* extends. In this way, the cream is maintained out of contact with atmosphere as it passes from the rotating bowl to the stationary discharge pipe 12.

The intermediate component discharged through the bowl outlets 5*a* is collected in an open receptacle 13 mounted on a cover 6*c* for the stationary frame. From the receptacle 13, the intermediate component is discharged through an outlet 14.

The operation of the centrifuge will now be described in connection with the concentration of sour cream which has been neutralized, although it will be understood that this example of the use of the centrifuge is only for illustrative purposes and that the centrifuge is not limited to this use. The neutralized cream is fed into the

spaces between the discs 2*a* by way of the spindle passage 1*a*, feed chamber 2*d*, tube 2*e* and distributing holes 2*f*. In the separating chamber of the bowl, the cream is separated into three components comprising a heavy or sludge-containing component, an intermediate component which is primarily skim milk, and a light component which is primarily cream concentrated to a fat content of 80–85%. The concentrated cream is displaced upwardly and inwardly within the top disc 4 and is discharged from the interior of this disc at its upper or reduced portion through the closed path formed by the axial tube 4*b*, the seal 12*a*, and the pipe 12. The skim milk component, which moves outwardly between the discs 2*a*, is discharged from the outer part 2*i* of the separating chamber through the upper conical interspace 3*a* and the intermediate component outlets 5*a* to the stationary receptacle 13. The sludge-containing liquid or heavy component is discharged through the peripheral outlets 2*j*, and part of this component is recirculated from the receptacle 7 to the auxiliary feed port 5*b* by way of the closed path formed by the stationary pipe 11 and its associated seals 11*a* and 11*b*. From the auxiliary feed port 5*b*, the sludge-containing liquid or auxiliary feed passes downwardly and outwardly through the lower conical interspace 4*a* countercurrently to the discharge of the skim milk and concentrated cream components which are divided from each other and from the auxiliary feed by the two upper cones 3 and 4. By adjusting the rate at which the sludge-containing liquid is delivered to the auxiliary feed pipe 11, the concentration of the sludge in the heavy component discharging through the peripheral outlets 2*j* of the bowl may be adjusted. Also, recirculation of the sludge component, as previously described, enables the use of larger peripheral outlets 2*j*, whereby clogging of these outlets is avoided.

The conical interspaces 3*a* and 4*a* may, if desired, be subdivided by radial ribs or wings extending upwardly and inwardly from the outer or peripheral portions of these interspaces. The ribs in the conical interspace 4*a* may then serve to support the conical member 3 on the top disc 4 in spaced relation thereto.

It will be apparent that the new centrifuge provides an efficient means for feeding an auxiliary liquid into the outer part of the bowl chamber, without complicating the construction of the centrifuge or interfering with the separating operation. By reason of the conical interspace 4*a* in the upper part of the bowl, the auxiliary liquid is distributed uniformly around the outer part 2*i* of the bowl chamber, thereby minimizing the formation of eddy currents in this outer region.

I claim:

1. A centrifugal bowl comprising a bowl shell rotatable about an axis and having a separating chamber, the chamber having an inlet for the material to be separated and a peripheral outlet for a separated heavy component, a conical disc mounted in the upper part of said chamber and forming at its reduced portion a light component outlet leading from within the disc, a pair of superimposed conical members rotatable with the shell and located above and outwardly from the disc, said members and disc being spaced from each other to form a pair of superimposed conical interspaces separated by one of said members, the bowl having an intermediate component outlet to which one of said conical interspaces

leads inward and upward with a taper from the outer part of the separating chamber, and an auxiliary feed port in the bowl from which the other conical interspace leads outward and downward with a flare to the outer part of said chamber.

2. A centrifugal bowl according to claim 1, in which the conical disc terminates at its reduced end in a hollow tube projecting axially from the bowl and forming said light component outlet.

3. A centrifugal bowl according to claim 1, in which the conical disc terminates at its reduced end in a hollow tube projecting axially from the bowl and forming said light component outlet, the bowl also comprising a hollow spindle projecting axially from the bottom of the bowl and forming a feed passage for the material to be separated.

4. A centrifugal bowl according to claim 1, in which the outermost of said conical members forms the top of the bowl.

5. A centrifugal bowl according to claim 1, in which the lowermost of said conical interspaces leads from the auxiliary feed port.

6. A centrifugal bowl according to claim 1, in which the conical disc terminates at its reduced end in a hollow tube projecting axially from the bowl and forming said light component outlet, the auxiliary feed port being of annular form and surrounding and partly formed by said tube.

7. In combination, a centrifugal bowl comprising a bowl shell rotatable about an axis and having a separating chamber, the chamber having an inlet for the material to be separated and a peripheral outlet for a separated heavy component, a conical disc mounted in the upper part of said chamber and terminating at its reduced end in a hollow tube projecting axially from the bowl to form a light component outlet leading from within the disc, a pair of superimposed conical members rotatable with the shell and located above outwardly from the disc, said members and disc being spaced from each other to form a pair of superimposed conical interspaces separated by one of said members, the bowl having an intermediate component outlet to which one of said conical interspaces leads inward and upward with a taper from the outer part of the separating chamber, a stationary discharge pipe for said light component, a seal between the wall of said pipe and the wall of said tube, and an auxiliary feed port in the bowl surrounding and partly formed by said tube and from which the other conical interspace leads outward and downward with a flare to the outer part of said chamber.

8. A combination according to claim 7, comprising also a neck on the bowl surrounding the tube and defining therewith said port, a stationary feed pipe for an auxiliary liquid, a seal between the wall of the feed pipe and the tube, and a seal between the wall of the feed pipe and said neck.

9. In combination, a centrifugal bowl rotatable about an axis and having a cylindrical outer wall provided with sludge outlets, the bowl also having an axial outlet for a light component separated in the bowl and a level outlet, located intermediate said central outlet and said sludge outlets, for discharging an intermediate component separated in the bowl, an axial spindle secured to the bowl for rotating the same, the spindle having a passage for supplying feed material to the bowl, a stationary discharge pipe for receiving the light component discharged through said central outlet, a seal between the wall of the

stationary pipe and the wall of said central outlet, the seal forming a closed path through which the light component is discharged from the central outlet to the stationary pipe, a stationary auxiliary feed pipe, and seals between said last pipe and the walls of said central outlet and level outlet and forming with said last walls an auxiliary feed passage leading into the bowl.

PER HILDING STAAFF.

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