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METHOD AND APPARATUS FOR SHOCKLESS FEEDING OF LIQUID TO THE SEPARATING CHAMBER OF A CENTRIFUGE

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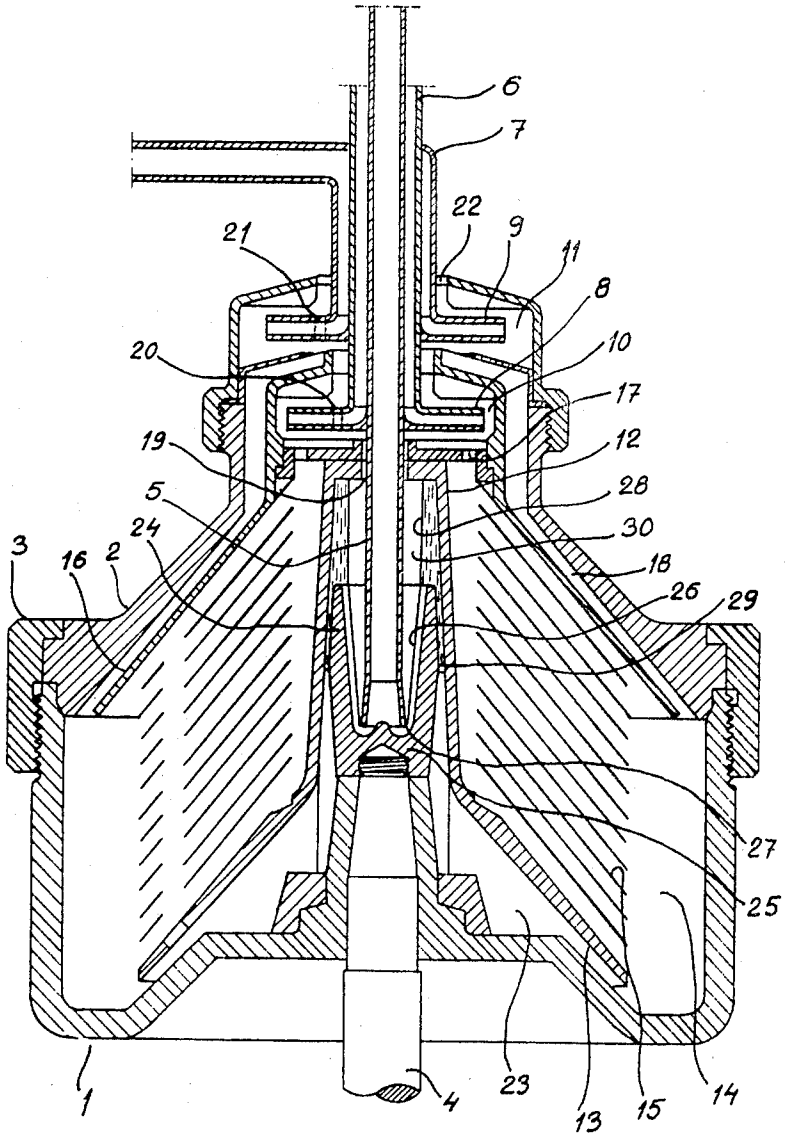

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METHOD AND APPARATUS FOR SHOCKLESS FEEDING OF LIQUID TO THE SEPARATING CHAMBER OF A CENTRIFUGE

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ABSTRACT OF THE DISCLOSURE

The liquid is fed continuously from a supply source in the form of a stationary feed pipe coaxial with the centrifugal rotor, and means rotatable with the rotor form a hollow body having an end wall closely opposing the discharge end of the feed pipe, this body also having a smooth inner surface which is a generally conical surface of revolution concentrically surrounding the feed pipe in spaced relation thereto. Liquid is directed without impact from the stationary pipe to the opposing rotating end wall and thence in an annular layer flowing radially outward and generally axially of the rotor along the smooth surface of revolution, which gradually increases the rotational speed of the liquid. From the latter surface, the liquid passes to the separating chamber of the rotor, preferably by way of another generally conical and smooth surface of revolution surrounding the first one and which effects a further gradual increase in the rotational speed of the liquid.

The present invention relates to a method for the introduction, without impacts, of a liquid into a centrifugal separating chamber from a stationary inlet pipe, and also to a centrifuge adapted to this purpose.

In the centrifugal separation of milk, it has been found that when the milk introduced into the centrifugal rotor is subjected to impacts, this counteracts an effective separation of cream from the milk for at least two reasons. The first is that the fat globules of milk are split, and the resulting fat globule fragments will separate poorly as compared to the unsplit fat globules. Secondly, the admixture of air in the milk incident to the impacts impairs the sedimentation ability of the fat globules. Therefore, various attempts have been made to avoid these drawbacks by introducing the milk into the centrifuge without impacts. One measure used for this purpose has been to provide an hermetically sealed inlet connection from the stationary feed pipe to the centrifugal rotor, which, of course, requires seals between stationary and rotary parts of the centrifuge. Thus, while this measure solves the problem of introducing the feed liquid without impacts, it creates the problem of having to replace seals at certain intervals due to normal wear.

The principal object of the present invention is to solve the above-mentioned problem, so that a liquid fed into a centrifugal rotor from a stationary inlet pipe can be brought into rotation without impacts or air admixture and without need for the aforementioned seals.

According to the invention, the liquid flows from the discharge opening of the stationary pipe in the axial direction of the centrifugal rotor and along a smooth (vaneless) surface of revolution provided in the rotor, up to a liquid level formed in the rotor. Due to the rotation, the liquid flows in a thin layer along this smooth surface. The air space around the outside of the inlet pipe prevents friction between the liquid layer and the pipe, which friction would oppose entraining of the liquid layer in the rotation of the rotor by the friction between the liquid layer and the smooth surface of revolution. Furthermore, the liquid layer is de-aerated, while flowing axially along the smooth surface of revolution, by the separating action of the centrifugal force; and this de-aeration can be so effective that when separating milk, for example, the cream will be separated more completely than in a centrifuge having an hermetically sealed inlet to the rotor. The invention can, of course, be used for other emulsions than milk.

In order to attain a good separation result, it is desired that the liquid, before the rotational speed of the rotor has been fully imparted to it, be allowed to move radially outward in the rotor along a smooth (vaneless) surface of revolution of the rotor. To this end, the liquid may be allowed to flow along one or several conical surfaces of revolution. It is especially favorable to the separation result if the rotational speed of the rotor is imparted to the liquid only by allowing the liquid to flow along one or several smooth surfaces of revolution of the rotor.

The new centrifuge comprises a stationary inlet pipe, coaxial with the rotor, having its discharge end closely opposed by a wall rotatable with the rotor and extending transversely of the axis of rotation, this wall forming an end wall of a hollow body. The inside of the hollow body forms a smooth (vaneless) surface of revolution concentrically surrounding the feed pipe and extending axially of the rotor. This surface of revolution widens conically from the discharge end of the pipe, and the liquid passes from this surface through a passage in the rotor leading to its separating chamber.

In order to effect continuous discharge of air which has been separated from the milk fed into the centrifuge, the air space within the annular liquid layer formed on the inside of the hollow body preferably has an open connection to the surrounding atmosphere.

Additional features of the invention are disclosed in the following more detailed description with reference to the accompanying drawing, in which the single illustration is a vertical sectional view of a centrifuge embodying an example of the invention.

In the drawing, a rotor body **1** has a cover **2** which is retained by means of a locking ring **3**. The rotor is supported on and driven by a shaft **4**, and extending into the rotor are a stationary inlet pipe **5** and two stationary outlets pipes **6** and **7**, the two outlet pipes being connected to stationary paring discs **8** and **9**, respectively. The paring discs **8** and **9** are located in paring chambers **10** and **11**, respectively, in the rotor. A distributor in the rotor is provided with an upper part **12** having a slight conicity and a lower part **13** having a more pronounced conicity; and the distributor **12–13** partly defines a passage through which liquid introduced by feed pipe **5** is conveyed to a separating chamber **14** of the rotor. Chamber **14** contains a set of conical discs **15** and a conical top disc **16**, the upper part of which forms the paring chamber **10**. Holes **17** connect the space inside the inner edges of the disc set **15** to the paring chamber **10**. An interspace **18** between the top disc **16** and the rotor cover **2** connects the outer part of the separating chamber **14** with paring chamber **11**. A clearance **19** around the inlet pipe **5** and axial ports **20** and **21** in the paring discs **8** and **9**, respectively, connect a central air space in the distributor part **12** to the surounding atmosphere, more exactly by way of a clearance **22** between the rotor top and the pipe **7**. The distributor part **13** is provided with radial entraining vanes **23**.

An internally conical hollow body **24** with a bottom **25** is screwed onto the top of the shaft **4**. The feed pipe **5** opens so close to this end wall **25** that a continuous thin conical liquid layer **26** is formed from the pipe opening **27** up to a cylindrical liquid level **28**. A part of the outside of the hollow body **24** forms with the inside of the distributor part **12** a conical slot **29** of uniform thickness. An air space **30** is formed inside the level **28**.

The centrifuge according to the invention is intended especially for the separation of emulsions, and in the following description it is assumed that whole-milk is to be separated. This milk is supplied through the pipe **5**, which is kept completely filled with milk. The milk discharging from the pipe opening **27** meets the opposing end wall **25** and is deflected immediately at the pipe opening so that the milk, without air admixture, is spread into a thin layer **26** on the rotating inner surface of the body **24**; and a rotary movement is imparted to this layer by friction wtih this inner surface but while allowing sliding of the liquid. Under the action of the centrifugal force, air is then separated from the liquid, and this air leaves the air space **30** through the connecting clearances and ports **19** through **22** and reaches the surrounding atmosphere. The layer **26** is shown with the maximum possible extension, i.e., to the top of the hollow body **24**. In order to avoid air admixture, the level **28** must not be kept radially outside the inside of the body **24**. The milk passes on its way to the separating chamber **14** through the narrow slot **29**, and its speed of rotation is increased still more by its frictional contact with the inner and outer surfaces of the slot **29**. Before the milk reaches the radial vanes **23**, it should have obtained essentially the same speed of rotation as the rotor, so that a splitting of the fat globules of the milk is avoided when the milk meets the vanes **23**. Cream separated in the disc set **15** flows through the holes **17** into the paring chamber **10** and is discharged by the paring disc **8**. In a similar way, skim milk flows from the periphery of the separating chamber **14** through the slot **18** and into the paring chamber **11** and is discharged by the paring disc **9**.

Experiments have shown that whole-milk fed and separated in the manner according to the present invention results in a skim milk which sometimes has even a lower fat content than skim milk obtained from centrifuges provided with an hermetically sealed inlet to the rotor.

It will be understood that the rotor forms a locus of centrifugal force including the separating chamber **14** and a feeding zone within the hollow body **24** and the upper part **12** of the distributor. In the upper and outer part of this zone, a body of the liquid is continuously rotated about the rotor axis to maintain the liquid body in annular form having the free internal liquid surface **28**. Liquid is continuously fed from this annular body to separating chamber **14**, by way of slot **29**, and is continuously supplied from the stationary source **5** to the feeding zone at its lower and inner region located radially between the rotor axis and the free liquid surface **28**. From this inner region, a thin annular layer **26** of the liquid is directed axially of the centrifugal locus and

radially outward to the free liquid surface **28** by way of the smooth surface of revolution within the hollow member **24**, whereby the liquid is brought into rotation gradually, that is, without impacts.

I claim:

1. In the feeding of liquid into the rotor of a centrifugal separator from a stationary inlet pipe coaxial with the rotor, said pipe having an inlet end and also having an outlet opening into the rotor, the method of feeding the liquid substantially without impacts and which comprises maintaining said pipe filled with liquid, maintaining a body of the liquid rotating in the rotor about the axis thereof to form a liquid level of said body substantially concentric to said axis, continuously passing liquid from said body to a separating chamber of the rotor, and continuously passing to said liquid level directly from said pipe outlet a layer of liquid flowing axially of the rotor toward said inlet end of the pipe along a smooth surface of revolution of the rotor without overflowing said smooth surface while exposing said liquid layer to a central air space in the rotor.

2. The method according to claim **1**, wherein the liquid in passing from said body to the separating chamber flows along an additional smooth surface of revolution surrounding the first-mentioned surface of revolution and rotating therewith.

3. In combination with a centrifugal rotor mounted for rotation about an axis and forming a chamber for centrifugal separation of a feed liquid, and a stationary feed pipe coaxial with the rotor for supplying said liquid and having an inlet end and a discharge end, means rotatable with the rotor and forming a hollow body having an end wall extending transversely of said axis, said end wall closely opposing said discharge end of the feed pipe, said hollow body also having an inner surface forming a smooth surface of revolution concentrically surrounding the stationary feed pipe and extending generally axially of the rotor while widening conically from said discharge end toward said inlet end of the pipe, said smooth surface being operable to direct a layer of the liquid from said end wall, the rotor including means maintaining a liquid level into which said smooth surface submerges and also including means forming a passage for flow of the liquid from said surface to the separating chamber.

4. The combination according to claim **3**, is which said passage forming means include an additional smooth surface of revolution which surrounds said first surface of revolution and is conical.

References Cited

UNITED STATES PATENTS

239,659	4/1881	Houston et al.	233—32 X
406,746	7/1889	Larsen	233—45 X

FOREIGN PATENTS

449,191	6/1949	Italy.

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