Sept. 19, 1939. H. W. FAWCETT 2,173,581

CENTRIFUGAL SEPARATOR

Filed Dec. 15, 1937

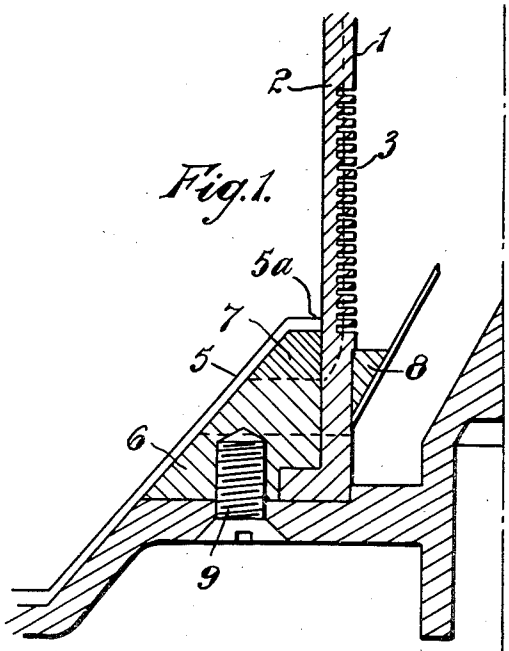


Fig.1.

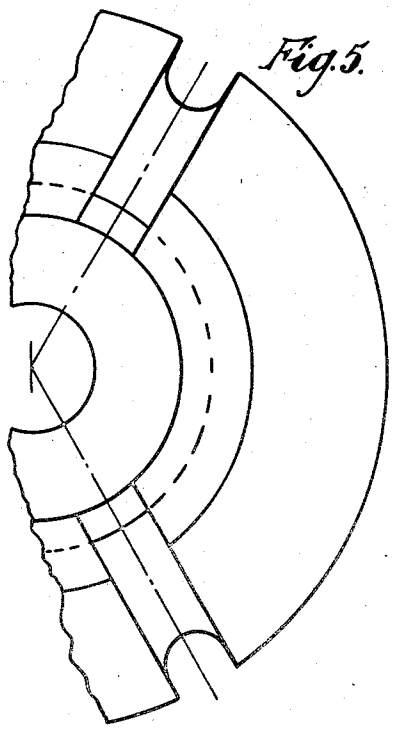


Fig.5.

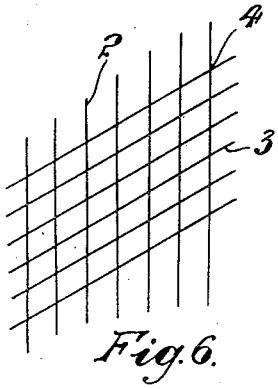


Fig.6.

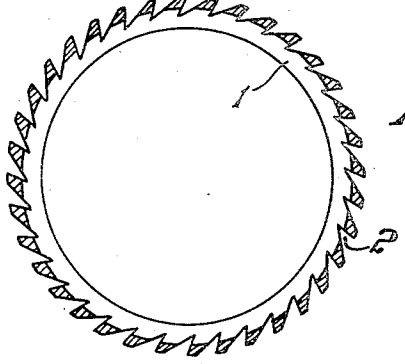


Fig.2.

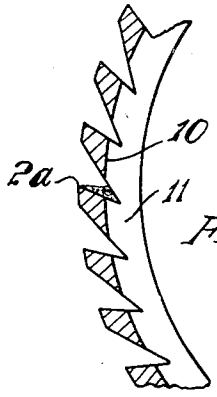


Fig.3.

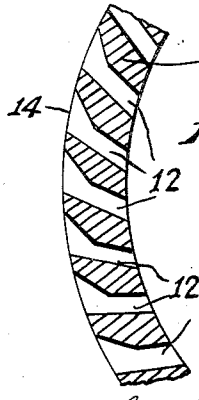


Fig.7.

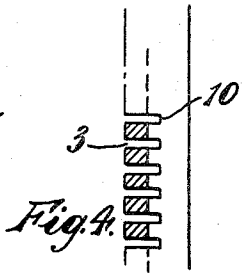


Fig.4.

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UNITED STATES PATENT OFFICE

2,173,581

CENTRIFUGAL SEPARATOR

Harold William Fawcett, Harrogate, England

Application December 15, 1937, Serial No. 179,994
In Great Britain December 16, 1936

9 Claims. (Cl. 233—1)

This invention relates to centrifugal separators and more particularly to cream separators, and aims at providing an improved method of operation and a construction of separator whereby the internal parts of said separator, and more particularly the discs of the disc pack, can be effectively washed and cleaned during the rotation of the apparatus.

In the specification of my co-pending United States application Serial No. 126,417, I have described a centrifugal separator which is designed to achieve the foregoing objects and which is provided, inter alia, with a perforated disc-carrying tube for the introduction of the washing or rinsing liquid, said liquid being directed through the perforations on to the discs during the rotation of the separator and thus scouring the same.

I have now found that the apertures in the wall of the disc-carrying tube should, for efficient scouring action, fulfil two conditions, namely, firstly that the distribution of liquid through said apertures over the discs should be as uniform as possible and secondly that the total area of the apertures at their most restricted points should be commensurate with the cross-sectional area of the inlet pipe for the rinsing liquid.

Exhaustive researches of the applicant have shown that the total area of the apertures in the disc-carrying tube must not be less than one-third of a minimum cross-sectional area of the disc-carrying tube nor greater than 2½ times said minimum cross-sectional area.

I have also found that in order to achieve an efficient scouring action of the discs, it is advisable to arrange the apertures in the disc-carrying tube so as to pass obliquely through the wall thereof instead of radially, and that it is preferable so to arrange said apertures that they lie back from the direction of rotation of the discs and tube, owing to the fact that radially arranged apertures tend to cause the rinsing liquid to issue in the form of jets which do not spread out and therefore portions of the discs between said jets are liable to escape the scouring action. Merely increasing the number of radial apertures is impracticable both on the grounds of expense and owing to the fact that the resulting holes will be of such small dimensions that they will be choked up by the slightest impurity in the rinsing liquid.

The arrangement of oblique apertures on the other hand, brings the paths of the jets of liquid impinging on the discs, closer to one another and thus provides a much more effective coverage of the disc area.

In the specification of my aforesaid co-pending application Serial No. 126,417 I have already described the provision of outwardly flared or countersunk apertures in the walls of the disc-carrying tube, the effect of which is to cause the rinsing liquid to spread in the vertical direction.

In contradistinction to this construction however, the present invention contemplates the provision of vertically running flutes or recesses in the outer or inner wall of the disc-carrying tube, the walls of said flutes or slots being, if desired, inclined at an angle to the radius of said tube.

Apertures are formed in said flutes or recesses by forming horizontally or substantially horizontally running grooves cut in the tube wall opposite that provided with said flutes or recesses, said grooves being cut to such a depth that the points of intersection thereof with the aforesaid flutes or recesses form the apertures through which the rinsing liquid can gain access to the discs.

This construction possesses the advantage that it reduces to an enormous extent, the number of machining operations which would otherwise be required in order to drill the same number of holes.

Moreover the foregoing construction has the advantage that it enables the tube to retain sufficient longitudinal strength to permit it to hold the two parts of the bowl together when rotating and full of liquid under pressure as illustrated for example in Fig. 3 of the drawings accompanying the specification of my aforesaid co-pending application Serial No. 126,417. Moreover the flutes, when provided on the outside of the disc-carrying tube ensure the spread of the rinsing liquid in a vertical direction so that the liquid issuing from each hole will impinge on more than one disc. This is an important advantage since in practice it is impossible to provide as many apertures in the axial direction of the disc-carrying tube as correspond to the number of discs carried thereby.

The flutes when provided on the outside of the disc-carrying tube, also provide efficient means for accurately registering the discs which are not properly cleaned unless accurately registered.

Alternatively, apertures may be drilled in the interior of the tube wall so as to make connection with the aforesaid flutes or slots but this

construction is not so advantageous as that embodying the horizontal grooves.

A particularly advantageous construction is to employ the vertical slots or grooves on the outside of the disc-carrying tube, which are intersected by helical grooves cut in the interior of said tube.

The effect of this construction is that the resulting apertures are in staggered formation, thus giving a very uniform coverage of the discs.

In any case, the effect of the vertically running flutes or slots on the exterior of the disc-carrying tube is to cause the rinsing fluid to spread out in the vertical direction during the cleaning of the disc pack, as in the case of the aforesaid outwardly flared apertures.

According to a modification of the invention the apertures in the flutes of the disc-carrying tube are replaced by a series of continuous slots which likewise ensure even distribution of the washing liquid over the discs. Said continuous slots may also be laid back from the direction of rotation of the disc-carrying tube and disc pack.

In order that the invention may be more readily understood, reference is made to the accompanying drawing which illustrates diagrammatically and by way of example a preferred embodiment of disc-carrying tube in accordance with the invention, and in which—

Fig. 1 is a vertical section through said tube, showing the method of mounting same;

Fig. 2 is a plan section of the tube;

Fig. 3 is an enlarged view of a construction similar to that of Fig. 2 and indicating what occurs when the centrifuge so constructed is rotating in a clockwise direction.

Fig. 4 is a view of a modification.

Fig. 5 is a plan view of the distributor viewed from the bottom.

Fig. 6 is a diagrammatic representation of the manner in which the external flutes and internal grooves intersect.

Figure 7 is a fragmentary section plane, similar to that of Figure 3, of a modified embodiment of the tube.

In said drawing, the disc-carrying tube **1** is fluted externally substantially in the vertical directions, said flutes being shown in Fig. 2, and denoted by **2**. Rings **3** are cut in the interior of the tube **1**, which intersect the flutes **1** forming a series of apertures **4**, the formation of which is shown diagrammatically in Fig. 6, wherein the flutes **2** are vertical and the internal rings or grooves **3** are spiralled, thus forming staggered apertures.

Owing to the fact that the bottom disc **5** of the disc pack (remainder not shown) must be effectively washed, it is essential to bring the flutes right down opposite said bottom disc. The method of machining the grooves would necessitate cutting away the base **6** of the distributor, as shown more heavily shaded at **7**. However, inasmuch as this is undesirable, it is found necessary to construct members **1** and **6** separately, the grooves being first cut in the tube wall **1**, below the point **5***a*, the tube being then registered in **6** to resist the tension of the top locking nut. The milk distributor **8** is made separately and fastened on to the tube **1**. The whole of the distributor parts **1**, **6** and **8** are secured to the base of the separator by screws or rivets **9**.

Fig. 3 is a detail of the flutes and illustrates the action thereof. The line **10** denotes the greatest diameter of the internal grooves, which intersects the bases of the external flutes, forming apertures at those points.

In the embodiment shown in Fig. 3, the walls of the flutes are shown inclined towards the direction of rotation of the centrifuge, with the result that the flutes remain full of liquid up to the edge of the flute **2***a*, thus facilitating the distribution of the liquid in a vertical direction.

Fig. 3 shows the formation of apertures by the intersection of an internal groove **11** and the flute **2**. The shaded portion shows the amount of metal giving strength in line with the axis and keeping the top and bottom of the bowl together.

The shaded portion at **2***a* shows what occurs when the centrifuge is rotating in a clockwise direction. The washing liquid inside the tube **1**, **2** slips and has a relative motion to **1**, **2** which is counter-clockwise. On passing through the aperture **4** it meets the leading edge of the flutes and is forced to stop slipping and move at the rotary speed of the bowl. This has the effect of spreading out the liquid entering the flutes from apertures in the same in a vertical direction, and feeding it to more than one disc.

Fig. 4 shows the reverse procedure to Fig. 1, in which spiral grooves **3** are cut on the outside of the tube **1**, **2** and flutes are cut on the inside forming the necessary intersection shown at the dotted line.

Fig. 5 is a plan of the distributor viewed from the bottom, the fluted parts shown being cut in the base and serving to convey the milk from the distributor **8** to the usual feed holes in the stack of conical discs.

Figure 7 shows a fragmentary section plane, similar to that of Figure 3, of a modification, in which said flutes extend entirely through the wall of the tube to form longitudinal slots **12** separated by bars **13** which are held together at the bottom by an annular portion **14**.

I claim:

1. In a centrifugal separator the combination with a revoluble bowl having near its axis outlets for the liquid to be treated, a pack of frusto-conical discs disposed in said bowl in spaced superposed relationship to one another, each disc being provided with a center hole and a series of spaced orifices disposed intermediate the inner and outer peripheries of the disc, the inner peripheral edges of the discs defining a substantially cylindrical space extending axially of said bowl and the corresponding orifices of all the discs being aligned to form eccentric vertical passages, and a distributor chamber disposed at the bottom of the bowl and having outlets opening into said passages, of a substantially cylindrical distributor tube rigid with said bowl and extending axially within and throughout said cylindrical space, said distributor tube being provided with a sufficient number of circumferentially and axially distributed perforations to insure the inner peripheries of all the discs being simultaneously covered completely and uniformly with washing liquid, a feed tube for the liquid to be treated fitted into the lower end of said distributor tube to revolve therewith and opening into said distributor chamber, and movable means to allow an unrestricted discharge of the washing liquid in substantially radial direction.

2. A centrifugal separator, as claimed in claim 1, in which said feed tube is made separate and removable from said distributor tube.

3. In a centrifugal separator the combination with a revoluble bowl having near its axis outlets for the liquid to be treated, and a pack of frusto-

conical discs disposed in said bowl in spaced superposed relationship to one another and having center holes arranged in axial alignment, the inner peripheral edges of the discs defining a substantially cylindrical space extending axially of said bowl, of a substantially cylindrical distributor tube for washing liquid rigid with said bowl and extending axially within and throughout said cylindrical space, said distributor tube being provided with a sufficient number of circumferentially and axially distributed perforations to insure the inner peripheries of all the discs being simultaneously covered completely and uniformly with washing liquid, means at the lower end of the distributor tube for deflecting the bulk of the washing liquids towards said radial perforations, and movable means to allow an unrestricted discharge of the washing liquid in substantially radial direction, the total area of said perforations in said distributor tube exceeding one third and being less than two and one-half times the minimum cross-sectional area of said distributor tube.

4. In a centrifugal separator, the combination with a revoluble bowl having near its axis outlets for the liquid to be treated, and a pack of frusto-conical discs disposed in said bowl in spaced superposed relationship to one another and having center holes arranged in axial alignment, the inner peripheral edges of the discs defining a substantially cylindrical space extending axially of said bowl, of a substantially cylindrical distributor tube for washing liquid rigid with said bowl and extending axially within and throughout said cylindrical space, the cylindrical wall of said tube being provided with a sufficiently large number of circumferentially distributed longitudinal flutes in communication with apertures in the tube wall to insure the inner peripheries of all the discs being simultaneously covered completely and uniformly with washing liquid, and movable means to allow an unrestricted discharge of the washing liquid in substantially radial direction.

5. A centrifugal separator, as claimed in claim 4, in which said flutes are disposed on the outside of said distributor tube.

6. A centrifugal separator, as claimed in claim 4, in which said flutes are disposed on the outside of said distributor tube and said discs are supported with their inner peripheral edges on the ribs left between said flutes.

7. A centrifugal separator, as claimed in claim 4, in which the wall of said distributor tube on the side thereof opposite to the fluted side is provided with grooves intersecting said flutes substantially cross-wise thereof so as to form said apertures in the tube wall.

8. A centrifugal separator, as claimed in claim 4, in which the wall of said distributor tube on the side thereof opposite to the fluted side is provided with a continuous helical groove of a pitch to intersect said flute substantially crosswise thereof, the intersections between said flutes and said groove constituting said apertures in the tube wall.

9. A centrifugal separator, as claimed in claim 4, in which each of said flutes extend entirely through the wall of the tube to form continuous longitudinal slots.

HAROLD WILLIAM FAWCETT.