Nov. 20, 1951 R. D. ACTON 2,575,506

SELF-WASHING CENTRIFUGE

Filed June 24, 1946 2 SHEETS—SHEET 1

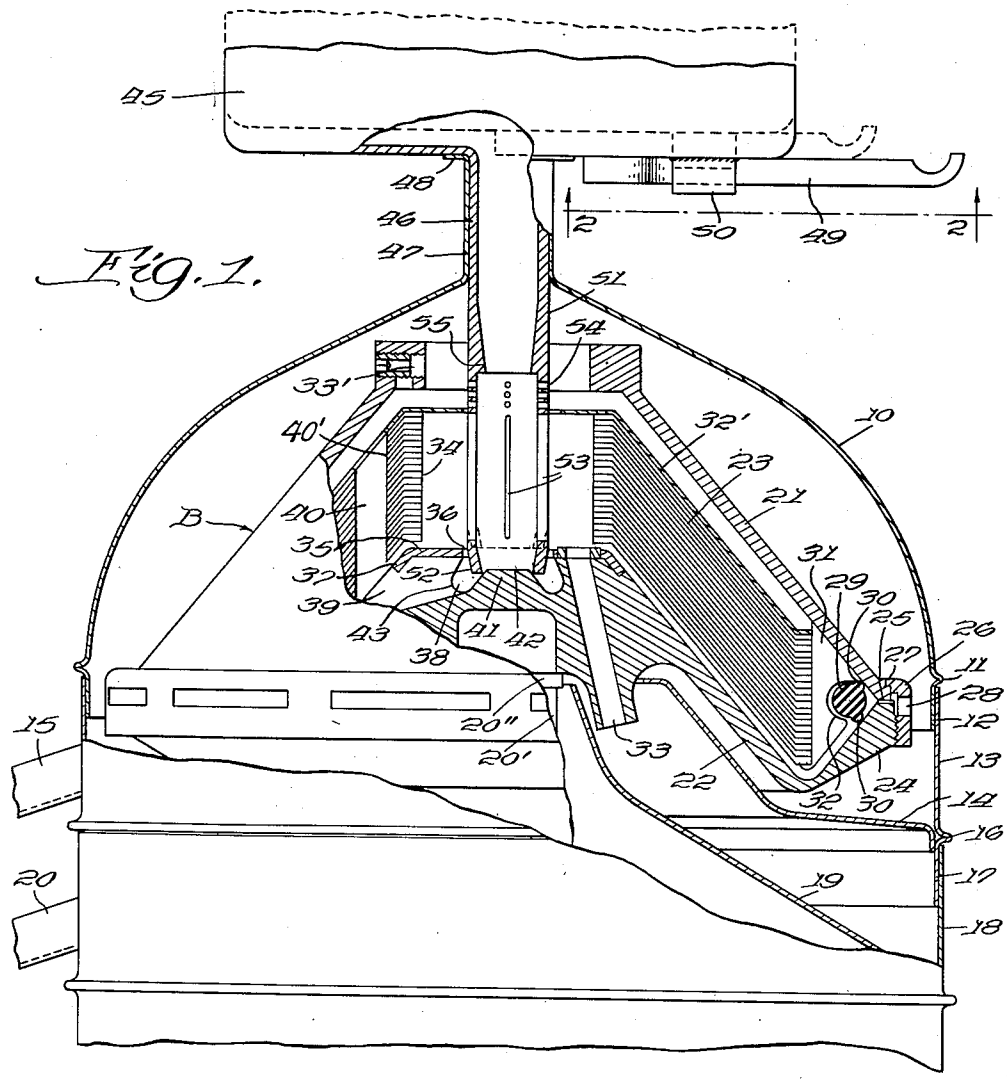

Fig. 1.

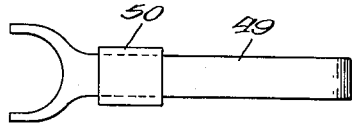

Fig. 2.

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Fig. 3.

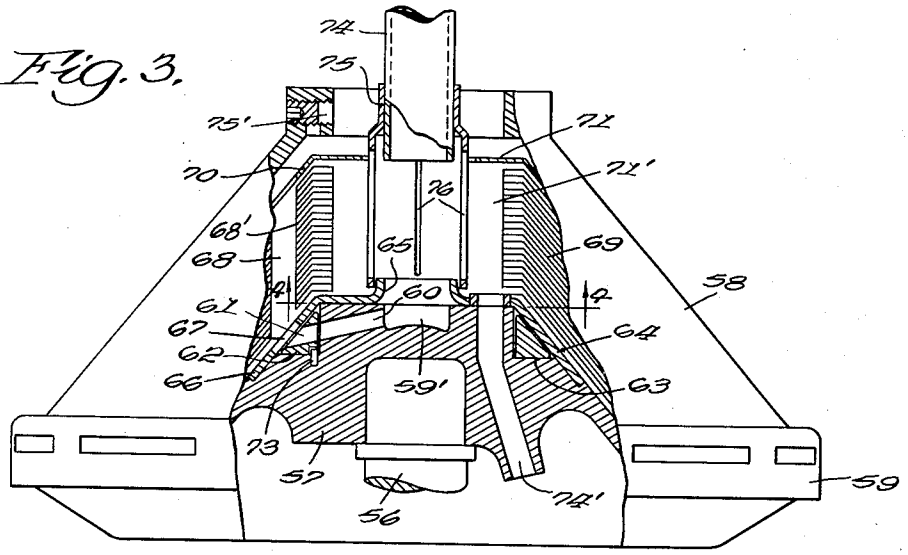


Fig. 4.

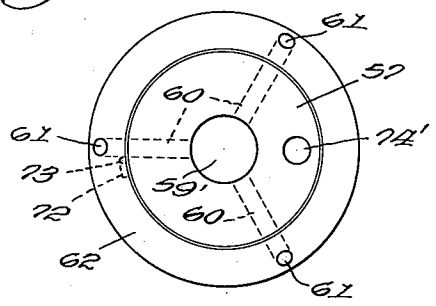
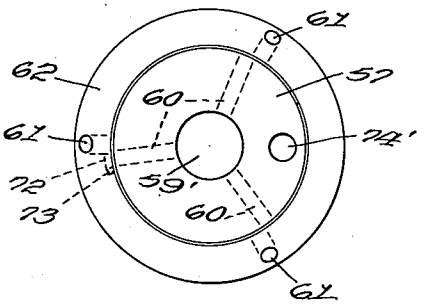


Fig. 5.



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SELF-WASHING CENTRIFUGE

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21 Claims. (Cl. 233—1)

1

This invention relates to centrifugal devices. More specifically, it relates to a self-washing cream separator.

In the construction and operation of cream separators, difficulties have been encountered in constructing a device which can be cleaned sufficiently to continue operation over a long period of time or to remain assembled for intermittent operation without disassembling the device and individually washing the components thereof, particularly the disks used in most cream separators at the present time. Attempts have been made to rinse the devices with washing liquid without providing any auxiliary valve structures. These attempts have not been satisfactory due to the low velocity with which the washing liquid passes over the surfaces which accumulate slime and other deposits. Other attempts have been made to provide self-washing cream separators by providing auxiliary valves in the periphery of the bowl structure with all surfaces slanting toward the valve openings whereby, upon opening the valves, washing liquid will be delivered at high velocity over all surfaces of the separating structure.

The principal object of the present invention is to provide improved self-washing cream separator devices of a type in which valve means are provided for opening the bowl structure at its periphery during a reduced speed of operation.

Another principal object is to provide diverting means for supplying milk through one path for a separating operation and to supply washing liquid through another path during a cleaning operation.

Another object is to provide washing liquid directing means whereby a minimum amount of washing liquid may be added directly through the supply means for liquid to be treated and distributed uniformly to the edges of separating disks.

A more specific object is to provide a manually movable valve means for diverting washing liquid to the edges of a disk pack.

Another more specific object is to provide a diverting valve structure automatically operable by centrifugal means to divert washing liquid to the disk edges simultaneous with the opening of valves in the periphery of the bowl structure for the discharge of washing liquid.

Another specific object is the provision of valve structure operable by a speed change in the bowl structure to overrun the bowl structure as the speed decreases and thereby divert washing liquid to the edges of the disk pack.

The above objects and others which will be apparent from the detail description to follow are accomplished by constructions such as shown in the drawings, in which

Figure 1 is an elevation of a cream separator construction with a portion broken away in section to show the interior of the bowl structure;

2

Figure 2 is a plan view taken on the line 2—2 of Figure 1;

Figure 3 is a combined elevation and sectional view showing another modification;

Figure 4 is a view taken on the line 4—4 of Figure 3;

Figure 5 is a view similar to Figure 4 with the valve member in a different positon.

Centrifugal devices have been long used for many purposes particularly for separating cream from whole milk. Such devices have become rather standardized, most types now utilizing a plurality of closely spaced, nested, conical disks. The disk pack is mounted in a bowl structure which is rotated at a high speed by suitable driving mechanism, usually around 9000 R. P. M. Because of the well known use of such structures, the drawings are somewhat diagrammatic except for the illustration of the specific parts of the bowl structure in which the invention is involved. In Figure 1 certain of the exterior parts of a separator construction are shown, these parts usually being referred to as the sheet metal ware. A dome-shaped sheet metal housing 10 has a bead 11 adjacent its lower extremity providing a flange 12 beyond the bead which slidably fits into a cylindrical wall 13, said wall, together with an annular interior deflector member 14 and a spout 15, comprise means for receiving and delivering skimmed milk with is delivered against the housing 10 and downwardly therefrom. The wall 13 is provided near its lower edge with a bead 16 and a flange portion 17 extending beyond the bead. Said flange portion fits in a cylindrical wall 18 which, together with an annular deflector 19 and a spout 20, comprise means for receiving separated cream. The supporting structure for the sheet metal ware has not been illustrated as it may be of any conventional construction many forms of which are well known in the prior art.

A spindle 20', which is to be driven by any conventional means as used in high speed centrifugal devices is provided with a shoulder 20'' to provide for mounting the bowl structure of the device for rotation. Said bowl structure, which will be referred to in its entirety by the reference character B, consists essentially of a conical outer shell 21, a base structure 22, and a plurality of nested conical disks 23. The base structure 22 is fitted on the spindle 20' against the flange 20'' for rotation at high speed with the spindle. Said base structure has an outer portion 24 which extends upwardly at an angle beyond the outside terminal edges of the disks 23. Said portion is generally conical and meets the shell portion 21 abutting thereagainst. A plurality of spaced openings, one of which, 25, is visible, are provided

around the abutting portions of said members to provide outlet means from the interior or inner compartment formed within the bowl structure.

An annular member 26 has a flange portion 27 overlapping the peripheral edge of the shell 21 for clamping said shell in position against the base structure. The annular member 26 is threaded onto the peripheral edge of the upturned portion 24 of the base structure. A plurality of openings 28 are provided in the annular member 27 for the escape of liquid passing outwardly through the passages 25.

An annular rubber ring 29 is illustrated for providing valve means. Said member has a plurality of spaced projections 30 which engage the inner surfaces of the shell 21 and the upturned portion 24 of the base structure spaced from their inner section. The ring 29 is of such resilience and the projections 30 are so positioned and spaced, that upon the exertion of centrifugal force on the ring 29 by high speed rotation of the bowl, said ring extends and fits against the inner surface of the shell 21 and the inner surface of the portion 24 to effect a seal against the escape of liquid during the separating operation. Upon a reduced speed of operation for washing, said ring releases to permit the escape of washing liquid through the passages 25 and the openings 28. This peripheral outlet valve construction is a part of this invention only generally as to the provision of means for permitting the escape of washing liquid at the peripheral portion of the bowl structure. The disk 23 may be supported in position by any conventional means. One web, 31, is shown in Figure 1 for engaging the edges of the disks. Said web is also provided with circular notches 32 for maintaining the ring 29 in position.

An upper cream separating disk 32' is illustrated which overlaps the other disks which are of uniform size to provide an internal annular channel for the collection of cream. As said cream collects at the inner edges of the disks and builds up a layer therein, it passes downwardly and out of the bowl through a channel 33 formed at an angle in the base structure 22 of the bowl. The milk which passes upwardly along the inside of the shell 21 and outside of the dividing disk 32 discharges through an adjustable milk outlet channel 33' provided at the top of the shell 21.

The inner edges of the disks 23 provide a generally unobstructed cylindrical space 34. Said space is limited at the top by the dividing disk 32 and at the bottom by an annular member 35 which has a central opening 36 and a downturned flange 37 fitting into a recess formed in the base structure 22. The opening 36 registers with a distributer chamber 38 formed in the base structure 22. Said distributer chamber has a plurality of outlets, one of which, 39, is visible in Figure 1; said outlets extending radially and registering with a distributer channel 40 provided by a plurality of aligned openings 40' in the disks 23 eccentric with respect to their center openings. This is a conventional construction for cream separators.

The distributer chamber 38 has a raised center portion 41 formed integrally with the base structure, which has a flat top portion 42. The top portion 42 lies a substantial distance below the annular member 35 and the distributer chamber shape is further altered by undercutting in an outwardly direction to form a curved wall 43 whereby any liquid discharged from the surface 42 will be deflected downwardly and retained in the distributer chamber until it is discharged through one of the outlets 39. A liquid supply receptacle 45 is provided with a tubular extension 46 which slidably fits into a cylindrical neck 47 formed on the housing 10. In the position shown in the drawings the bottom of the receptacle 45 fits into a flange 48 formed on the neck 47. A manually operable member 49 slidable through a retainer 50 secured to the bottom of the receptacle 45 is position to be inserted between the flange 48 and the bottom of the receptacle 45 when it is lifted to the dotted-line position for retaining said receptacle in said lifted position.

The tubular extension 46 extends downwardly into the bowl 10 to provide a liquid supplying means in the form of a supply tube 51 within said housing. Said liquid supplying means being carried by the housing 10, it is held against rotation. Said tube extends through the cylindrical space 34 and is provided at its lower end with an inwardly tapered or restricted-delivery end portion 52. Said end portion, as shown in full lines in Figure 1, overlaps the top surface 42 of the upwardly extending portion 41 in the distributer chamber 38 whereby liquid delivered from said surface during rotation will engage the inner conical wall of said end and will be delivered upwardly thereby.

Within the space 34 and for the entire axial extent of the inner edges of the disks 23, the supply tube 51 is of a foraminous construction being provided with radial outlets illustrated as a plurality of narrow axially extending opening means in the form of slits 53. Above the dividing disk 32, a plurality of openings 54 are provided in the supply tube 51. The tube 51 formed with the slits 53 and the openings 54 provides foraminous means extending throughout the center of the bowl to deliver washing liquid radially outwardly when the flow is cut off through the distributing chamber 38. A restriction 55 is formed in the supply tube above said openings to deliver fluid in a stream of substantially less diameter than the slitted lower portion of the supply tube whereby said stream of liquid will initially be delivered to the restricted lower end of said supply tube.

In normal operation of a cream separator as above described and as shown in Figure 1, milk to be separated will be delivered through the supply tube 51 and due to the restriction 55 will be delivered as a stream at the restricted lower end 52 of the supply tube which will be in the dotted-line position as shown in Figure 1. The milk will be discharged from said end into the distributer chamber and will be discharged therefrom through the outlets 39 and to the channels 40 for separation in the conventional manner.

When the separator is to be washed after completion of a separating operation, the supply tube being axially shiftable is dropped to the position shown in Figure 1 by withdrawal of the member 49. Wash liquid is then delivered through the supply tube 51. As the restricted end 52 of the milk tube in cooperation with the upstanding portion 41 within the distributer chamber forms a valve means to cut off and to block the flow of liquid through the distributer chamber, the liquid will build up in the tube 51 assisted by the centrifugal force of impinging liquid delivered off of the rotating surface 42. Liquid will then build up in the tube 51 and will flow outwardly through the slits 53 and the openings 54. These streams of liquid will impinge against the inner edges of the disks reaching all of said edges as

the bowl structure rotates at high speed. During the washing operation, the power is cut off whereby the speed of the bowl drops, releasing the rubber ring **29** and permitting the discharge of the washing liquid at the periphery of the bowl structure.

With a construction as above described and by its operation as explained, a relatively small quantity of wash liquid is effectively delivered to the inner edges of all of the disks to obtain a satisfactory washing action. Liquid is also discharged through openings **54** to other parts of the separator for cleaning other passages. A certain amount of liquid will also escape through the distributer chamber, cleaning these parts of milk and accumulated slime.

Figure 3 represents a modification in which a different type of flow control means, or valve means, is utilized for altering the flow path of liquid through the bowl structure for a washing operation. In Figure 3 a spindle **56** carries a bowl structure including a base **57** and a shell **58** secured together by a clamping member **59** identical in structure with the clamping member **26**. It is to be understood also that the same annular ring valve and outlet means would be provided in the modification of Figure 3, such structure not being shown as said figure shows in elevation the outer portions of the bowl structure.

The base structure **57** is formed centrally with a distributer chamber **59'** having a plurality of discharge outlets **60**. Said outlets are adapted to register, as shown in Figure 3, with radially disposed openings or passages **61** formed in an annular valve member **62** mounted for limited angular movement or rotation in an annular chamber **63** formed concentric with the distributer chamber around the upper portion of the base structure **57**. An annular member **64** has an upturned flange **65** extending above the distributer chamber **59'** and a conical, downwardly extending portion **66** overlapping the recess **63** and forming therewith a closed compartment for the member **62**. The conical portion **66** of the member **64** is provided with openings **67** registering with channels **68** formed by a plurality of aligned openings **68'** in nested disks **69** which constitute a disk pack for carrying on a separating operation. At the top of said disk pack, a dividing disk **70** is provided, said disk having a flange **71** extending inwardly and overlapping a cylindrical space **71'** formed by the aligned inner edges of the disks **69**.

The valve member **62** is provided with a slot or recess **72** into which a pin **73** extends. Said pin permits relative or overrunning angular movement of the member **62** with respect to the base structure **57** in the recess **63** a sufficient angular distance to substantially block the outlets **60** as shown in dotted lines in Figure 5. In this position only a small portion of liquid flows through the distributing chamber **59'**.

A supply tube **74** coaxial with the bowl structure and adapted to be supported and held stationary by any conventional means such as the means shown in Figure 1, extends inwardly within the bowl structure as far as the dividing disk **70**. A concentric tube **75** of substantially greater diameter than the tube **74** is secured thereto and extends downwardly into overlapping relation with respect to the flange **65** in closely adjacent relation thereto to restrain the flow of liquid between the end of said tubular structure and the adjoining portion of the bowl structure which in the structure shown in Figs. 3 and 6 is the flange **65**. Discharge openings are provided in

the tube **75** throughout its length by means of a plurality of narrow slits **76**. Said slits extend substantially the entire height of the disk pack whereby liquid discharged through said slits reaches the edges of all of the disks.

A cream discharge passage **74'** is provided in the base structure **57**. A milk discharge outlet **75'** is provided at the top of the shell **58**.

The operation of the modification shown in Figure 3 will be readily understood from the description of the component parts. Milk delivered through the supply tube **74** is discharged as a stream directly through the distributer chamber **59'** from whence it flows outwardly through the outlets **60** and the passages **61** which register with the outlets **60** to the channels **68** for separating in the conventional operating manner of a conical disk type of separator. This action takes place when the separator is operated at uniform speed. When it is desired to wash the separator the power is cut off whereupon the bearing friction and air friction of the bowl structure starts decelerating the speed of the bowl structure, the valve member **62** being freely mounted and not being subjected to the same degree of resistance, upon a predetermined change in speed of the bowl structure overruns from the position shown in Figure 7 to the position shown in Figure 8, thereby closing the outlets **60** and stopping the flow of liquid from the distributer chamber. When the bowl structure is being brought up to separating speed, the valve member lags behind and moves back to the position of Fig. 7 to open the outlets **60** for the flow of liquid from the distributer chamber. The wash liquid then being supplied builds up within the concentric tube **75** and discharges therefrom radially against the disks. The washing operation then takes place in the same manner as in the modification of Figure 1 with the peripheral outlet valves opening as the speed of the bowl structure decreases.

The different modifications of applicant's self-washing bowl construction for centrifugal devices are preferred embodiments of his novel valve means for altering the path of liquid flow during a separating operation and during a washing operation, all modifications, however, falling within the appended claims are contemplated as a part of the invention.

What is claimed is:

1. A bowl construction for a self-washing centrifugal separator comprising a bowl structure formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings to provide a generally cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributer chamber being provided with radially delivering outlet means, said disks being formed with aligned openings eccentric to the center openings and communicating with said outlet openings means, foraminous means extending through the cylindrical space and to the distributer chamber for supplying liquid thereto, and means for blocking flow of liquid through said distributor chamber thereby diverting the liquid flow from the distributer chamber through the foraminous means.

2. A device as set forth in claim 1 in which means are provided for holding the liquid supplying means against rotation.

3. A device as set forth in claim 1 in which outlet means are provided at the periphery of

the bowl structure operable to discharge liquid therefrom at one speed of operation.

4. A device as set forth in claim 1 in which the foraminous means is a tube having a slit extending axially thereof.

5. A device as set forth in claim 1 in which the liquid supply means includes a non-rotatable tube extending downwardly to the top of the disk pack and a concentric tube of larger diameter extending from the first tube to the distributer chamber, said second tube being provided with discharge openings for radial delivery of liquid upon operation of the means for blocking the flow of liquid through the distributor chamber.

6. A bowl construction for a self-washing centrifugal separator comprising a bowl structure formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings to provide an unobstructed cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributor chamber being provided with radially delivering outlet means, valve means operable to close said outlet means, said disks being formed with aligned openings eccentric with respect to the center openings and communicating with said outlet means, means for supplying liquid to the distributer chamber, said means being operable upon closing of the valve means to thereafter supply liquid to the interior of the cylindrical space and to the inner edges of the disks.

7. A device as set forth in claim 6 in which the liquid supply means is a tube extending downwardly through the cylindrical space and to the distributer chamber, said tube being provided with openings for discharging liquid therefrom operable when the valve means close the distributer chamber outlet means.

8. A device as set forth in claim 6 in which the liquid supply means includes a non-rotatable tube extending downwardly to the top of the disk pack and a concentric tube of larger diameter extending from the first tube to the distributer chamber, said second tube being provided with discharge openings for radial delivery of liquid upon closing of the valve means.

9. A device as set forth in claim 6 in which the valve means for the outlet means of the distributer chamber is a member mounted for limited angular movement with respect to the bowl structure about the same axis, said member being constructed to regulate flow through the outlet means by over-running movement with respect to the remaining bowl structure.

10. A device as set forth in claim 6 in which the valve means includes an annular valve member carried for limited relative rotation with respect to the bowl structure on the same axis, said valve means being operative to control liquid flow through the distributer chamber by over-running movement of said member upon predetermined changes in the speed of the bowl structure.

11. A device as set forth in claim 6 in which the valve means is an annular valve member mounted for limited relative angular movement with respect to the bowl structure and around the distributer chamber, said member having radially disposed openings adapted to register with the outlet means in the distributer chamber in one angular position and to close said outlet means in another angular position.

12. A bowl construction for a self-washing centrifugal separator comprising a bowl structure

formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings providing a generally cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributer chamber being provided with outlet openings extending radially from the central portion thereof, said disks being formed with aligned openings eccentric with respect to the center openings and communicating with said outlet means from the distributer chamber, a liquid supply tube adapted to extend downwardly into said distributer chamber, said tube being provided with axially arranged openings, and said tube having an annular imperforate bottom portion and being adjustable from a lower position with the bottom portion extending into the liquid distributing chamber with said bottom portion arranged in a liquid flow blocking position with respect to the distributing chamber to an upper position with said tube terminating above said distributer chamber, whereby in the raised position liquid to be separated may be discharged into the distributing chamber and radially outwardly therefrom and whereby when the tube is in the lower position liquid will be restrained from movement out of the distributer chamber whereby the tube fills with liquid which discharges radially therefrom through the openings, whereby the liquid engages the inner edges of the disk pack, and means in said bowl structure at the periphery thereof for releasing the liquid therein upon a lower speed of the bowl, whereby the disks may be washed by the liquid delivered through the openings in the supply tube.

13. A device as set forth in claim 12 in which the liquid supply tube is stationary with respect to the bowl structure during washing operation.

14. A device as set forth in claim 12 in which the opening means in the tube includes a continuous narrow slit extending longitudinally of the tube coextensive with the disk pack.

15. A device as set forth in claim 12 in which the supply tube is provided with a restriction above the top of the disk pack whereby liquid passing therethrough drops downwardly intact as a stream of smaller diameter than the interior of the tube below the restriction.

16. A bowl construction for a self-washing centrifugal separator comprising a bowl structure formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings whereby the inner disk edges provide a generally cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributer chamber being provided with outlet openings extending radially from the central portion thereof, said disks being formed with aligned openings eccentric with respect to the center openings and communicating with said outlet means from the distributer chamber, a raised center portion in the distributer chamber providing an annular surrounding bottom channel in the distributer chamber, a liquid supply tube adapted to extend downwardly into said annular channel, said tube having an inwardly tapering bottom portion of reduced diameter, said portion being adapted to extend below and around the raised center portion in the distributer chamber, whereby liquid thrown therefrom encounters said tapering portion, whereby the liquid is forced upwardly into the tube, said tube being provided

with axially extending opening means and said tube being adjustable from a lower position with the bottom portion extending into the liquid distributing chamber to an upper position with said tube terminating above said distributer chamber, whereby in the raised position liquid to be separated may be discharged into the distributing chamber and radially outwardly therefrom and whereby when the tube is in the lower position liquid will be restrained from movement out of the distributer chamber and will be forced upwardly into said tube whereby the tube fills with liquid which discharges radially therefrom through the opening means whereby the liquid engages the inner edges of the disk pack, and means in said bowl structure at the periphery thereof for releasing the liquid therein upon a lower speed of the bowl, whereby the disks may be washed by the liquid delivered through the openings in the supply tube.

17. A device as set forth in claim 16 in which the liquid supply tube is stationary with respect to the bowl structure during washing operation.

18. A device as set forth in claim 16 in which the opening means in the tube includes a continuous narrow slit extending axially of the tube coextensive with the disk pack.

19. A bowl construction for a self-washing centrifugal separator comprising a bowl structure formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings whereby the inner disk edges provide a generally cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributer chamber being provided with outlet openings extending radially from the central portion thereof, said disks being formed with aligned openings eccentric with respect to the center openings and communicating with said outlet means from the distributer chamber, a raised center portion in the distributer chamber providing an annular surrounding bottom in the distributer chamber, liquid supply means including a stationary tubular structure having a circular downwardly opening discharge conduit terminating at the top of the cylindrical space and a surrounding tube having an inside diameter larger than the inside diameter of said discharge conduit tube and extending to the distributor chamber, said tube having an inwardly tapering annular and imperforate bottom portion of reduced diameter, said portion being adapted to extend below and around the raised center portion in the distributer chamber, whereby liquid thrown therefrom encounters said inclined wall portion whereby the liquid is forced upwardly into the tube, said tube being provided with an axially arranged opening means coextensive with the edges of the disk structure, and said tube being adjustable from a lower position with the bottom portion extending into the liquid distributing chamber to an upper position with said tube terminating above said distributer chamber, whereby in the raised position liquid to be separated may be discharged into the distributing chamber and radially outwardly therefrom and whereby when the tube is in the lower position liquid will be restrained from movement out of the distributer chamber and will be forced upwardly into said tube, whereby the tube fills with liquid which discharges radially therefrom through the openings, whereby the liquid engages all interior surfaces of the inner edges of the disk pack, and means in said bowl structure at the periphery thereof for releasing the liquid therein upon a lower speed of the bowl, whereby the disks may be washed by the liquid delivered through the openings in the supply tube.

20. A bowl construction for a self-washing centrifugal separator comprising a bowl structure formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings, the edges of the disks around said openings providing a generally cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributer chamber being provided with radially delivering outlet means, said disks being formed with aligned openings eccentric to the center openings and communicating with said outlet opening means, tubular fluid supply means extending through the cylindrical space and to the distributer chamber arranged and constructed to supply liquid to be separated therethrough to the distributer chamber, said supply means having openings over an area axially coextensive with the cylindrical space, and valve means operable for a washing operation to block flow of washing liquid to the distributer chamber thereby diverting the liquid flow from the distributer chamber through the openings in the supply means to the edges around the center opening of the disks.

21. A bowl construction for a self-washing centrifugal separator comprising a bowl structure formed with a compartment therein, a stack of spaced conical disks mounted in said compartment, said disks having aligned center openings, the edges of the disks around said openings providing an unobstructed cylindrical space extending axially of the bowl structure, a distributer chamber formed in said structure at the bottom of said cylindrical space, said distributer chamber being provided with radially delivering outlet means, a valve means for said distributer chamber for regulating the flow of fluid through said outlet means, said disks being formed with aligned openings eccentric with respect to the center openings and communicating with said distributer outlet means, means for supplying liquid to the distributer chamber, said means being operable upon closing of the valve means to thereafter supply liquid to the interior of the cylindrical space and to the inner edges of the disks.

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