

Sept. 29, 1959

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2,906,449

FLUSHING OF CENTRIFUGAL SEPARATORS OF THE HERMETIC TYPE

Filed Jan. 5, 1955

2 Sheets-Sheet 1

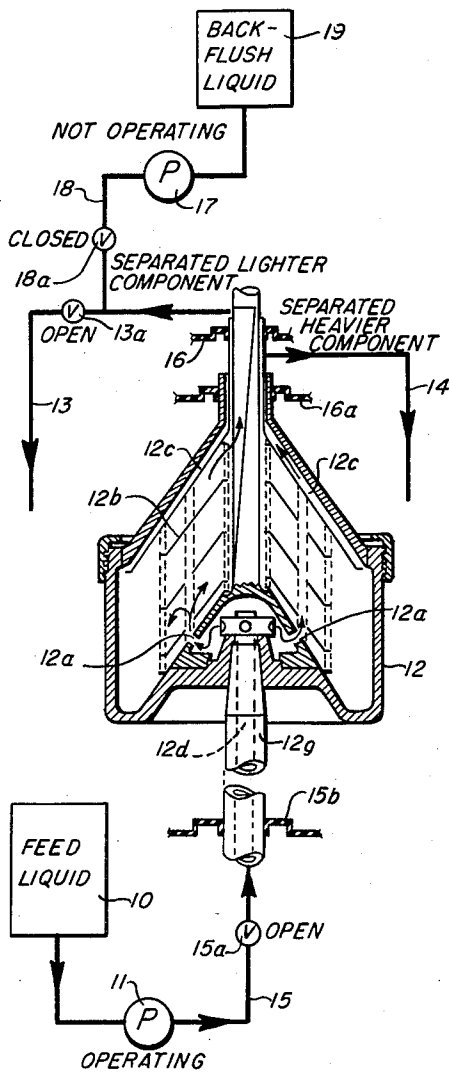


FIG. 1

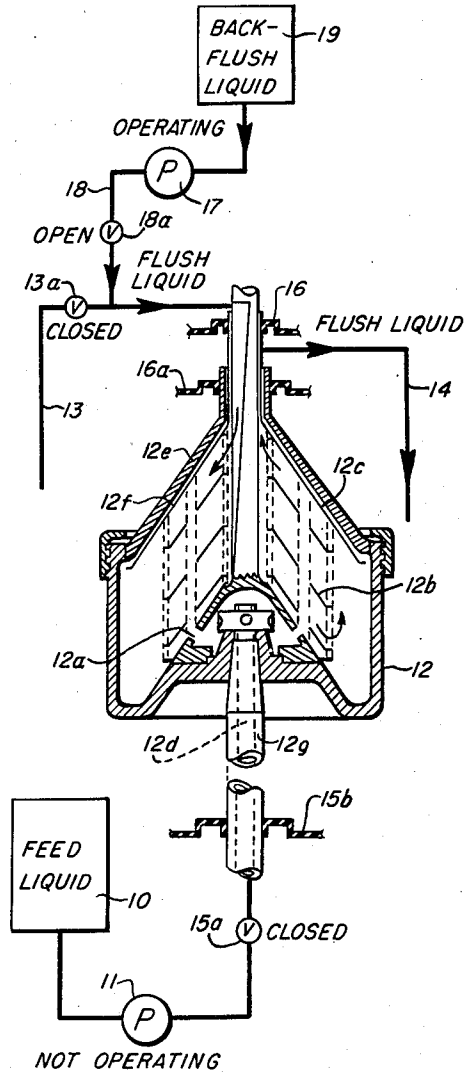


FIG. 2

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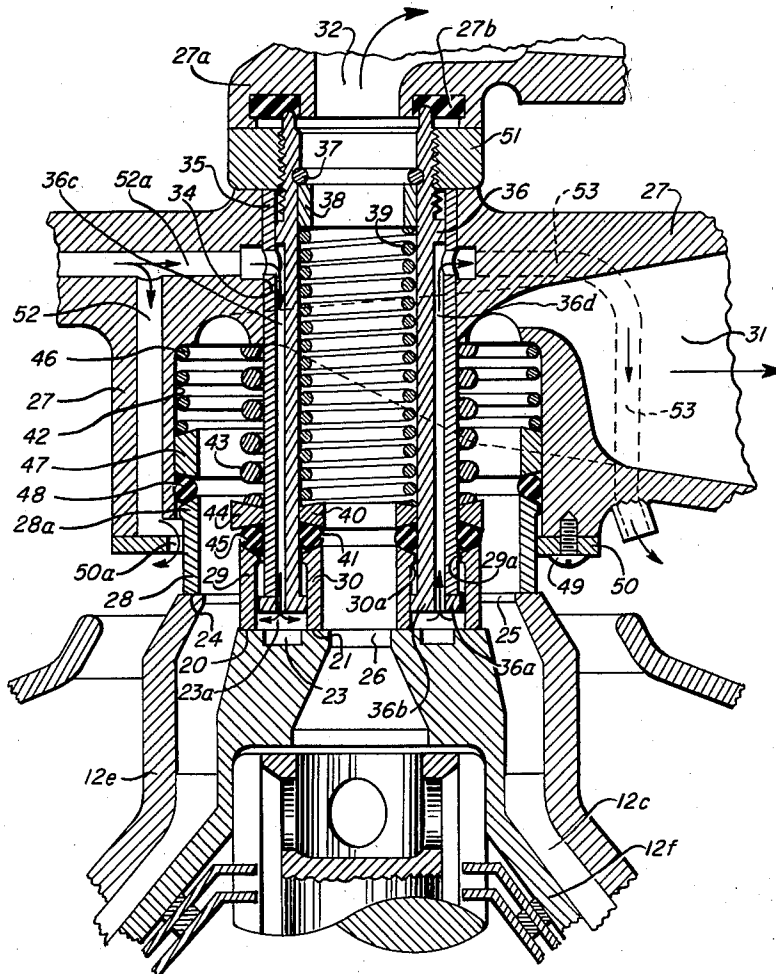


FIG. 3

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FLUSHING OF CENTRIFUGAL SEPARATORS OF THE HERMETIC TYPE

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17 Claims. (Cl. 233—14)

This invention relates to centrifugal separators and particularly to a method and arrangement for flush cleaning of a separator bowl, including the discs therein, without dismantling the same.

Centrifugal bowl separators of the hermetically closed type disclosed in Andersson et al. Patent No. 2,536,793, granted January 2, 1951, are used in many industrial processes. One field of use involves the separation of sludge or solid-like impurities, which will be referred to as slimes, from a liquid mixture containing the slimes. In such operations, the separated slimes are concentrated centrifugally at the peripheral part of the bowl from which a major proportion of the slimes are discharged through a suitable outlet from the bowl. A small proportion of the separated slimes, however, do not readily pass out of the bowl through the slime outlet but accumulate in an ever increasing amount in the peripheral part of the bowl where they remain until the rotation of the separator bowl has been stopped and the slimes are removed by manual cleaning of the bowl.

If the separating operation is continued for an extended period, the centrifuge will operate efficiently only until the accumulated slimes completely fill the sludge space of the bowl, that is, until the peripherally arranged layer of accumulated slimes reaches a depth sufficient to contact the outer periphery of the discs within the bowl. The centrifuge must then be stopped, the bowl dismantled, and the accumulated slime removed, as by scraping.

If the materials being separated by centrifugal force within the bowl are of a particularly slimy nature, experience has shown that some grouping or packing of the slimes may take place between the discs of the bowl. In such a situation, the manual cleaning of the bowl must also include a washing of the individual discs in the stack, in addition to the removal of accumulated slimes from the peripheral part of the interior of the bowl.

As a measure for partial cleaning of the bowl and discs, it has been proposed to connect the separator inlet pipe to a source of water supply or other suitable liquid, and thereby flush the bowl and discs by feeding the liquid through them after the centrifuge has been stopped. In this way, the slimes are more or less flushed out of the bowl and carried away with the flush liquid flow by way of branch pipes.

With such an arrangement, it is necessary to continue the flushing operation for a considerable period of time before a point is reached where the flush liquid removes no more slime from within the bowl. Consequently, the use of this prior arrangement to obtain its maximum

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flushing effect requires a large amount of water or other flushing liquid and the attendance of a workman throughout an extended period of time.

Another undesirable feature of this prior flushing arrangement is that the slimy material being flushed from the bowl may become lodged in either of the discharge lines from the centrifuge where they can be picked up by the subsequent normal flow of either of the separated components when the centrifuge is again placed in normal separating operation.

The principal object of this invention is to provide an improved method and arrangement for centrifugal separators of the hermetically closed type whereby the above-mentioned difficulties in connection with in-place flush cleaning are avoided.

In accordance with the present invention, the centrifuge is of the hermetic type including a rotatable centrifugal bowl having a feed inlet, a separated lighter component outlet and a separated heavier component outlet. A stationary feed pipe has an hermetically sealed flow connection with the feed inlet of the bowl, and two stationary discharge pipes are provided with hermetically sealed flow connections from the respective outlets of the bowl, so that the feed is delivered to the bowl and the separated components are discharged therefrom through hermetically sealed paths. Valves are provided in the feed pipe and in one of the discharge pipes (preferably the discharge pipe for the lighter separated component) for closing these pipes when the bowl is to be flushed. The centrifuge also comprises a source of flushing liquid and means for delivering liquid from this source under pressure to the valved discharge pipe at a point located between the valve therein and the bowl outlet connected to this pipe. With this arrangement, the bowl can be flushed by simply closing the valves in the feed pipe and the one discharge pipe and feeding the flush liquid into the latter pipe at the above-mentioned point, as by pumping the liquid through a pipe connected to this discharge pipe. The flush liquid is thus introduced into the bowl through one of its normal outlets and is forced through the bowl to the other outlet, the liquid being made to bypass the normal inlet of the bowl due to closing of the feed pipe and because of the sealed flow connection between the latter and the bowl inlet.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which:

Figures 1 and 2 are diagrammatic views of a centrifugal separator installation embodying one form of the invention, showing the direction of the flow streams to and from the centrifugal bowl during the normal separating operation and the back-flushing operation, respectively, and

Figure 3 is a vertical sectional view of the upper part of the centrifuge, showing the hermetically sealed flow connections from the centrifugal bowl.

In the preferred form of the invention, the discharge pipe to which the flushing liquid is delivered is the pipe connected to the bowl outlet for the lighter separated component; and this outlet communicates with the inner or central part of the centrifugal bowl within a set of conical discs forming separating spaces for the feed material, while the peripheral part of the bowl surrounding the outer edges of the discs communicates with the outlet for the separated heavier component. Accordingly, when the valves are set for flushing of the bowl, the flush

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liquid is forced into the bowl through the normal outlet for the lighter component and then outwardly through the spaces between the discs to the outer part of the bowl, from which it is discharged through the usual discharge path for the separated heavier component. In other words, the flushing liquid is made to flow in a direction opposite to that of the separated lighter component when the bowl is used for a normal separating operation, but in the same direction as the normal flow of the separated heavier or sludge component. In this way, the sludge or slime substances accumulated within the centrifugal bowl are removed by the flushing liquid in such a manner as to prevent any of these dislodged substances from remaining on the surfaces normally contacted by the separated lighter component when the separating operation is resumed. This, of course, is of particular advantage in cases where it is especially important to avoid contamination of the separated lighter component, as in the centrifuging of vegetable and animal oils. However, the normal discharge path for the separated heavier component is also effectively flushed by the practice of the present invention, since the closing of the feed pipe results in the passage of all the flushing liquid through the disc spaces and the outer part of the bowl and along the surfaces normally contacted by the discharging heavier component when the separating operation is resumed.

The flushing may be effected according to the invention while the centrifugal bowl is rotating at operating speed or at a reduced speed, or is stationary. If it is effected while the bowl is rotating at operating speed or at a lower speed, the effective pressure of the flush liquid must be sufficient to overcome the centrifugally generated discharge pressure of the lighter separated component of the normal feed material remaining in the bowl after closing of the feed valve. In this way, the flush liquid will overcome the tendency for the lighter component to discharge through its normal outlet and will force it to discharge from within the bowl via the only other outlet remaining open, namely, the normal outlet for the separated heavier component of the feed material. This avoids the possibility of incompletely separated sludge becoming lodged in the normal discharge path for the lighter separated component and being carried out of the bowl with this component once the flushing operation is completed and the normal separating operation resumed.

As previously indicated, the present invention depends upon the use of hermetically sealed flow connections to and from the centrifugal bowl. These connections may be of a form known in the art, as disclosed, for example, in said Patent No. 2,536,793. However, I prefer a special construction of the sealed connections between the bowl outlets and the stationary discharge pipes. According to this construction, the connections comprise a stationary housing having a central discharge opening connected to the lighter component discharge pipe, and an annular partition in the housing forming a central passage extending to this opening from a central outlet of the bowl. The housing forms an annular chamber surrounding the partition and aligned with a second bowl outlet of annular form surrounding the central outlet and separated therefrom by an inner annular sealing surface of the bowl which is normal and concentric to the bowl axis, the bowl also having a similar outer annular sealing surface surrounding the second or annular outlet. An inner sealing ring has one end engaging the inner sealing surface of the bowl around its central outlet and is held laterally by the annular partition but moveable lengthwise thereof. An outer sealing ring is disposed in the annular chamber of the housing with one end of the ring engaging the outer annular sealing surface of the bowl, the outer ring being held laterally by the housing but movable lengthwise of the annular partition. This second or annular bowl outlet communicates between the two sealing rings and through the annular chamber of the housing with a second discharge opening thereof which is connected to the heavier

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component discharge pipe. Through the action of biasing means in the housing, the sealing rings are urged against the respective sealing surfaces of the bowl to prevent leakage between the discharge paths from the two outlets of the bowl.

In the preferred form of the invention, the annular partition in the housing is formed internally with cooling liquid feed and discharge channels leading to and from an annular space located between the inner sealing surface of the bowl and the adjacent end of the partition and defined by the inner sealing ring which the partition surrounds and by an intermediate sealing ring which surrounds the partition. The outer sealing ring may be cooled by liquid delivered to the outer surface of this ring by a branch of the liquid inlet passages which supply the channels in the partition. To complete the sealing of the two component discharge passages from each other and from the cooling liquid, resilient rings are interposed between the biasing means and the three sealing rings, so that the resilient rings seal against the inner and outer surfaces of the annular partition and against the outer wall of the surrounding annular chamber, respectively.

Referring now to Figs. 1 and 2, the feed liquid to be centrifugally separated into its components according to their specific gravities is pumped from a tank 10, or other source of supply, by means of a pump 11 through a hermetically closed centrifugal separator 12 of the type generally illustrated and described in the aforementioned Patent No. 2,536,793. The separator 12 has stationary discharge pipes 13 and 14 sealed thereto for conveying the separated lighter and heavier components, respectively, of the feed liquid from within the bowl. The stationary feed pipe 15 between pump 11 and the centrifugal bowl 12 is equipped with a valve 15a to control liquid flow therethrough; and the pipe 15 is connected to the bowl through a sealing or tightening device shown generally at 15b, which forms an hermetically sealed flow connection for delivering the feed liquid to the interior of the bowl. The sealing or tightening devices forming hermetically sealed flow connections between the rotating bowl outlets and the stationary piping, two of which are diagrammatically represented at 16 and 16a, may be constructed as shown in said Patent No. 2,536,793 or in Cramton Patent No. 2,147,691, granted February 21, 1939. The sealing device 15b between the bowl inlet and the feed pipe 15 may be arranged as disclosed in said Patent No. 2,536,793.

During the normal separating operation (Fig. 1) the feed stream from pump 11, upon entering the centrifugal bowl, is fed through distributing holes 12a to an aligned stack of frusto-conical discs 12b between which it separates into its relatively heavier and lighter components in a manner well known in the centrifugal separating art. The heavier component moves outwardly between the discs into the peripheral portion of the bowl chamber, thence upwardly through passages 12c between the top-disc and the bowl top to the heavier component discharge outlet hermetically connected to the discharge piping 14. The lighter separated component moves inwardly between the discs to the central portion of the bowl chamber, and then upwardly to the lighter component discharge outlet hermetically connected to the discharge piping 13.

The lighter component discharge piping 13 has a pump 17 connected thereto by means of a pipe 18, the latter joining the pipe 13 at a point between valve 13a and the centrifugal bowl. The pump 17 and pipe 18 form a means for delivering a flushing liquid under pressure from a tank or other source 19 to the discharge piping 13. Valves 13a and 18a are arranged in the discharge piping 13 and branch pipe 18, respectively, to control liquid flow in either pipe. During a normal separating operation (Fig. 1) the feed pump 11 is operating and the valve 15a in the feed pipe is open, as is the valve 13a in the separated lighter component discharge piping 13. At the

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same time, the valve 18a in branch pipe 18 is closed and the flush-liquid pump 17 is not operating.

When it is desired to back flush the centrifugal bowl 12 (Fig. 2), the feed pump 11 is shut down and the valve 15a in the feed pipe is closed, as is the valve 13a in discharge piping 13. The valve 18a in branch pipe 18 is then opened and pump 17 is placed in operation to supply flush liquid to the bowl 12 via the pipe 13 and the separated lighter component outlet. From this outlet, which now serves as the flush liquid inlet, the liquid flows downward into the inner or central part of the bowl adjacent to the inner edges of the discs 12b, then outwardly between these discs to the peripheral part of the bowl, and then upward through the heavy component passages 12c, from which it is discharged through the heavy component outlet to the pipe 14. Due to the closing of valve 15a, the flush liquid is made to by-pass the distributing holes 12a for the feed so that the liquid flows completely through the disc stack 12b from the inner edges to the outer edges of the discs, and this flow is opposed by the substantial back pressure incident to forcing the liquid upward and inward through the discharge passages 12c. Thus, the spaces between the discs 12b are substantially completely filled with the flush liquid under pressure as it flows through the bowl, and the slimes are effectively flushed from the surfaces of the discs and the bowl walls. If desired, the valve 15a may be opened near the end of the flushing operation to permit flow of flushing liquid through the distributing holes 12a and the feed inlet 12d in the hollow spindle 12g of the bowl, this liquid being discharged through a valved branch (not shown) of the feed pipe 15. In this way, the normal feed path leading to the bowl interior can be flushed to remove slimes which may have deposited therein.

It is preferable that the pressure maintained on the flush liquid by the pump 17 be considerably in excess of that on the normal feed liquid. In this way, a complete reversal of liquid flow through the central portion of the bowl chamber may be assured under all flushing conditions, that is, whether the flushing is undertaken with the bowl operating at normal speed or a reduced speed, or the bowl is at rest.

It will be apparent from the foregoing that it is not necessary to effect a complete removal of the slimes accumulated in the peripheral portion of the centrifugal bowl 12 or lodged between the outer portions of the discs 12b, since the point of entry and the direction of the flow of the flushing liquid in the bowl are such as to prevent any portion of the accumulated slimes from reaching and entering the normal outlet for the separated lighter constituent. Moreover, the flushing effect is greatest where it is most needed, namely, at the surfaces normally contacted by the lighter component during and after its separation from the heavier one. It will be understood that most of the separating action occurs between the discs 12b at a region located somewhat inward from their outer edges, and in this region where the discs contact the lighter component the flushing liquid will have a greater velocity and flushing effect than at the outer portions of the discs and the bowl, where the through-flow area for the liquid is greater.

As previously mentioned, the sealing or tightening means for connecting the centrifugal bowl outlets to the stationary discharge pipes 13 and 14 may be as disclosed in said Andersson et al. Patent No. 2,536,793 (see particularly Fig. 11). However, an improved tightening device of the form illustrated in Figure 3 of the accompanying drawings is preferred.

Referring now to Figure 3, the top of the bowl is shown at 12e and the top disc within the bowl is shown at 12f. The exposed upper edge of the top disc 12f is formed with an inner sealing surface divided into two annular concentric parts 20 and 21 lying in a plane at right angles to the bowl axis and separated from each other by a depressed circular groove 23. The exposed upper edge

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of the bowl top 12e is provided with an outer annular surface 24 concentric with the surfaces 20 and 21. The surface 24 may be in the same plane as the inner surfaces 20 and 21 but is preferably, for operational reasons, at a different level in a parallel plane, as shown. Between the concentric surfaces 20 and 24 an outlet 25 is formed for the heavier separated component. A central outlet 26 for the lighter separated component is formed in the top disc 12f within the annular surface 21.

The stationary portion of the new sealing device is contained within a removable housing 27 held in position directly over the annular surfaces 20, 21 and 24 by a bail and a cooperating nut arrangement (not shown), in the usual manner fully disclosed in said Andersson et al. patent. The housing 27 contains means for axially guiding and establishing pressure on three concentric rings 28, 29 and 30 of a hardened and ground material such as "Stellite," so that these rings, when the housing is assembled with the centrifuge, will abut in edgewise relation the concentric annular surfaces 24, 20 and 21, respectively, of the bowl top and top disc. The housing 27 also contains channels 31 and 32 for the heavier and lighter separated components, respectively, discharged from the bowl. These channels, in turn, connect with the stationary discharge piping, 14 and 13 (Fig. 1), respectively. For convenience in assembling the stationary portion of the sealing device, it is preferable that the housing 27 be provided with a removable upper portion 27a in axial alignment with the main portion 27 and separated therefrom by a suitable gasket 27b. The heavier component discharge piping 14 is secured to the lower portion 27 of the housing in communication with channel 31, and the lighter component discharge piping 13 is secured to the upper removable portion 27a of the housing in communication with channel 32.

The means for establishing the axial alignment of and the downward pressure on the concentric sealing rings 28, 29 and 30 comprise concentric sleeves and loading springs arranged axially within stepped bores formed within the housing part 27, in a manner which will now be explained in conjunction with Fig. 3.

The housing 27 has a central bore 34 therethrough into which a sleeve 35 is fitted. An axially movable second sleeve 36 is arranged within the first sleeve. Sleeve 36 is threaded exteriorly at its upper end and has an outwardly extending flange 36a at its lower end which engages the lower end of sleeve 35 and extends slightly beyond the outer face thereof. The internal surface of sleeve 36 is adapted to receive a snap ring 37 of the O-ring type which limits the upward movement of an upper collar 38 arranged within the sleeve below the O-ring. The sleeve 36 also contains a spirally-wound spring 39 compressed between the upper collar 38 and a lower collar 40, the latter engaging a resilient ring 41 which, in turn, engages the inner sealing ring 30. To hold the ring 30 in place in sleeve 36 when the housing 27 is removed from its normal position on the centrifuge, interlocking flanges may be provided, one flange 36b extending inwardly from the bottom of the sleeve 36 and the other flange 30a extending outwardly from the upper part of the ring 30.

The lower portion of housing 27 is counterbored to a diameter considerably in excess of the bore 34, thereby forming an annular chamber 42 surrounding the sleeves 35-36. The outer face of sleeve 35 is fitted within bore 34 and within the coils of a compression spring 43 having its upper end in abutment with the shoulder formed by the counterbore. The expansive force of this spring is transmitted downward to ring 29 through a collar 44 and a resilient ring 45 surrounding the sleeve 35. An internal flange 29a may be provided on the upper portion of the intermediate ring 29 to engage the outwardly extending bottom flange 36a on sleeve 36, in order to hold the sealing ring 29 in place when housing 27 is removed from the centrifuge.

Another compression spring 46, of larger diameter

than spring 43, is arranged within the outer portion of counterbore 42. The top of this spring engages the shoulder formed by the counter bore, and the expansive force of spring 46 is transmitted downward to the outer sealing ring 28 through a collar 47 and resilient ring 48. The bottom of housing 27 has secured thereto, as by screws 49, a ring 50 having a central opening of a diameter slightly less than the diameter of the counterbore 42. This reduced diameter opening may be utilized to hold the ring 29 in place, when the housing 27 is removed from the centrifuge, through the medium of an outwardly extending flange 28a at the upper portion of the ring 28.

The housing 27 may be bored as shown at 52, 52a and 53 to provide inlet and outlet passages for a cooling liquid for the sealing surfaces. In such an arrangement, the inner edge of ring 50 is notched, as shown at 50a, thus providing for a cooling liquid flow, via passage 52, inwardly over ring 50 and through the notches 50a in its inner edge against ring 28. The cooling liquid is then thrown off ring 28 by centrifugal force and discharged to waste or into a collecting vessel (not shown). Cooling liquid for the rings 29 and 30 flows via passage 52a through ports in sleeve 35 aligned therewith, then downwardly through vertically milled slots 36c in the exterior face of the sleeve 36, and through holes in the bottom flange 36a thereof aligned with the slots, to the annular space between the rings 29 and 30 directly above the surfaces 20 and 21 and the groove 23. The cooling liquid then flows upwardly through another set of milled slots 36d in sleeve 36 to and through outlet passage 53, from which it discharges to waste or a collecting vessel. Experience has shown that when superatmospheric pressure is applied to the cooling liquid entering via inlet 52a, the milled slots 36c and 36d not only prevent direct short-circuiting of the cooling liquid to the outlet connection 53 but also have a pumping effect. In any event, the cooling liquid will pass downwardly through the milled slots 36c and upwardly through the milled slots 36d, thus maintaining adequate circulation past the rings 29 and 30.

The resilient rings 41, 45 and 48 are compressed between the underlying sealing rings 30, 29 and 28 and the overlying collars 40, 44 and 47, respectively. Accordingly, these resilient rings 41, 45 and 48 effectively seal off the cooling liquid passages previously described as well as the passages for the separated liquid components discharged from the centrifugal bowl. The heavier liquid discharged from the bowl via its outlet 25 passes upwardly into the housing 27 between the sealing rings 28 and 29, thence through the annular chamber or counterbore 42 surrounding the sleeve 35, and outwardly to the discharge piping 14 via channel 31 in the housing 27. The lighter liquid discharged from the bowl via bowl outlet 26 passes directly upward into housing 27 within the sealing rings 29 and 30, thence through the interior of sleeve 36, and outwardly through channel 32 in the housing 27a to the discharge piping 13.

In assembling the sealing device herein disclosed, the sleeve 36 is held upright (the threaded end up) and the following parts in the order named are inserted therein from the top: sealing ring 30, resilient ring 41, collar 40, spring 39 and collar 38. The spring 39 is then forced downwardly until the snap ring 37 may be inserted. Next, the sleeve 35 is passed around the sleeve 36 and the following parts in the order named are passed around sleeve 35 from the top: sealing ring 29, resilient ring 45, collar 44, and spring 43. The parts, thus assembled, are inserted within housing 27 from the bottom, with the upper end of sleeve 35 passing through bore 34 of the housing so as to expose the upper threaded end portion of sleeve 36. A nut 51 bearing against the upper surface of housing 27 is then turned down on the threaded portion of sleeve 36 until the sleeve 35 is drawn upwardly (by means of the exterior flange 36a on the bottom of

sleeve 36) into contact with the bottom of the nut 51. The housing 27 is then turned bottom up and the following parts in the order named are inserted in the counterbore 42 of the housing: spring 46, collar 47, resilient ring 48, and sealing ring 28. Next, the ring 50 is affixed to the bottom of the housing 27, as by means of screws 49. The housing may then be placed over the concentric surfaces 24, 20, 21 of the bowl. The assembly is continued by placing the resilient washer 27b on top of the housing 27 in a position encircling the channel 32, and then placing the housing part 27a on the washer. Next, the standard bail and wing nut construction shown in Fig. 1 of said Andersson et al. patent are moved into position over the housing parts, and the housing assembly is secured to the centrifuge by tightening the wing nut.

While I have described the sealing rings 28, 29 and 30 as made of "Stellite" and the respective cooperating surfaces 24, 20 and 21 of softer metal, the latter surfaces may be made with "Stellite" or a similar hard material, and the sealing rings of a softer material, such as graphite, Bakelite, etc.

It will be apparent that the sleeves 35 and 36 constitute an annular member or partition defining a central passage extending between the central outlet or opening 26 of the bowl and the central discharge opening formed by channel 31 of the housing. This partition 35-36 not only holds the intermediate and inner sealing rings 29-30 laterally on the inner sealing surface 20-21 but also contains the cooling liquid feed and discharge channels 36c and 36d, respectively, leading to and from the annular space 23a which is formed by the sealing rings 29 and 30 between this partition and the sealing surface 20-21. The annular chamber 42 surrounding the partition 35-36 is aligned with the second outlet 25 of the bowl, so that this chamber and the space between the sealing rings 28 and 29 afford communication from outlet 25 to the discharge opening formed by channel 31 of the housing.

The springs 39, 43 and 46 form biasing means which impose yielding pressures upon the sealing rings 30, 29 and 28, respectively, to maintain a tight engagement of the rings with the respective sealing surfaces 21, 20 and 24 of the bowl as it rotates. These sealing surfaces can move laterally relative to the sealing rings 30, 29 and 28 to accommodate any lateral displacements of the bowl during its rotation, and the springs and the resilient rings 41, 45 and 48 can flex to accommodate any tilting or vertical movements of the rotating bowl, while maintaining tight engagement between the sealing rings and the sealing surfaces 21, 20 and 24.

When the bowl is to be flushed, the steps previously described in connection with Figs. 1 and 2 are performed, whereby the flush liquid is forced downward into the bowl by way of channel 32, the interior of sleeve 36 and the lighter component outlet 26, which now serves as a flush liquid inlet; and the flush liquid leaves the bowl by way of passages 12c and outlet 25.

I claim:

1. In a centrifuge of the hermetic type including a rotatable centrifugal bowl having a feed inlet, a separated lighter component outlet and a separated heavier component outlet, a stationary feed pipe having an hermetically sealed flow connection with said inlet, and stationary discharge pipes having hermetically sealed flow connections with said outlets, respectively, whereby the feed is delivered to the bowl and said components are discharged therefrom through hermetically sealed paths, the improvement which comprises a valve for closing the feed pipe, a source of flushing liquid, means for delivering liquid under pressure from said source to one of said discharge pipes, and a valve for closing said one discharge pipe at a point located beyond said liquid delivering means reckoned in the direction of flow of the separated component discharged through said one pipe, whereby said

liquid is adapted to be forced through the bowl from said one discharge pipe to the other discharge pipe when said valves are closed.

2. The improvement according to claim 1, in which said one discharge pipe is the pipe connected to the lighter component outlet of the bowl, whereby said liquid is adapted to be forced through the bowl from the lighter component discharge pipe to the heavier component discharge pipe.

3. The improvement according to claim 1, comprising also a set of conical discs in the bowl forming separating spaces, said spaces communicating at the inner portions of the discs with the lighter component outlet and at the outer edges of the discs with the heavier component outlet, said liquid delivering means being connected to the discharge pipe for the lighter component, whereby the liquid is adapted to be forced outwardly through said disc spaces in passing through the bowl from the lighter component discharge pipe to the heavier component discharge pipe.

4. In a centrifuge comprising a rotatable centrifugal bowl having inner and outer annular sealing surfaces which are normal and concentric to the bowl axis, said surfaces defining two outlets for lighter and heavier separated components, respectively, one of said outlets being disposed centrally of said surfaces, and the second outlet lying between said inner and outer surfaces, the combination of a stationary housing having a central discharge opening, an annular partition in the housing forming a central passage extending between said central outlet and discharge opening, the housing forming an annular chamber surrounding the partition and aligned with the second outlet, an inner sealing ring movable lengthwise relative to the partition and held laterally thereby, said ring having one end engaging said inner annular surface around the central outlet, an outer sealing ring disposed in said annular chamber and movable lengthwise relative to the partition, the outer ring being held laterally by the housing and having one end engaging said outer annular surface around said second outlet, the housing having a second discharge opening communicating with said second outlet through said annular chamber and between the sealing rings, and biasing means in the housing urging the sealing rings against the respective sealing surfaces.

5. The combination according to claim 4, comprising also resilient rings interposed between the biasing means and the sealing rings and forming seals between the inner sealing ring and the partition and between the outer sealing ring and the outer wall of said annular chamber.

6. The combination according to claim 4, in which said partition is removably secured in the housing.

7. The combination according to claim 4, comprising also an intermediate sealing ring having one end urged against said inner annular surface, said intermediate ring closely surrounding the partition and being slidable lengthwise thereof, the inner sealing ring being disposed in said central passage within the partition.

8. The combination according to claim 4, comprising also an intermediate sealing ring having one end urged against said inner annular surface, said intermediate ring closely surrounding the partition and being slidable lengthwise thereof, the inner sealing ring being disposed in said central passage within the partition, biasing means urging said intermediate ring against said inner surface, and a resilient ring interposed between the intermediate ring and said last biasing means and forming a seal between the intermediate ring and the partition.

9. The combination according to claim 4, comprising also an intermediate sealing ring having one end urged against said inner annular surface, said intermediate ring closely surrounding the partition and being slidable lengthwise thereof, the inner sealing ring being disposed in said central passage within the partition and forming with the intermediate ring an annular space between the par-

tion and said inner surface, the partition having cooling liquid feed and discharge channels leading to and from said space.

10. The combination according to claim 4, comprising also an intermediate sealing ring having one end urged against said inner annular surface, said intermediate ring closely surrounding the partition and being slidable lengthwise thereof, the inner sealing ring being disposed in said central passage within the partition and forming with the intermediate ring an annular space between the partition and said inner surface, the partition including a pair of concentric sleeves forming between them a plurality of cooling liquid channels leading to and from said space.

11. The combination according to claim 4, comprising also an intermediate sealing ring having one end urged against said inner annular surface, said intermediate ring closely surrounding the partition and being slidable lengthwise thereof, the inner sealing ring being disposed in said central passage within the partition and forming with the intermediate ring an annular space between the partition and said inner surface, the partition having cooling liquid feed and discharge channels leading to and from said space, the housing having a cooling liquid inlet passage leading to said feed channel and to the outer surface of said outer sealing ring.

12. The combination according to claim 4, comprising also an intermediate sealing ring having one end urged against said inner annular surface, said intermediate ring closely surrounding the partition and being slidable lengthwise thereof, the inner sealing ring being disposed in said central passage within the partition and forming with the intermediate ring an annular space between the partition and said inner surface, the partition having cooling liquid feed and discharge channels leading to and from said space, the housing having a cooling liquid inlet passage leading to said feed channel and to the outer surface of said outer sealing ring, the housing also having a cooling liquid discharge passage leading from said discharge channel.

13. A combination according to claim 4, in which the centrifugal bowl has a feed inlet, the combination comprising also a stationary feed pipe having an hermetically sealed flow connection with said inlet, stationary discharge pipes leading from said discharge openings of the stationary housing, a valve for closing the feed pipe, a source of flushing liquid, means for delivering liquid under pressure from said source to one of said discharge pipes, and a valve for closing said one discharge pipe at a point located beyond said liquid delivering means reckoned in the direction of flow of the separated component discharged through said one pipe, whereby said liquid is adapted to be forced through the bowl from said one discharge pipe to the other discharge pipe when said valves are closed.

14. In a centrifuge comprising a rotatable centrifugal bowl having an annular sealing surface normal and concentric to the bowl axis and surrounding an opening in the bowl communicating with the interior thereof, the combination of a stationary annular member forming a passage communicating with the bowl interior through said bowl opening, a pair of concentric sealing rings held laterally by said member and each having one end urged against said sealing surface around the bowl opening, the outer ring surrounding said member and the inner ring being surrounded by said member and forming with the outer ring an annular space between said member and sealing surface, said member having cooling liquid feed and discharge channels leading to and from said space, and resilient rings disposed inside and outside the annular member, respectively, and forming seals between the inner sealing ring and the inner surface of said member and between the outer sealing ring and the outer surface of said member.

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15. The combination according to claim 14, in which the annular member includes concentric sleeves one of which has longitudinal slots adjacent the other sleeve and forming said channels.

16. The combination according to claim 14, in which the sealing rings are movable lengthwise of the annular member and said passage, the combination comprising also biasing means acting through said resilient rings to urge the sealing rings against said sealing surface.

17. The combination according to claim 14, in which the sealing rings are movable lengthwise of the annular member and said passage, the combination comprising also biasing means acting through said resilient rings to

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urge the sealing rings against said sealing surface, and interengageable flanges on said annular member and the sealing rings for limiting lengthwise movement of said rings relative to said member by the biasing means.

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