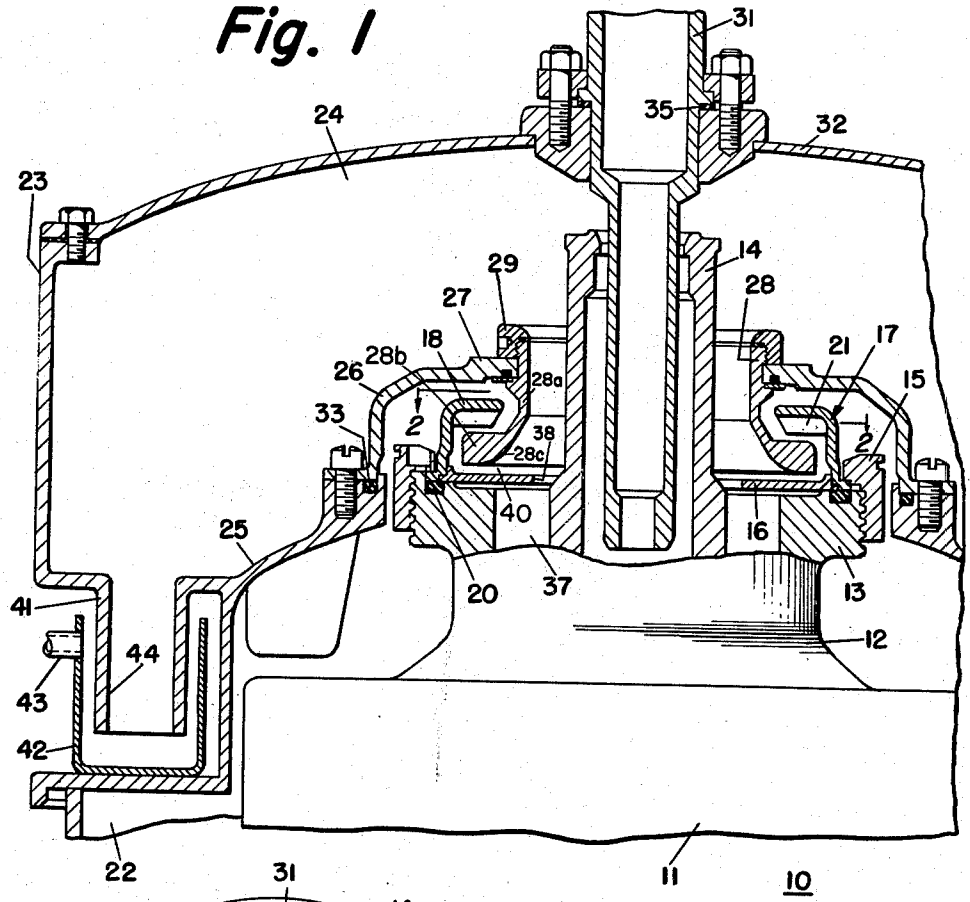
Feb. 2, 1965 H. C. FITZSIMMONS 3,168,472

CENTRIFUGE DISCHARGE MEANS

Filed June 15, 1961 4 Sheets-Sheet 1

Fig. 1



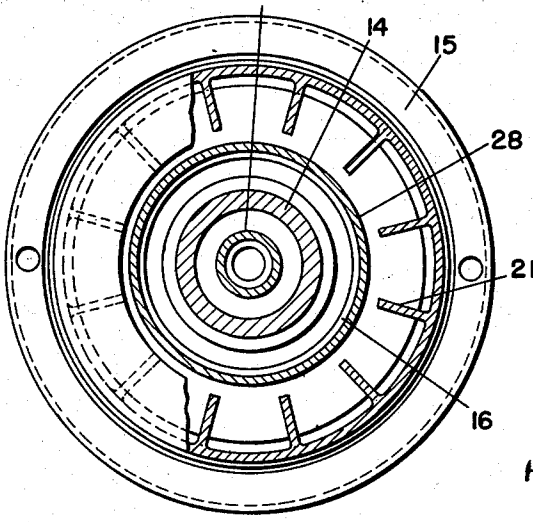


Fig. 2

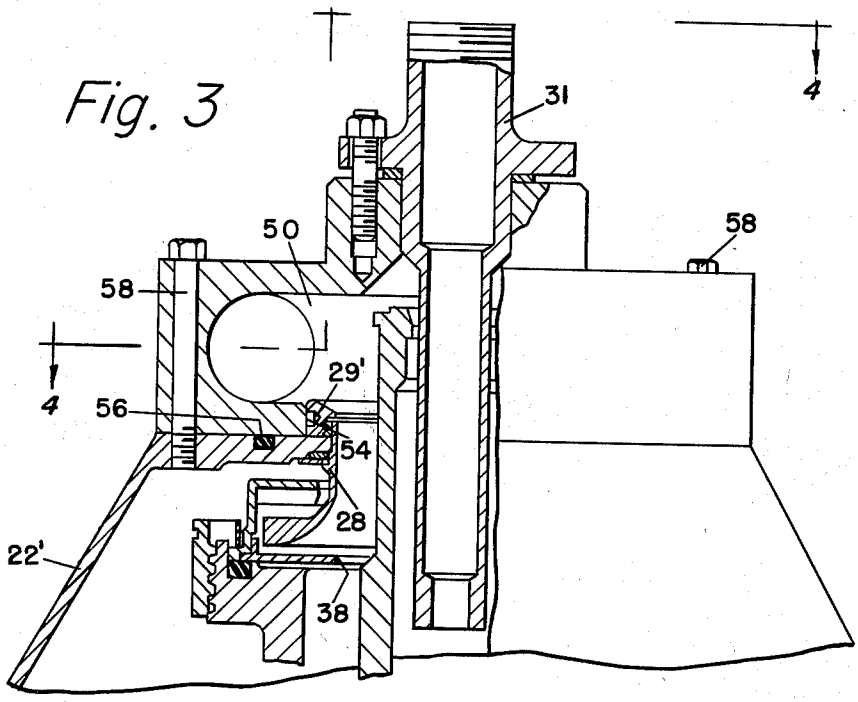
INVENTOR.
HAROLD C. FITZSIMMONS
BY Dallett Hoopes

Feb. 2, 1965 H. C. FITZSIMMONS 3,168,472

CENTRIFUGE DISCHARGE MEANS

Filed June 15, 1961 4 Sheets-Sheet 2

Fig. 3



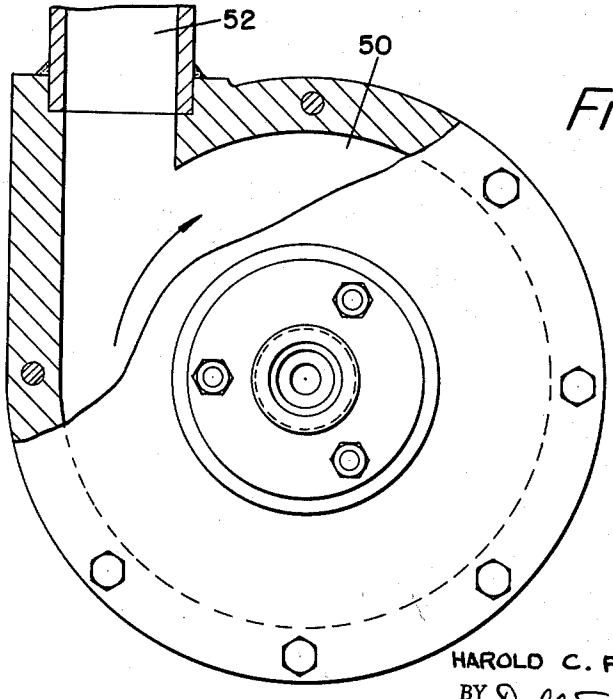


Fig. 4

INVENTOR.
HAROLD C. FITZSIMMONS
BY Dallett Hoopes

ATTORNEY

Feb. 2, 1965 H. C. FITZSIMMONS 3,168,472

CENTRIFUGE DISCHARGE MEANS

Filed June 15, 1961 4 Sheets-Sheet 3

Fig. 5

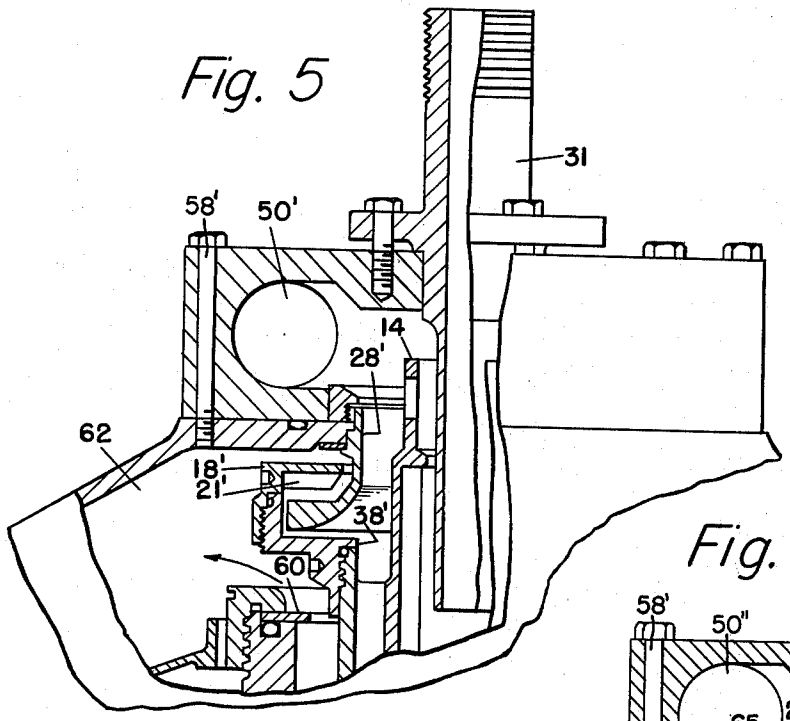


Fig. 5a

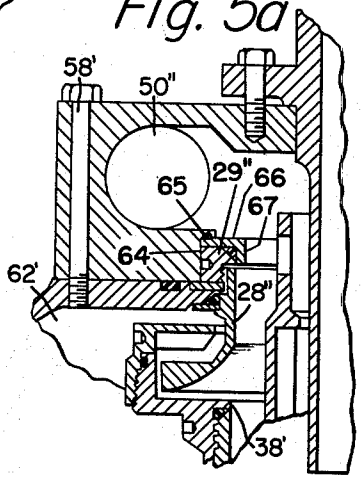
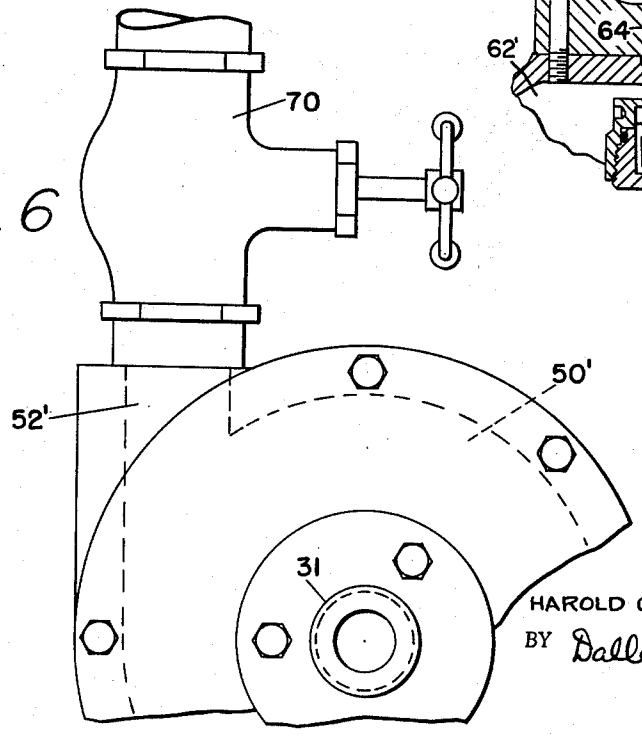


Fig. 6



INVENTOR.
HAROLD C. FITZSIMMONS
BY Dallett Hoopes
ATTORNEY

Feb. 2, 1965 H. C. FITZSIMMONS 3,168,472

CENTRIFUGE DISCHARGE MEANS

Filed June 15, 1961 4 Sheets-Sheet 4

Fig. 7

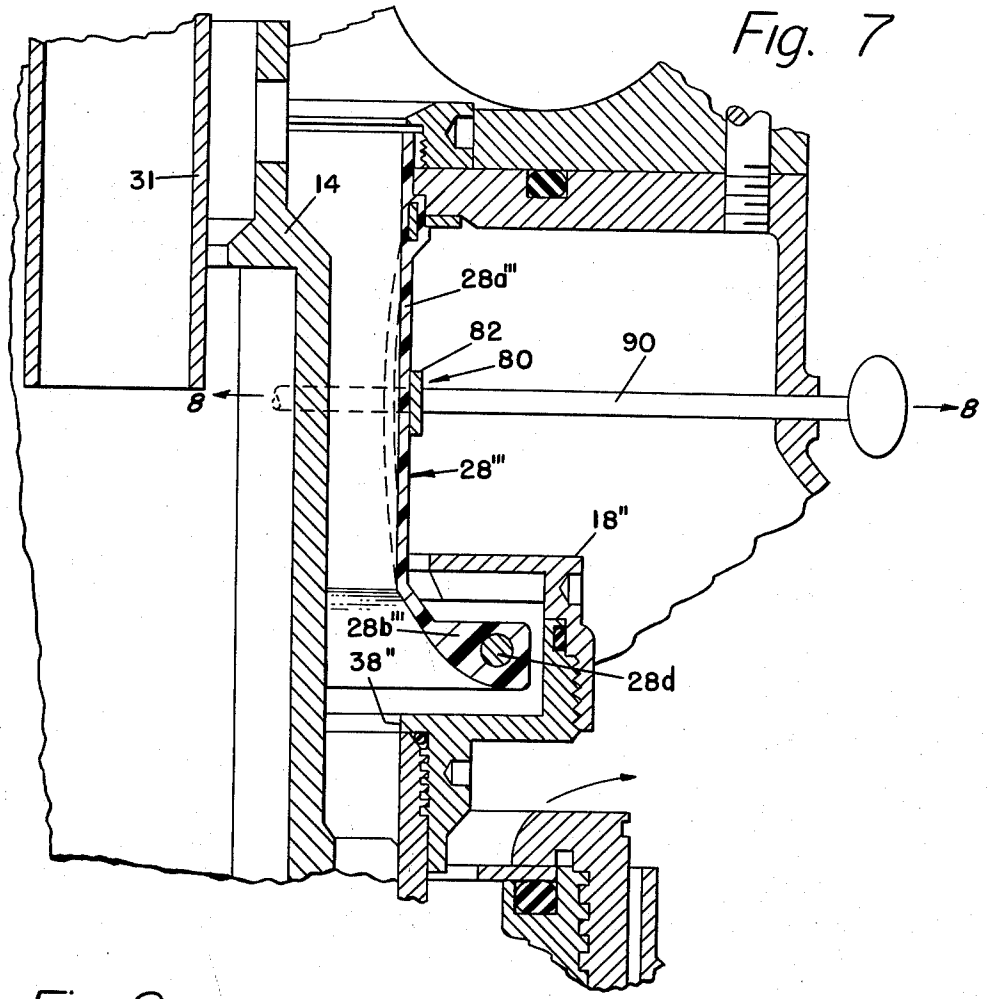
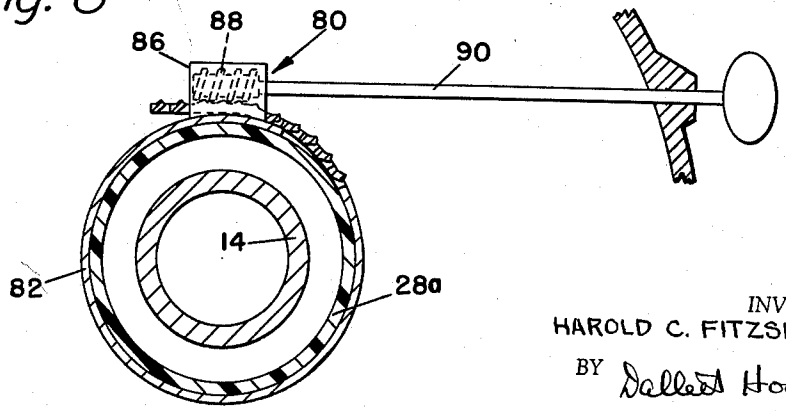


Fig. 8



INVENTOR.
HAROLD C. FITZSIMMONS
BY Dallett Hoopes

ATTORNEY

United States Patent Office 3,168,472 Patented Feb. 2, 1965

3,168,472

CENTRIFUGE DISCHARGE MEANS

Harold C. Fitzsimmons, West Chester, Pa., assignor to Pennsalt Chemicals Corporation, a corporation of Pennsylvania

Filed June 15, 1961, Ser. No. 117,467
6 Claims. (Cl. 233—19)

This application constitutes a continuation-in-part of my co-pending application Serial No. 785,451, filed in the United States Patent Office on January 7, 1959, and now abandoned.

This invention pertains generally to centrifuges, and particularly to centrifuges adapted to discharge an effluent or effluents relatively free from foam.

Foam reducing structures as embodied in centrifuges of the prior art operate on the principle of converting the kinetic energy of rotation of the wall of liquid comprising the effluent into pressure sufficient to force the effluent through a discharge conduit, contact with the wall or surface of effluent being made by a device called a skimmer. Since the entrainment of air in the liquid effluent is a major cause of the formation of foam, it is necessary in these prior art devices to discharge the liquid effluent against sufficient back pressure to keep the inlet or inlets of the skimmer submerged in the liquid effluent to avoid entrance of air. This requirement makes necessary the use of rather complicated and cumbersome structure including pressure measuring and control mechanism, adding considerably to the cost and maintenance of the centrifugal machine. Then too the power requirements for operating a centrifuge of the type under discussion are frequently approximately twice that for operating the same centrifuge equipped to discharge the liquid effluent over a conventional ring dam instead of through the skimmer and liquid discharge conduit.

The present invention is directed to a new combination and arrangement of parts designed to discharge effluent from the bowl freely through an open stationary tubular baffle connected to the bowl by seal means. By so discharging the effluent better control of the effluent can be achieved. For instance, the effluent can be discharged into a sealed cover, reducing the tendency of air to become entrapped in the liquid; the kinetic energy of the effluent can be effectively used to obviate the need for a discharge booster pump or to control the position of the interface; the kinetic energy of the effluent can be decreased also to reduce foaming; and the level of the discharge can be regulated.

Further features of the invention will become apparent to persons skilled in the art as the description proceeds, particularly in connection with the accompanying drawings in which:

FIGURE 1 is an elevation shown broken and largely in section of an embodiment of the invention;

FIGURE 2 is a section taken on line 2—2 of FIGURE 1;

FIGURE 3 is a section comparable to FIGURE 1 but of a modified form of the invention;

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

FIGURE 5 is a sectional view comparable to FIGURE 3 of a centrifugal separator embodying the invention and incorporating a volute discharge;

FIGURE 5*a* is a fragmentary sectional view of a further modified form of the invention in the area of the ring nut;

FIGURE 6 is a fragmentary top plan view of the modification of FIGURE 5;

FIGURE 7 is an enlarged fragmentary sectional view of a modified form of the invention wherein the discharge weir may be adjusted while the machine is operating; and

FIGURE 8 is a sectional view of the plane of line 8—8 of FIGURE 7.

Referring now more particularly to FIGURES 1 and 2, at 11 is shown broken the upper portion of centrifuge rotor 10, neck 12 of which terminates in an integral annular flange 13.

Rotor 10 is shown provided with a more or less conventional center tube 14 which serves as an inlet for mixtures to be separated in the rotor.

Secured to flange 13, as by ring dam nut 15, is annular ring dam or weir 16, the peripheral edge of which is engaged by ring dam housing 17 which in turn is engaged by an inwardly projecting shoulder on ring dam nut 15, gasket 20 being provided to prevent leakage. Ring dam housing 17 defining an annular inwardly facing pocket is annular in shape and has an inwardly projecting overhanging portion 18 provided underneath with a plurality of circumferentially spaced vanes 21. Vanes 21 are arranged in a direction having a radial component, and are preferably arranged in radial planes, i.e. in planes passing through the axis of rotation. Any other velocity controlling members for liquid may be substituted.

It will be noted that ring dam 16 and ring dam housing 17 are secured to and rotate with rotor 10.

Frame 22 surrounds rotor 10, and has an upper portion or cover 23 which is so constructed as to provide a receiving chamber 24 for liquid effluent discharged from rotor 10. Supported on inner wall 25 of cover 23 of frame 22 is an annularly shaped member 26 having an inwardly projecting circular edge 27 to which is secured tubular baffle 28, held stationary as by ring nut 29. As will be seen from the drawings, the axis of tubular baffle 28 is substantially coincident with the axis of rotor 10.

In the FIGURE 1 and other embodiments hereafter disclosed, the baffle 28 or discharge conduit has a tubular wall 28*a* and the annular flange 28*b* extending outward into the pocket formed by the housing 17. The upper face or face more remote from the bowl of the flange 28*b* is substantially radial to the axis of the bowl and closely confronts the vanes 21 to enhance engagement of liquid between flange 28*b* and portion 18 by the vanes. As shown distal edges of the vanes are substantially parallel to said upper face. At the same time, the outer periphery of the flange 28*b* is substantially thicker than the tubular wall 28*a* for necessary strength. This permits the face of the flange 28*b* which is more proximate the bowl to be formed with a smooth inwardly rounded portion 28*c* of large radius to permit flow of liquid upward into the tubular wall with a minimum of disturbance.

Feed pipe 31 mounted on top 32 of chamber 24 projects downwardly into tube 14 for purposes of feeding influent into rotor 10.

Gaskets, such as illustrated at 33 and 35 are preferably provided, the purpose of which is to prevent leakage of air into chamber 24 at the various points where located.

Rotor 10, as illustrated in FIGURE 1, is of the clarifier type having a single outlet for liquid effluent adjacent the axis of rotation. In operation the liquid effluent ascends through channels 37 at the top of rotor 10, and flows upwardly over inner circumferential edge 38 of ring dam or weir 16. The angular velocity of the effluent as it passes over the inner discharging edge 38 of ring dam 16 is the same as the angular velocity of rotor 10, as will be obvious, for channels 37 and weir 16 are a part of the rotating mechanism. Tubular baffle 28, on the other hand, being mounted on frame 22, is stationary, and as shown in this embodiment is of larger inner radius than

the inner radius of ring dam 16. The effluent upon flowing upwardly and coming into contact with baffle 28, slows in angular velocity and ascends upwardly therethrough.

The stationary tubular baffle 28 in somewhat decreasing the angular velocity of fluid emerging from the bowl also reduces the opportunity of the effluent to exercise its tendency to foam. Obviously, the longer the baffle 28 the more reduced is the angular velocity of the liquid as it spills over ring 29, and, hence, the more reduced the foaming.

A rotary liquid seal is provided between rotor 10 and baffle 28, the purpose of which is to prevent flow of air from the exterior of rotor 10 inwardly into the escaping effluent. The initial portion of the liquid escaping over inner edge 38 of dam 16 flows outwardly into ring dam housing 17 which rotates with rotor 10. Such liquid upon entering ring dam housing 17 is engaged by vanes 21 and rotates with the same angular velocity as rotor 10. This generates considerable radially outwardly directed pressure on the liquid in ring dam housing 17, causing the liquid effluent escaping over weir 16 to back up in the space 40 between ring dam 16 and baffle 28 to such extent that the liquid effluent now escapes upwardly directly through baffle 28 as previously described. It will be understood that the tangential velocity of the liquid in space 40 is considerably less than the tangential velocity of the liquid engaged by vanes 21 on housing portion 18 which is due in part to difference in radius, and in part to the fact that although ring dam 16 rotates with the rotor, baffle 28 is held stationary, and there are no vanes to accelerate the liquid therebetween. The liquid flowing out over the nut 29 loses tangential velocity in space 40. Thus greater centrifugal force or pressure is applied to the liquid at vanes 21 than in space 40, the result of which is that no liquid escapes from ring dam housing 17, and all effluent is caused to flow upwardly through baffle 28 to be decelerated in rotational velocity.

While it is preferred to remove liquid effluent from chamber 24 through a trap or seal to prevent atmospheric air from flowing backwardly into chamber 24, such is not absolutely essential even though better results from the standpoint of suppression of foam usually are obtained. In other words, a substantial suppression of the formation of foam is obtained even though the chamber into which the effluent is discharged is open to the atmosphere. Nevertheless it is preferred to prevent the inward flow of atmospheric air into chamber 24 to assure best results.

A seal is illustrated in FIGURE 1 wherein portion of cover 23 of frame 22 is provided with a downwardly extending outlet 41 which projects into container 42 having an upper outlet 43. Liquid discharged into chamber 24 drains down into container 42 from which it is withdrawn through outlet 43. The result is that lower end 44 of extension 41 is continuously surrounded by liquid. A liquid seal is thus provided preventing the backward flow of air into chamber 24.

Various other forms of liquid effluent collecting chambers may be substituted for chamber 24. FIGURE 3 discloses a housing having a compact volute discharge chamber 50. Under this modification effluent swirling over the ring nut 29' enters the volute chamber with considerable angular velocity to build up a clockwise moving layer (FIGURE 4) about the peripheral wall of the chamber. This layer proceeds out the tangential outlet port 52 at a linear velocity which has been found to be sufficient to raise its level 10 to 20 feet, for instance. Obviously this means of employing the kinetic energy of the discharge fluid is advantageous, since a discharge booster pump may be obviated thereby.

Details of construction of the volute effluent collecting chamber 50 are well disclosed in FIGURE 3. As shown, the central opening 54 of the chamber fits over the ring nut 29', and the chamber housing is supported on element 22'. The frame carries an annular seal 56 which

prevents leakage between the frame and the housing. Bolts 58 may secure the chamber housing to the element 22'.

Obviously to preserve the angular velocity of the liquid discharge from the bowl in the FIGURE 3 embodment for translation into linear velocity in discharge from volute chamber 50, it is desirable to make baffle 28 as short as possible.

FIGURES 5 and 6 disclose a centrifugal separator embodying the form of the invention which employs a volute effluent collecting chamber 50'. In this organization the light phase passing over the weir edge 38', upward along the stationary tubular baffle 28' discharges into the volute chamber whereby its energy may be used to raise its level. The seal element 18'–21' is comparable to that of FIGURE 1. In the FIGURE 5 embodiment heavy effluent will discharge over the ring dam 60 into the receiver 62.

Aside from the advantage of enabling the use of the energy of the discharge fluid to raise its level to a height above the discharge ring 29, the volute chamber embodiments are advantageous for their compactness. In some installations where space is at a premium advantages of this arrangement will be considerable.

It should be understood that while the seal and volute discharge are applied to the light phase outlet in the apparatuses of FIGURES 5 and 6, they may be readily applied to the heavy phase outlets.

In the further modified form of the invention shown in FIGURE 5*a* the bottom wall of the volute housing is undercut in the area 64 about the opening. This provides a horizontal annular shoulder 65 immediately above the area. The ring nut 29'' as in the other embodiments engages the threaded upper end of the baffle 28'' and holds the baffle in position on the top of the receiver 62'. The housing for the volute 50'' may be easily removed from the top of the receiver 62'. As shown, the annular ring dam 66 is provided and is clamped between the ring nut 29'' and the shoulder 65 by the housing bolt 58'. Preferably the ring dam 66 has a downturned lip 67 and may enclose against the ring nut 29'' a sealing O-ring 68.

With the arrangement shown in FIGURE 5*a* the ring dam 66 may be removed and replaced with one of a different size while the bowl is rotating. The bolt 58' is merely removed and the housing for volute 50'' is lifted off to make possible the substitution. This arrangement obviates necessity for shutting down the machine to change dam size.

In FIGURE 6 it will be noted that in the discharge line 52' from the volute chamber 50' may be disposed an ordinary valve 70. This valve may be used to regulate the back pressure on the liquid in the chamber 50'. An increase in this back pressure will cause the liquid level in the volute to approach the axis of the bowl to a radius even less than the radius of the baffle and the ring dam edge 38'. The consequent inward movement of the liquid level in the bowl will force the interface between the liquids in the separator outwardly. It will be seen that such an arrangement as shown in FIGURE 6 affords convenient means for adjusting the interface, for instance to its optimum position in the feed apertures of a disc stack if disc machine is used.

A further embodiment is disclosed in FIGURES 7 and 8. In this form, otherwise comparable to that of FIGURE 5, the stationary tubular baffle 28''' is formed with an elongated resilient neck portion 28*a*'''. The lower outwardly extending flange 28*b*''' is, however, made rigid by having a metal ring 28*d* embedded therein. Surrounding the neck is a restricting clamp 80 which comprises a flexible strap 82 having serrations 84 on one end and a housing 86 on the other. The housing 86 journals a screw element 88 engaging serrations 84 and operable by a reach rod 90 from without the centrifuge. Thus by turning the screw 88 the strap 82 may be made to restrict the neck 28*a*'''. The rigid flange of the modified baffle will remain

in position between housing 18'' and weir 38'' to perfect the annular seal as with the earlier disclosed embodiments.

Provided the inner diameter of the neck 28*a*''' is less than the diameter of the weir 38''', adjustment by the clamp means 80 of the inner diameter of the neck, as shown in broken lines, will regulate the discharge level and, hence, the level of the interface of the fluids in the separator.

It is to be understood that the foregoing particular description is by way of illustration and not of limitation, and that changes, omissions, additions, substitutions and/or other modifications may be made without departing from the spirit of the invention. Accordingly it is intended that the patent shall cover by suitable expression in the claims the various features of patentable novelty that reside in the invention.

I claim:

1. A centrifuge comprising

(*a*) a bowl mounted for rotation about an axis, the bowl having a liquid discharge opening with its margin disposed about the axis,

(*b*) an annular pocket on the outside of the bowl about the opening and facing toward the axis, the pocket having a remote wall spaced from the bowl,

(*c*) a stationary liquid discharge conduit mounted on the axis and having a tubular wall with a smooth interior and first and second ends, the first end having an annular flange with opposite faces extending outward therefrom and into the pocket, the annular flange being substantially thicker at its outer periphery than the tubular wall, the opposite faces on the annular flange being smooth, the face more remote from the bowl being disposed substantially radially of the axis, the face more proximate the bowl formed with a smooth inwardly rounded portion approaching the smooth interior of the tubular wall,

(*d*) vanes on the inside of the remote wall and having distal edges disposed substantially parallel to and closely confronting the said radial face of the flange, and

(*e*) a gas-tight sealed liquid-collection chamber surrounding and sealed to the second end of the conduit,

whereby the discharging liquid passes smoothly from the bowl through the conduit and into the collection chamber, the smooth nature of the flange surfaces and the interior of the conduit and the sealed nature of the collection chamber serving to minimize foaming of the discharging liquid.

2. The centrifuge as described in claim 1 wherein a ring dam is secured adjacent the second end of the tubular wall.

3. A centrifuge as described in claim 1 wherein the liquid collection chamber is volute in shape and has an outlet directed tangentially of the chamber.

4. A centrifuge as described in claim 1 wherein the bowl is a separator bowl.

5. A centrifuge as described in claim 1 wherein means are provided to adjust the inside diameter of the tubular wall.

6. A centrifuge as described in claim 5 wherein the tubular wall is resilient and is engaged by adjustable annular clamping means.

References Cited by the Examiner

UNITED STATES PATENTS

165,785	7/75	Braun	233—20
1,232,370	7/17	Morison	210—322 X
1,750,395	3/30	Ellor	233—21
2,125,453	8/38	Lindgren	233—46 X
2,145,541	1/39	Forsberg.	
2,228,816	1/41	Doran.	
2,302,168	11/42	Ayres et al.	233—46 X
2,376,744	5/45	Wilsmann	233—21 X
2,648,433	8/53	Wright et al.	210—512 X
2,668,658	2/54	Peltzer	233—21
2,738,070	3/56	Cottrell.	
2,752,089	6/56	Zachariassen	233—19
2,928,546	3/60	Church	210—512 X
3,004,050	10/61	Ayres	233—21 X
3,025,965	3/62	Bergman et al.	210—512

FOREIGN PATENTS

707,152	4/31	France.
453,558	12/27	Germany.
681,680	9/39	Germany.
257,767	9/26	Great Britain.
616,405	1/49	Great Britain.

HARRY B. THORNTON, *Primary Examiner.*

ROBERT F. BURNETT, EUGENE F. BLANCHARD, *Examiners.*