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A. U. AYRES ET AL
CENTRIFUGAL SEPARATOR

2,302,168

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FIG.1

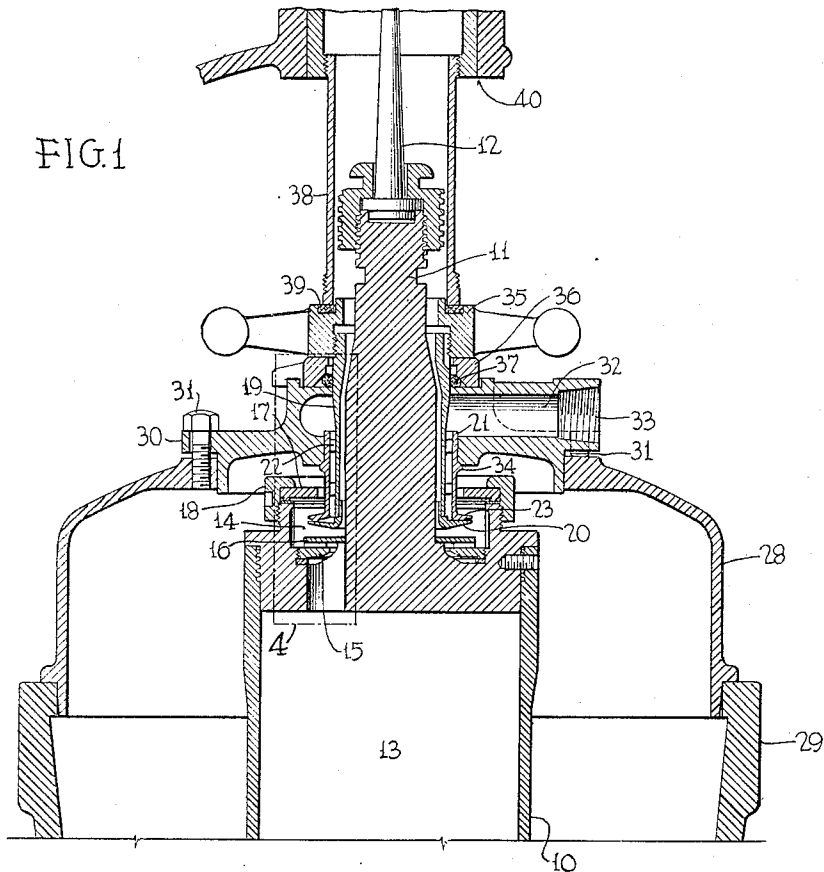


FIG.2

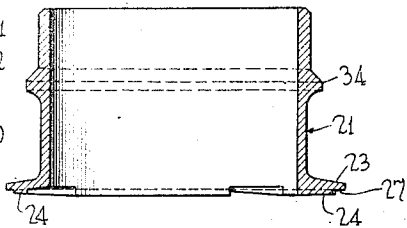


FIG.3

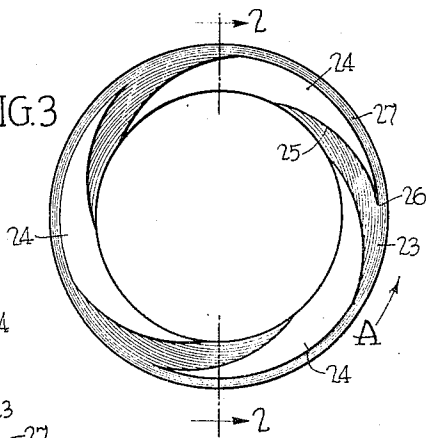
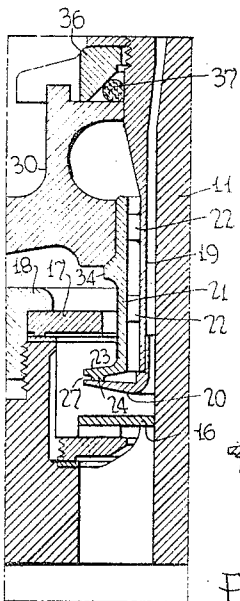


FIG.4



INVENTORS:
Arthur U. Ayres
Jean Esmieu.
BY *Maurice A. Crowl*
ATTORNEY.

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CENTRIFUGAL SEPARATOR

Arthur U. Ayres, Chestnut Hill, Pa., and Jean Esmieu, Ruell, France, assignors to The Sharples Corporation, Philadelphia, Pa., a corporation of Delaware

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11 Claims. (Cl. 233--22)

The present invention pertains to the art of centrifugal separators of the type provided with stationary skimming discs or nozzles penetrating beneath the surface of the treated liquid or liquids for removing such liquids from the centrifugal rotor. Such machines discharge the liquid from the rotor by converting the kinetic energy of rotation of the wall of liquid adjacent the skimmer into the pressure necessary to force the liquid through a discharge conduit connected to the skimmer.

Machines of this type have been used principally in the performance of centrifugal clarifying and separating operations in which there has been a desire to minimize entrainment of gases in the discharged liquid and/or to suppress the tendency of the liquid to form foam incident to centrifugal treatment and discharge thereof. Objects of the present invention have been to minimize air entrainment and suppress foam formation in a more effective manner than could be accomplished by the use of machines of this general type heretofore available.

A further object of the present invention has been to provide a skimming arrangement and means for mounting the skimmer about the neck of a centrifugal rotor which forms the driving connection between the rotor and drive spindle, liquid being fed to the rotor at the opposite end thereof from this driving connection.

A further object of the invention has been to provide an annular skimmer about the neck of the centrifugal rotor, and to mount this skimmer in such a way that the skimmer and associated parts of the rotor may be conveniently assembled, and removed and taken apart for cleaning.

Still further objects of the invention will be obvious from a reading of the following specification in connection with the attached drawing, in which,

Figure 1 is a cross section illustrating the upper part of a centrifugal rotor provided with a skimming arrangement in accordance with the invention,

Figure 2 is a cross section of a sleeve forming the outer wall of the skimmer of the invention,

Figure 3 is an end view of the sleeve illustrated in Figure 2,

Figure 4 is an enlarged section illustrating the parts within the line 4 of Figure 1.

In the form of the invention illustrated in the drawing, the centrifugal machine may comprise a rotor 10 provided with a neck 11 having a threaded portion at its upper end for securement to a drive spindle 12. Liquid which is to be

subjected to centrifugal treatment is fed to the rotor through a feed connection (not shown) at the end thereof opposite to the neck 11, and impurities are removed from this liquid by the action of centrifugal force in the centrifugal treating chamber 13. Both the feed and driving connections of the rotor may be similar to those illustrated in Figure 1 of the patent to Jones 1,625,613.

After treatment in the chamber 13, the liquid is passed to the skimming chamber 14. An annular weir 15 controls the passage of liquid from the chamber 13 to the chamber 14 and insures maintenance of a substantial depth of liquid in the treating chamber 13.

An important feature of the invention consists in the provision of an arrangement for preventing passage of foam from the treating chamber 13 into the skimming chamber 14, and the incorporation of this feature enables us to minimize foaming of liquid skimmed from the rotor. This result is achieved by providing an imperforate dam extending from a central part of the rotor to a point beyond the level of the annulus of liquid under treatment in the rotor. In accordance with the preferred embodiment of the invention, this dam may comprise a plate in the form of a disc or flange 16 secured to the neck 11 of the rotor at a part thereof within the skimming chamber 14. The outer circumference of the dam 16 thus dips into the liquid in the skimming chamber, while its inner circumference is secured to the imperforate neck 11 of the rotor, thereby entirely precluding passage of foam which may form on the surface of the liquid in the treating chamber 13 from that chamber into the skimming chamber 14.

Liquid discharged over weir 15 through the space between that weir and the dam 16 is discharged into the body of liquid in the skimming chamber 14 beneath the surface of that liquid, and this arrangement affords a seal to prevent gas or foam existing in treating chamber 13 from entering skimming chamber 14, since all liquid entering the skimming chamber 14 must overcome the super-atmospheric pressure existing at the outer circumference of the dam 16 by reason of the rotation of the body of liquid in the skimming chamber 14 lying inwardly of this circumference.

An annular plate 17 defines the upper wall of the skimming chamber 14 and may be detachably secured to the upper end of the main body of the rotor, by means of a nut 18. The skimming member through which liquid is discharged

from the skimming chamber 14 consists of a pair of annularly spaced stationary sleeves surrounding the neck of the rotor. The inner sleeve 19 is provided with a radially extending annular flange 20 on its under side, and this flange constitutes the lower lip of the skimmer. The outer sleeve 21 is maintained in uniformly spaced relationship annularly with respect to the inner sleeve 19 by means of suitable spacer members such as the spacer buttons 22, which may be secured to the inner sleeve. The outer sleeve 21 is provided with a flange 23 which overlies the flange 20 and is spaced therefrom to form the upper lip of the skimmer member. Radially extending abutments between flanges 20 and 23 separate these flanges and maintain the lips on the outer circumference of these flanges in properly spaced relationship longitudinally of the rotor. In the form of the invention illustrated, the abutments are in the form of lands 24 (Figure 3) formed on the under side of the flange 23, and the inner surfaces of these lands are curved in such a way as to provide wings 25 having points 26 adapted to intercept liquid rotating in the direction of the arrow A (Figure 3) and retard that liquid during its passage inwardly through the space between the flanges 20 and 23 into the longitudinally extending annular space between the inner and outer circumferences respectively of the sleeves 21 and 19. The outer surfaces of the lands 24 terminate within the outer circumference of the flange 23 on which they are formed or to which they are secured, and the skimming surface 27 at the outer circumferences of the flanges 20 and 23 is therefore of smooth annular configuration. It has been found that this arrangement of providing wings which terminate within the outer circumferences of thin skimming lips enables use to effect a skimming operation in which much less air is entrained with the liquid skimmed from the chamber 14 than is the case when wings extending to the peripheries of the flanges 20 and 23 are provided.

In the preferred mounting of the skimmer assembly described above, this assembly is secured to a dome 28 which may be mounted on the upper end of the frame 29 in which the centrifugal rotor is secured. A cover plate 30 is adjustably secured to the upper end of the dome 28 by means of pushing and pulling screws 31, and a discharge conduit 32 communicates with the upper end of the sleeve 21 and with the inner surface of the sleeve 19. Liquid discharged upwardly from between these sleeves is discharged from the machine through a suitable piping (not shown), connected to the conduit 32 through connection 33.

An annular abutment 34 is formed on the outer surface of the sleeve 21, and this abutment is secured against the lower surface of the plate 30. A nut 35 is secured to the upper end of the sleeve 19, and a clamping ring 36 is secured between the nut 35 and the upper side of the plate 30. A gasket 37 seals the space between the outer wall of the sleeve 19 and the ring 36 adjacent the upper side of the plate 30. The dome 28 and associated skimmer assembly are maintained in place by a sleeve 38 which bears against the gasket 39 on the upper side of the nut 35, and which is secured at its upper end to the bearing base 40 of the driving connection for the spindle 12, this arrangement being similar to that illustrated in Figure 1 of the patent to Jones 1,625,613.

In the assembly of the rotor and skimmer member in the frame of the machine, the sleeves 19 and 21 may first be assembled with each other and arranged around the neck of the rotor with the flanges 20 and 23 occupying the space within the skimmer chamber 14. The plate 17 and nut 18 may then be secured to the upper end of the rotor. The dome 28 and plate 30 may then be placed on the frame 29 and the clamping ring 36 and gasket 37 arranged above the plate 30. The nut 35 is next screwed home, with the result that the skimming sleeves 19 and 21 are pulled upwardly until the abutment 34 engages the under side of the plate 30, thereby clamping the skimmer sleeve in proper relationship to the skimming chamber and compressing the ring 37, thereby sealing conduit 32 against leakage. The screws 31 may be manipulated to adjust the longitudinal position of the skimmer if necessary.

During all of the above assembly operations, the sleeve 38 and rotor spindle 12 are held within the bearing base 40. After the skimmer parts are assembled as described above, the spindle 12 is pulled downwardly and secured to the rotor neck 11 and the sleeve 38 is pulled downwardly and the screw threaded connection between this sleeve and bearing base 40 is manipulated until the lower end of the sleeve 38 bears against the gasket 39 with considerable pressure, holding the entire skimmer assembly firmly in place in vapor-proof relationship to the frame 29 of the machine.

When the operator desires to disassemble the parts for any purpose, such as cleaning, he may accomplish this by a reversal of the steps discussed above. It will be seen that the invention provides convenient means for disassembling all of the parts of the skimmer arrangement in order that these parts may be cleaned.

Since the feed connections at the base of the rotor (not shown) are preferably of the closed type, and the mounting of the skimmer assembly and sleeve 38 with respect to the frame and bearing base of the rotor are also substantially vapor-proof, there is very little chance for air to enter the space within the centrifugal frame, and this fact contributes to the efficiency of the machine in preventing entrainment of air in the discharged liquid.

The efficiency of the machine in accomplishing the functions of avoiding air entrainment and foaming is also due, to a large extent, to the arrangement of the weir 15 and dam 16. It is to be noted particularly that the dam 16 is rotatable with the rotor itself, as contrasted to arrangements of the prior art in which a dam extending from the center of the machine is provided to prevent foam from entering the skimmer chamber, such arrangements involving securing of the dam to a stationary member at the center of the rotor. However, these dams of the prior art caused a great deal of foaming on their own account due to turbulence created by friction between the stationary disc and the rotating liquid in the rotor.

Modifications will be obvious to those skilled in the art, and we do not therefore wish to be limited except by the scope of the sub-joined claims.

We claim:

1. In a centrifugal separator of the type comprising a centrifugal rotor having a circumferential wall and end wall defining a chamber for effecting centrifugal treatment of a liquid, means

for feeding liquid to said rotor at one end thereof,

a neck on said rotor opposite to the end thereof through which liquid is fed thereto, and means secured to said neck for driving said rotor, characterized by the provision of a circumferential wall and end wall defining a skimming chamber surrounding the neck of said rotor and communicating with said treating chamber, a stationary skimming member projecting into said skimming chamber, said skimming member comprising a pair of annularly spaced sleeves providing a conduit for discharging liquid from said rotor, and terminating in a pair of radially directed spaced flanges projecting into the space normally occupied by liquid in said skimming chamber, a housing surrounding said centrifugal rotor, a base member surrounding said means for driving the rotor, and a sleeve interconnecting the lower portion of said base member and the upper portion of said housing for preventing entry of air from above said rotor into said skimming chamber.

2. A centrifugal separator of the type comprising a centrifugal rotor having a circumferential wall and end walls defining a chamber for effecting centrifugal treatment of a liquid, means for feeding liquid to said rotor at one end thereof, a neck on said rotor opposite to the end thereof through which liquid is fed thereto, and means secured to said neck for driving said rotor, characterized by the provision of a circumferential wall and end wall defining a skimming chamber surrounding the neck of said rotor and communicating with said treating chamber, a stationary skimming member projecting into said skimming chamber, said skimming member consisting of a pair of annularly spaced sleeves provided with longitudinally spaced flanges at the base thereof for projecting into the liquid space of said skimming chamber to effect the skimming function, one of said flanges being provided with abutment means adapted to maintain the flanges in proper spaced relationship, one of said sleeves being provided with a surface adapted to abut a surface of the frame of the machine, and the other sleeve being provided with means, operating through said abutment means, for forcing said surfaces into abutting relationship to secure said sleeves in proper relationship with each other and with the frame of the machine.

3. A centrifugal separator of the type comprising a centrifugal rotor having a circumferential wall and end walls defining a chamber for effecting centrifugal treatment of a liquid, means for feeding liquid to said rotor at one end thereof, a neck on said rotor opposite to the end thereof through which liquid is fed thereto, and means secured to said neck for driving said rotor, characterized by the provision of a circumferential wall and end wall defining a skimming chamber surrounding the neck of said rotor and communicating with said treating chamber, a stationary skimming member projecting into said skimming chamber, said skimming member consisting of a pair of annularly spaced sleeves provided with longitudinally spaced flanges at the base thereof for projecting into the liquid space of said skimming chamber to effect the skimming function, one of said flanges being provided with abutment means adapted to maintain the flanges in spaced relationship, the outer sleeve being provided with a surface adapted to abut a surface of the frame of the machine, the inner sleeve projecting through an opening in the frame of the machine and being provided with means, co-acting with the frame of the machine to draw the

inner sleeve upwardly and, operating through said abutment means, to force said surfaces on said outer sleeve and the frame of the machine into abutting relationship to secure said sleeves in proper relationship with each other and with the frame of the machine.

4. A centrifugal separator of the type comprising a centrifugal rotor having a circumferential wall and end walls defining a chamber for effecting centrifugal treatment of a liquid, means for feeding liquid to said rotor at one end thereof, a neck on said rotor opposite to the end thereof through which liquid is fed thereto, and means secured to said neck for driving said rotor, characterized by the provision of a circumferential wall and end wall defining a skimming chamber surrounding the neck of said rotor and communicating with said treating chamber, a stationary skimming member projecting into said skimming chamber, said skimming member consisting of a pair of annularly spaced sleeves provided with longitudinally spaced flanges at the base thereof for projecting into the liquid space of said skimming chamber to effect the skimming function, one of said flanges being provided with abutment means adapted to maintain the flanges in spaced relationship, the outer sleeve being provided with a surface adapted to abut a surface of the frame of the machine, the inner sleeve projecting through an opening in the frame of the machine and being provided with means, co-acting with the frame of the machine to draw the inner sleeve upwardly and, operating through said abutment means, to force said surfaces on said inner sleeve and the frame of the machine into abutting relationship to secure said sleeves in proper relationship with each other and with the frame of the machine, and means abutting the upper surface of said means for drawing said inner sleeve upwardly, and surrounding the driving means for said rotor, for preventing entry of air into the space within said inner sleeve.

5. A centrifugal separator as defined in claim 4, in which the means for drawing said inner sleeve upwardly constitutes a screw threaded connection with said inner sleeve, and the means for abutting the upper surface of said last-mentioned means constitutes a sleeve having a lower end bearing against an element of said screw threaded connection, and an upper end adjustably secured in a bearing base of the machine.

6. In a centrifugal separator, the combination comprising a centrifugal rotor having a chamber for effecting centrifugal treatment of a liquid and a skimming member projecting into the liquid space of said rotor, said skimming member comprising a pair of superposed closely spaced discs affording a pair of thin lips through which liquid is skimmed from said rotor, and wings between said discs for reducing the rotational velocity of liquid between said discs, the outer ends of said wings lying within the outer circumferences of said discs, and the space between said discs which lies outwardly of the termini of said wings being unobstructed.

7. A centrifugal separator as defined in claim 6, in which the surfaces of said wings which direct the liquid inwardly between said discs are curved to effect gradual reduction of the rotational velocity of the liquid between said discs.

8. A centrifugal separator as defined in claim 6, in which the surfaces of said wings which direct the liquid inwardly between said discs are curved to effect gradual reduction of the rota-

tional velocity of the liquid between said discs, and in which said discs constitute flanges on the ends of annularly spaced sleeves, and in which the annular space between said sleeves constitutes a conduit through which liquid is discharged after passage inwardly between said discs.

9. In a centrifugal separator, the combination comprising a centrifugal rotor having a circumferential wall defining the outer surface of a separating chamber and an end wall defining the discharging end surface of said separating chamber, said end wall being provided with outlets through which liquid is adapted to be discharged into a skimming chamber of said rotor formed by an imperforate circumferential wall and an end wall which extends inwardly from said circumferential wall and insures maintenance of a substantial depth of liquid in said skimming chamber, a weir for limiting the maximum depth of liquid in said separating chamber, a stationary skimming member projecting into the liquid space of said skimming chamber, and a substantially imperforate member secured to said rotor for rotation therewith and projecting from a central part of said rotor adjacent the zone of discharge from said separating chamber into said skimming chamber and into the space of said rotor normally occupied by liquid during operation thereof, said member affording a substantially imperforate dam extending from beneath the normal liquid level of said rotor inwardly to a point adjacent the center of said rotor, and said dam and said weir cooperating to form a passageway including a path by which liquid is passed through a zone of high pressure beneath the normal level of liquid contacting said dam in said rotor and to a point beneath the level of liquid in said skimming chamber.

10. In a centrifugal separator, the combination comprising a centrifugal rotor having a circumferential wall defining the outer surface of a separating chamber and an end wall defining the discharging end surface of said separating chamber, said end wall being provided with outlets through which liquid is adapted to be discharged into a skimming chamber of said rotor formed by an imperforate circumferential wall and an end wall which extends inwardly from said circumferential wall and insures maintenance of a substantial depth of liquid in said skimming chamber, a weir for limiting the maximum depth of liquid in said separating chamber, a stationary skimming member projecting into

the liquid space of said skimming chamber, and a substantially imperforate member secured to said rotor for rotation therewith and projecting from a central part of said rotor adjacent the zone of discharge from said separating chamber into said skimming chamber and into the space of said skimming chamber normally occupied by liquid during operation thereof, said member affording a substantially imperforate dam extending from beneath the normal liquid level of said skimming chamber inwardly to a point adjacent the center of said rotor, and said dam and said weir cooperating to form a passageway including a path by which liquid is passed through a zone of high pressure beneath the normal level of liquid contacting said dam in said skimming chamber and to a point beneath the level of liquid therein.

11. In a centrifugal separator, the combination comprising a centrifugal rotor having a circumferential wall defining the outer surface of a separating chamber and an end wall defining the discharging end surface of said separating chamber, said end wall being provided with outlets through which liquid is adapted to be discharged into a skimming chamber of said rotor formed by an imperforate circumferential wall and an end wall which extends inwardly from said circumferential wall and insures maintenance of a substantial depth of liquid in said skimming chamber, a weir between said outlets and said skimming chamber for limiting the maximum depth of liquid in said separating chamber, a stationary skimming member projecting into the liquid space of said skimming chamber, and a substantially imperforate member rotatively secured to said rotor at a point within said skimming chamber and axially spaced from said weir and projecting from a central part of said rotor adjacent said weir and into the space of said skimming chamber normally occupied by liquid during operation thereof, said member affording a substantially imperforate dam extending from beneath the normal liquid level of said skimming chamber inwardly to a point adjacent the center of said rotor, and said dam and said weir forming between them a passage by which liquid is passed through a zone of high pressure beneath the normal level of liquid contacting said dam in said skimming chamber and to a point beneath the level of liquid therein.

ARTHUR U. AYRES.
JEAN ESMIEU.