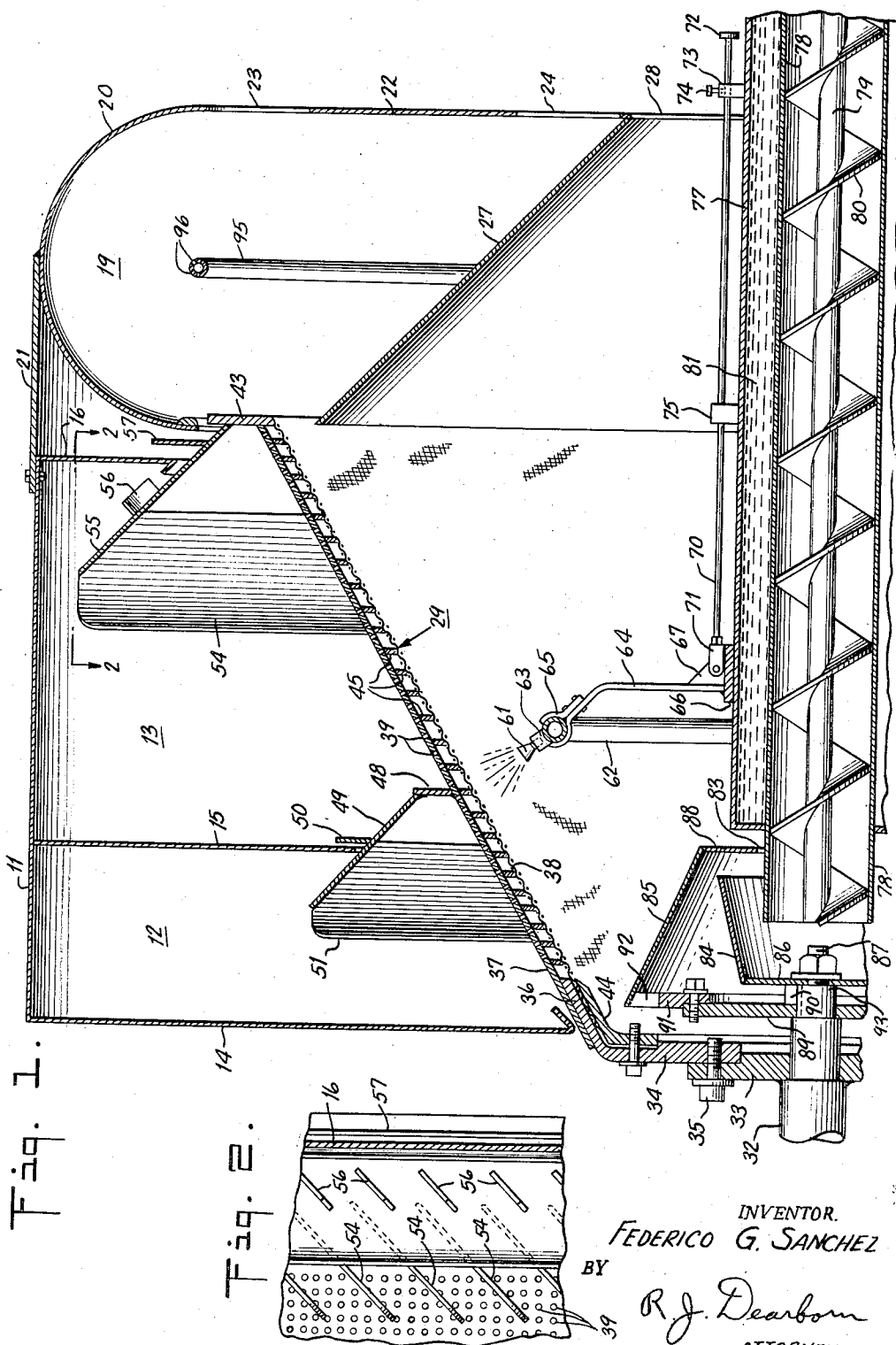


April 21, 1959

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CENTRIFUGAL SEPARATOR
Filed Feb. 4, 1955

2,883,054



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1

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Application February 4, 1955, Serial No. 486,114

5 Claims. (Cl. 210—85)

This invention is concerned generally with centrifugal separators, and more specifically with improvements for centrifugal separators of a type that are particularly adaptable for use in the sugar industry.

In separating raw sugar magma, it is usual for the process to include a washing and separating of the magma to obtain two liquid products and solid sugar crystals. In such separation, there have been various difficulties encountered which exist in the heretofore known separators that have been employed in the sugar industry. Among such difficulties is the fact that an incomplete separation of the liquids from the solid crystals of sugar is apt to exist. Also, there is some loss of the syrup by creepage in the vicinity of the widest diameter, or extremity, of the separator centrifugal element.

Furthermore, another difficulty has been the inability to observe the separation during the action of actual separation, as the machine is operating. This has been due to the type of construction of separators as heretofore employed and creates a real difficulty in optimum control of the separation process.

Other difficulties encountered have been the return of some of the separated solids back into the centrifuge, because of air turbulence near the extremity of the centrifuge. Also, it has been necessary heretofore to employ a dissolving tank, for use in the affination process, which makes use of the sugar crystals dissolved in water.

Consequently, it is an object of this invention to provide an improved centrifugal separator that includes means for overcoming the various difficulties indicated above.

Another object of this invention is to provide vanes attached to the rotating purging cone of the separator and situated to cause an extraction-fan action that will cause a local forced air flow through the purging cone and into the various collector sections of the separator.

Another object of this invention is to provide circumferentially-located spacers or ribs, for supporting the screen on the purging cone. The screen is thus substantially separated from the entirely perforated surface of the cone. Consequently, the flow of liquid through the purging screen and through the perforations of the purging cone will be evenly distributed over the entire surface of the purging cone. In this way no clogging or backing up of the purging liquid, after having passed through the screen, will occur. At least not to an extent which could cause a blocking of the flow of liquid through the purging cone whereby incomplete purging of the liquids from the solid sugar crystals would be had.

Another object of this invention is to provide a frusto-conical air duct which cooperates with the purging cone and the final collector for the sugar crystals so as to allow a free passage of intake air which may be then distributed evenly over the entire surface of the cone. In addition, the use of an air duct of this type renders

2

the inside of the purging cone freely visible so that the action of the separator may be observed at all times.

Another object of this invention is the provision of adjustable spray nozzles for directing washing spray against the inner surface of the purging cone. Such adjustable nozzles being not only adjustable in universal manner for the individual nozzles but in addition being bodily adjustable longitudinally parallel to the axis of the purging cone. Such adjustable nozzles render the separator much more versatile in that adjustments may be made for different materials being purged.

Another object of this invention is the use of a spray pipe for introducing hot water to dissolve the sugar crystals after they are separated, while they are still within the collector compartment of the separator. By this means the use of dissolving tanks may be eliminated and their cost saved, in addition to the time which is saved over that necessary for the dissolving of the sugar crystals in tanks. This same spray pipe may be used in different ways when different processes are employed. For example, it may be desirable to blow in hot air for drying the sugar crystals, or in some cases, hot molasses may be introduced for making new magma.

Other objects include provision for an overlapping disc to act as a seal for preventing contamination of the separated solid crystals by any of the purged liquid, as well as the provision of access doors into the final collector compartment for observation of the separation action in this compartment as well as for cleaning operations.

Briefly, the invention is concerned with the improvement in a centrifugal separator for use with sugar magma or the like which comprises a centrifugal purging member for separating solid crystals from the liquids of the magma in which such purging member has a plurality of vanes thereon for forcing air to circulate through the member in the direction of the liquid flow there-through. Similarly, the invention also concerns an improvement in the centrifugal separator for use with sugar magma or the like which comprises a purging cone for separating solid crystals from the liquid, said purging cone being rotated with its axis substantially horizontal and including a perforated supporting surface. The purging cone also includes circumferential ribs included on said supporting surface for supporting a purging screen which is separated therefrom; the ribs being also for distributing the flow of purging liquid evenly over the surface of said supporting surface.

These and other objects and principles of the invention are set forth in greater detail below and are illustrated in the drawings, in which:

Fig. 1 is a partial cross-sectional view showing the elements of a separator according to this invention; and

Fig. 2 shows a detailed view taken along the line 2—2 and looking in the direction of the arrows, to show the location of the vanes relative to the purging cone of the separator.

The various elements and features according to this invention may best be described in connection with the entire separator as illustrated in the drawings and by describing the various elements thereof and their related functions.

The separator includes a generally cylindrical housing 11, having an opening at the bottom like an inverted U, which is divided into two compartments 12 and 13 on the interior thereof. The compartment 12 is the first collector section of the separator and includes an outer circular end panel 14 which is securely attached to, or may be formed of, a continuous part of the housing 11. The panel 14 is generally circular in shape and lies in a plane that is perpendicular to the axis of the rotating parts of the separator.

The other wall of the accumulator compartment 12 is formed by a circular partition 15 which is located inside the housing 11 and lies parallel to the panel 14. The partition 15 also forms one wall of the compartment 13, which is an accumulator section for a second stage or quality of separated liquids, and which has as its other enclosing wall an outer panel 16 that is attached to the housing 11 (and in fact forms one end thereof).

It will be appreciated that there are convenient exhaust ducts or openings (not shown) located in each of the accumulator compartments 12 and 13 for drawing off the separated liquids.

The stationary portion of the separator includes in addition to the housing 11 an accumulator section 19, which is formed by a rounded sheet of housing material 20, that is attached firmly to the housing 11 by means of a plurality of struts 21. These struts 21 may be attached in any convenient manner to the material 20 of the accumulator section 19, as by means of welding, illustrated, and will be fastened to the housing 11 of the separator in a detachable manner such as by means of bolts as illustrated.

The housing material 20 includes a flat circular end disc portion 22 having at least two access holes 23 and 24 therein for observing the action within accumulator compartment 19, as well as for access within the compartment, for cleaning, etc. There are doors or closing panels (not shown) over these holes 23 and 24 to keep the separated crystals or other material from flying out, when the holes are not in use.

Within the housing material 20, and forming one boundary for the accumulator section 19, there is a frusto-conical duct 27 which is securely attached, e.g. by welding, to become an integral part of the end portion 22 of the housing material 20. This construction is such that the duct 27 leaves an unobstructed opening 28 at the small diameter end thereof, for the entrance of air as it is forced to circulate through the separator. The other end of this frusto-conical duct 27 is also open, and is located just inside of the extremity, or discharge end, of a purging cone structure 29. In this manner, the air which is drawn through the separator is guided to, and evenly distributed over, the entire purging surface of the purging cone structure 29.

The purging cone structure 29 includes as support therefor a rotatable shaft 32, which has firmly attached thereon, as by welding illustrated, a disc 33. Disc 33 has fastened thereto an outer supporting collar member 34 by means of any convenient attachment that is sufficiently strong and secure, such as a ring of bolts like bolt 35 illustrated. The collar member 34 has an angled extremity 36 to which is attached a conical sheet of material 37 that acts as the supporting surface for a purging screen 38, which is situated parallel to the conical surface 37. It will be observed that conical surface 37 is perforated over its entire effective surface, having holes 39 therethrough to allow the liquids as separated to pass through the surface 37 via the holes 39. A disc 43 is securely fastened to the outer extremity of the conical sheet material 37. At the inner edge of the screen 38, it is securely clamped in place by means of a clamping ring 44 that is drawn tightly over the screen to clamp it by means of a series of bolts as illustrated. Separating the screen 38 from the perforated conical sheet material 37 and supporting the screen, there is a series of ribs or rings 45 which are located circumferentially relative to the purging cone 29 and which are securely attached in an integral manner to the conical sheet material 37.

To maintain a separation between compartments 12 and 13, there is a solid disc 48 that is securely attached as by welding to the supporting sheet material cone 37, and that has attached at its outer edge a solid frusto-conical panel or partition 49. On the outside of panel 49, at about the midpoint thereon, there is a flange 50 which is

situated adjacent to the partition 15 and overlaps the inner circular boundary of partition 15.

Attached to the panel 49, as well as to the conical sheet material 37, there is a plurality of vanes 51 which are set at an angle of about forty-five degrees to the axis of the shaft 32 and the entire separator, in order to act as fan blades for drawing air (as introduced via the duct 27) through the purging cone 29 and into the accumulator compartment 12, so as to aid the purging action of the purging cone 29. A detailed view illustrating the situation of vanes like vanes 51, is had in Fig. 2 in connection with a similar set of vanes located further out on the purging cone 29.

For providing the same local forced draft action in accumulator compartment 13, as was had by reason of the vanes 51 in accumulator compartment 12, there is a set of vanes 54, which may also be viewed in Fig. 2 and which are attached to a panel 55 that is similar to the panel 49 in connection with the vanes 51. It will be observed that the vanes 54 extend beyond the outer edge of the panel 55 to increase the forced circulation or fan action with regard to air flow through the purging cone 29 and into the accumulator section 13 to be expelled therefrom at the exhaust opening.

In connection with the accumulator compartment 13 there is an additional set of small vanes 56 which are located on the outside of the panel 55 and are set at an angle of about forty-five degrees to the axis of the separator, similarly to the vanes 54. This may be readily observed in Fig. 2. The action of auxiliary vanes 56 is such that air is forcibly drawn in around the inner edge of panel 16 (which forms one end of the housing 11). In this way, any creepage of liquid, which has been purged from the sugar crystals at the purging cone 29, is entirely avoided so that any loss in this manner is obviated.

Also, another and more harmful result of creepage of the liquid from accumulator compartment 13, which is avoided, is that of the contamination of the solid sugar crystals by having some of the purged liquid drops creep out to the extremity where they might be thrown into the final accumulator section 19. Such contamination action is further avoided or insured against by reason of a solid disc 57 which is attached to the outside of the panel 55 and overlaps the lower edge of panel 16 of the housing.

Within the purging cone 29, and adjustably there located, there is a group of spray nozzles 61. Nozzles 61 are situated to discharge a washing liquid, e.g. water, against the screen 38, as the purging cone 29 is rotated. Any desired number of these nozzles may be located around a circular pipe 62 which has short nipple extensions 63, one for each nozzle 61. The nozzles 61 are held in the nipples 63 by means of a ball-and-socket joint arrangement, in order to be able to adjust the direction of flow from the nozzle as desired. There may be any convenient number of nozzles around the entire circle of the pipe 62, but it has been found entirely satisfactory to use six of these nozzles. It is contemplated that the nozzles 61 will be set to direct their spray in a direction that is against the direction of rotation of the purging cone 29. It is to be noted that with the construction illustrated, the purging cone 29 will be rotated clockwise when viewed from the opening 28 of the machine, i.e. the upper half of the cone 29 will be rotating away from the viewer when viewed as illustrated in Fig. 1.

The water supply for the nozzles may be any convenient arrangement such as a flexible hose (not shown) that is connected to the pipe 62. Pipe 62 is supported in the position illustrated by means of a number of arms 64 which have clamps 65 at the end thereof for securely holding the pipe 62. The arms 64 are attached integrally to a circular band 66 which also has triangular braces 67 attached thereto for adding stability to the support of arms 64. The pipe 62 and nozzles 61 thereon may be bodily adjusted in position, longitudinally along the axis

5

of the separator, by means of sliding the band 66 back and forth as controlled by a rod 70 which has a convenient attaching buckle or the like, such as a U-shaped buckle 71 for attaching the rod 70 to the band 66 by means of a pin coupling fastened through the triangular brace 67. At the outer extremity of the rod 70 there is a knob 72 and also a supporting lug 73 which has a set screw 74 therein to fix the position of the rod 70.

Lug 73 and a similar lug 75, which slidably support the rod 70, are each attached securely to the outside of a hot water jacket 77. Jacket 77 surrounds an intake pipe 78 through which the magma or other material to be separated, is fed. Within the pipe 78 there is a screw-fed mechanism which includes a rod 79 having a thin flange 80 that is shaped in a spiral around the rod 79 and attached thereto in the usual manner for providing a screw-feed. This screw-feed carries material along the inside of the pipe 78, which has a circular cross-section. The jacket 77 is watertight and provides a chamber surrounding the pipe 78 wherein hot water 81 will be contained in order to keep the magma to a desired high temperature for softening the same.

At the center of the purging cone 29, there is a pair of distributing cones 84 and 85 which are made of imperforate material and which have their conical surfaces tapered in opposite directions. The inner cone 84 has a closed back 86 that is integral with the conical portion 84 and that has a hole at the center thereof for accommodating a small diameter threaded extension 87, of the shaft 32. Thus the inner distributing cone 84 is securely attached to the extremity 87 of the shaft 32 by means of a nut and washer as illustrated.

The outer distributing cone 85 is faced in the opposite direction from cone 84 and has a closed end formed by a disc 88 integrally attached to the small end of the cone 85. The disc 88 has a hole 83 therein for permitting entry of the feed-pipe 78 therethrough. The cone 85 is attached to rotate with the shaft 32 in any convenient manner, e.g. by means of a disc 89 that is keyed to a reduced portion 93 of the shaft 32 by means of a key 90 which is shaped to also act as a spacer between disc 89 and the back 86 of the inside distributing cone 84. Cone 85 is then attached to the disc 89 for rotation therewith by means of a ring-shaped bracket 91 that is integrally fastened to the cone 85. There is a substantial amount of space to allow an exit for passage of the material to be separated, such as an opening 92 illustrated. The bracket 91 is attached to the disc 89 by means of bolts as illustrated. It will be observed that the disc 89 has a hole at the center thereof which fits slidably over the reduced portion 93 near the extremity of the shaft 32. There is, of course, a keyway notch in the hole at the center of disc 89, to accommodate the key 90.

Located centrally within the accumulator section 19 there is an inverted U-shaped pipe 95 which has a series of holes 96 therethrough on the outer periphery of the pipe 95. Pipe 95 may be supported in any convenient manner (not shown) and will have a desired fluid introduced therein to be sprayed out through the holes 96 so as to contact the purged sugar or other material, for any desired purpose such as to dissolve the sugar when using an affination process. In some instances, the pipe 95 may carry hot air under pressure so that the air will be blown over the purged sugar to dry the same. Or, in some operations, hot molasses may be blown through the pipe 95 when a new magma is desired, e.g. for further purging in another centrifugal.

Operation

In operation, the separator takes material to be separated, e.g. sugar magma, which is introduced into the feedpipe 78 and feeds it out by means of the screw-feed 79 to the end of the pipe 78. In leaving feedpipe 78 it falls against the inside of cone 84, which is rotating at the desired high speed along with the shaft 32. The

6

magma thus is partially distributed over the inner surface of cone 84 and flows out off the edge of the widest portion of cone 84 into contact with the inside of the second distributing cone 85. The material is kept within cone 85 by reason of the closed end disc 88 and flows in the opposite direction out along the inside of cone 85 until it is discharged off the edge of the widest end of the cone 85 (through openings 92). It is then carried back in the opposite direction again by the ring 44 and out on to the screen 38 of the purging cone 29.

As it continues to flow outward along the screen 38, liquid is forced through the screen and into the hollow spaces between the circumferential ribs 45, from where it is discharged through the perforation holes 39 of the sheet material cone 37. This action is aided by air flowing in through the opening 28 and the diverging duct 27 to the inside of purging cone 29, and then through the screen 38 and spaces between the ribs 45 to and through the perforation holes 39, all by reason of centrifugal force and of the air extracting action caused by vanes 51 and 54.

At a desired location along the purging cone 29, wash-water is introduced from the nozzles 61 and the material continues to flow outward along the screen 38 while liquid is extracted by reason of the centrifugal force and flows out as just described.

After a predetermined distance along the screen 38, i.e. when the disc 48 is passed, the liquids that are extracted from the material will flow into the second accumulation chamber 13. The action here is the same as before in connection with the accumulator chamber 12, and in aid of this liquid flow into the chamber 13 there is the set of vanes 54 which draw air through the purging cone 29. In addition to the vanes 54 small vanes 56, located above the panel 55, create a fanning action to draw air in around the panel 16 so as to keep any liquids contained in the accumulator chamber 13 from creeping out of this opening.

Finally, the solid sugar crystals, or other purged material, will be ejected over the extremity of the purging cone 29, i.e. this solid material will fall away beyond the outer edge of disc 43 and be caught in the final accumulator section 19. Here the solid material is treated by spray which is ejected from the pipe 95 through its holes 96, and then the material is carried out via a duct or other opening (not shown) as it leaves the separator.

It will be noted that during the course of this separation action, or at any desired time, the longitudinal position of the pipe 62 (which carries spray nozzles 61) may be adjusted axially of the purging cone 29, by loosening the set screw 74 and grasping the knob 72 to slide the rod 70 in or out through the supporting lug 73. This will slidably adjust the position of the band 66, which supports the pipe 62 carrying the nozzles 61.

While a specific embodiment of the invention has been described in some detail in accordance with the applicable statutes, this is not to be taken as in any way limiting the invention, but merely as being descriptive thereof.

It is claimed:

1. In a centrifugal separator for use with sugar magma or the like, the improvement comprising a purging cone for separating solid crystals from the liquid, said cone lying with its axis substantially horizontal, a collector for receiving solids from the widest end of said purging cone, said collector having a rounded peripheral configuration, and a spray pipe located near the periphery of said collector and centrally of said rounded configuration for spraying said solids while in said collector to eliminate the need of a dissolving tank.

2. An improved centrifugal separator for use with sugar magma or the like comprising a purging cone for separating the liquids from the solids, at least three accumulator sections adjacent to said cone for receiving separated materials, at least two sets of vanes on said cone extending into said accumulator sections for drawing

7

air through said cone in aid of the flow of liquid there-through, a third set of vanes for drawing a separate stream of air into the last liquid accumulator at the external joint thereof to prevent creepage of liquid out of the accumulator, circumferential ribs spaced axially apart on said purging cone to spread the accumulation of liquid being purged evenly over the whole cone, a frusto-conical air duct extending from the exterior of said separator to the interior of said purging cone for supplying air and for leaving clear visual access thereto, and a set of spray nozzles within said purging cone, adjustable in direction and movable axially of the purging cone.

3. In a centrifugal separator having a feed pipe arrangement for use with sugar magma or the like, the improvement comprising a purging cone for separating solid crystals from the liquid, said purging cone having a plurality of vanes on the outside thereof for forcing air to flow through the cone in the direction of the liquid flow therethrough, and a frusto-conical air intake duct having open ends, the larger of said ends extending adjacent to the discharge extremity of said purging cone, the smaller of said ends being unobstructed for inspection of the interior of the separator at all times and allowing ready insertion or withdrawal of the feed pipe arrangement.

4. In a continuous action centrifugal separator for use with sugar magma or the like, said separator having a horizontally mounted frusto conical purging cone surrounded by two separate collector chambers, the improvement comprising a plurality of fan action blades extending radially into each of said collector chambers and mounted on said cone for rotation therewith, a partition separating said chambers and lying transversely of the axis of said cone, and imperforate annular means attached to said cone and extending radially from the surface of the cone in overlapping relation with said partition to maintain good separation between said chambers.

5. In a continuous action centrifugal separator for use with sugar magma or the like, said separator having

8

a horizontally mounted frusto conical purging cone surrounded by two separate collector chambers and including an accumulator chamber located at the discharge end of said cone, the improvement comprising a plurality of fan action blades extending radially into each of said collector chambers and mounted on said cone for rotation therewith, a partition separating said collector chambers and lying transversely of the axis of said cone, first imperforate annular means attached to said cone and extending radially in overlapping relation with said partition for separating said chambers, second imperforate annular means extending radially outward from said discharge end of the cone in close proximity to a wall of one of said collector chambers, and a plurality of relatively small fan action blades rotating with said cone and located close to said wall of said collector chamber for drawing air into said chamber to prevent escape by creepage of any purging liquid.

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