

May 4, 1965

N. M. CASSIE ETAL
PRESSURE OR VACUUM RELEASE CLOSURE FOR
A CONTAINER OR THE LIKE
Filed July 5, 1962

3,181,720

FIG. 1.

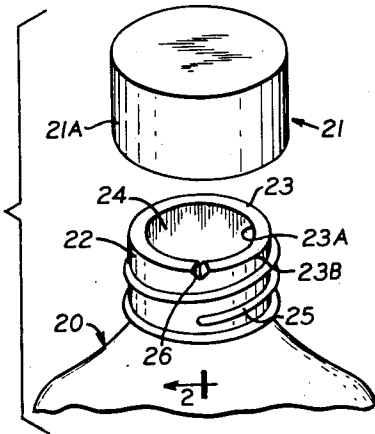


FIG. 2.

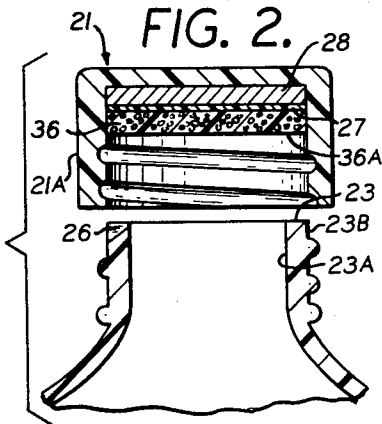


FIG. 3.

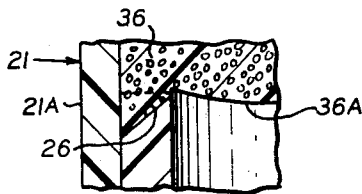


FIG. 4.



FIG. 5.

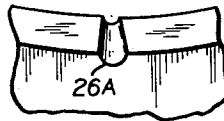


FIG. 10.

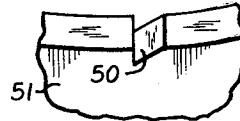


FIG. 6.

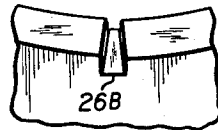


FIG. 9.

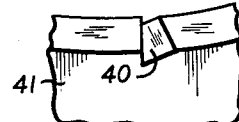


FIG. 7.

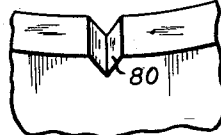


FIG. 8.

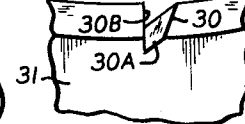


FIG. 11.

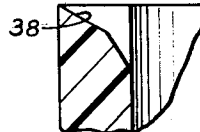


FIG. 12.

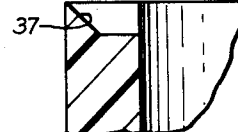


FIG. 13.

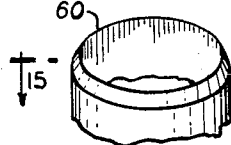


FIG. 14.

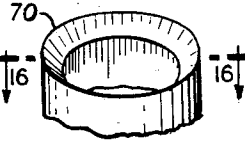


FIG. 15.

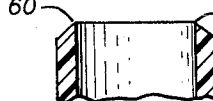
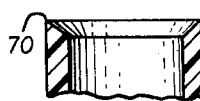


FIG. 16.



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PRESSURE OR VACUUM RELEASE CLOSURE FOR A CONTAINER OR THE LIKE

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16 Claims. (Cl. 215—56)

This invention relates in general to a closure for venting a container, and more specifically to an improved pressure or vacuum release closure for use on a container.

Many products packaged and distributed in bottles or the like are chemically unstable. Certain compositions as for example hypochloride, hydrogen peroxide, and other bleaching solutions, due to extended shelf life, or to changing conditions of temperature and/or light, tend to break down or decompose. In decomposing, these products tend to generate or liberate a gas, which unless vented, will create an excessive build up of pressure within a closed container. Such build up of pressure in a closed container presents a definite hazard and a serious problem to the bottlers, manufacturers and retailers of such compositions. This is because an excessive build up of pressure within a closed container can and does result in serious and sudden explosions. If this should occur, not only is waste of the bottled content committed, but there further exists a potential danger of damage to property or bodily harm to persons exposed to such explosion.

In the event that the pressure built up within such a container is insufficient to explode or disintegrate the container there is nevertheless the danger that abnormal pressures within a closed container, unless relieved, will upon the opening thereof result in a sudden uncontrollable discharge or spillage of the contents therefrom.

Conversely, there are other bottled products that tend to absorb the oxygen from the air space within the container. In such an event, a partial vacuum is created within the bottle which, unless equalized to the external atmosphere pressure, will tend to collapse the bottle. In either case, the results due to conditions conducive to either the build up of excessive pressure or to the creation of a vacuum within a closed container are highly undesirable. With the advent of bottles and containers formed of polyethylene and the like, the above mentioned difficulties are rendered even more undesirable.

Heretofore, many efforts have been made for venting containers, to release excessive build up of pressures therein. Evidence of such efforts are U.S. Patents 2,138,376, 2,423,295, 2,424,801, 2,626,073, and 2,965,257. In each of these patents venting of the container was attained by the use of specially constructed means that are relatively complicated and/or relatively difficult or costly to fabricate. Further the venting construction evidenced by these patents had specific application for venting excessive pressure only, there being no indication or teaching nor is it readily apparent therefrom that any of these known constructions are equally capable of relieving a vacuum should such condition occur within a container.

Therefore, an object of this invention is to provide a seal or closure which is equally adaptable for releasing either an excessive build up of pressure within a closed container or for equalizing a vacuum created within a closed container.

Another object is to provide a seal or closure for a container adapted to contain a liquid which will allow a gas to vent from the inside to outside of the container in the event of an internal build up of pressure or which will permit air to pass from the outside to inside of the

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container to equalize a vacuum condition therein without effecting the loss or seepage of any liquid therefrom.

Still another object is to provide a closure having a standard cap construction provided with a novel liner for valving the passage of a gas from inside to outside, or from outside to inside of the container.

A feature of this invention resides in the provision that the improved pressure and vacuum release means is relatively simple in structure, relatively inexpensive to manufacture, and positive in operation.

The above objects, features and other advantages are attained in accordance with this invention by forming in the lip or neck of a bottle type container, defining the opening thereto, a notch that extends transversely of the width or thickness of the lip. Preferably the notch is formed so that it varies both in depth and width. In accordance with this invention a cap or closure of conventional structure provided with a resilient liner formed of a foam material is utilized for sealing the bottle opening. The arrangement is such that when the cap or closure is normally disposed in sealing position over the neck of the bottle, the resilient liner seals off the notch, and in doing so the density of the foam liner within the notch is varied bilaterally. Therefore, under increased pressure or vacuum formed within the sealed container, the foam facing of the liner will deform within the notch permitting the air or gas to leave or enter the bottle depending upon the relative differences in pressure within and without the container. The bilateral variation in density of the foam liner within the notch affords venting in either direction effective without resulting in loss of liquid stored in the container or bottle.

Other features and advantages will become more readily apparent when considered in view of the drawing and description in which:

FIG. 1 is an exploded view of a bottle type container and closure therefor in accordance with this invention.

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is a fragmentary sectional view taken through the notch formed in the lip of the container with the cap disposed thereon in sealing position.

FIG. 4 is a perspective view of a modified notch detail.

FIG. 5 to 14 are enlarged fragmentary neck portions of a container disclosing other modified notch constructions.

FIG. 15 is a sectional view taken along line 15—15 of FIG. 13.

FIG. 16 is a sectional view taken along lines 16—16 of FIG. 14.

Referring to the drawings there is shown in FIG. 1, a container or bottle 20 and pressure-vacuum release closure or cap 21 therefor. The container 20 may comprise a plastic bottle formed of polyethylene or the like having a reduced neck portion 22 terminating in a lip 23 which defines the opening or mouth 24 thereof. Formed about the neck of the bottle are threads 25 by which the cap or closure 21 may be threaded thereto for sealing. In accordance with this invention a notch 26 is formed in the lip 23 of the bottle 20. The notch 26 extends across the entire width or thickness of the bottle between the inner and outer surfaces thereof. As shown in FIG. 1, the notch 26 is V-shaped in cross-section and is formed so that it tapers upwardly and inwardly. The V of the notch is made quite faint at the inside periphery 23A of the lip, with the V becoming progressively more pronounced as it approaches the outer surface 23B of the lip. Thus it will be noted that the width and depth of the notch 26 varies between the inside and outside surfaces of the bottle.

The closure 21 for sealing the mouth of the bottle comprises a conventional cap having a depending skirt

21A formed with internal threads for complementing the external thread 25 about the neck 22 of the bottle. In accordance with this invention a resilient liner 36 of foam material is disposed within the cap 21. Preferably the foam liner 36 may be formed of a conventional foam, e.g. Ethafoam having cell sizes of $\frac{1}{2}$ mm. to 5 mm. The cells of the foam material may be either opened or closed. With open cell foam a board backing material is required. Foam material having a density of two to ten pounds per cubic foot has proven to give satisfactory results. It is important for the practice of this invention that the resilient foam material have a minimum of hysteresis loop.

In the illustrated embodiment the foam liner 36 may be backed by a thin low moisture vapor transfer film 27 reinforced by a board 28, e.g. cardboard, paper board and the like coated with wax, resin and the like. Accordingly, the wax coating functions to seal off the backing and to enhance the adhesion of the foam thereto. Although the backing 28 is not imperative, it is advantageous in that it forms a support for the foam for slitting and punching operations and also permits for normal adherence of the liner to the cap. Without the backing material some foams will adhere to the cap when they are wetted.

To seal the bottle 20, the cap 21 is screwed sufficiently tight so that a fluid tight seal is formed between the exposed face 36A of the resilient liner 36 and the lip 23 of the bottle. Under nominal pressure or vacuum the facing 36A of the foam liner 36 seals off the notch 26. However, in accordance with this invention, the arrangement is such that the density of the foam liner 36 within the notch for sealing the same is less than the density of the foam forming the line seal about the remaining portion of the lip, and further the density of the foam within the notch varies. Consequently there will be a density differential in the liner along the depth of the notch. Because of both the reduced density of the foam at the notch and the differential in density thereof within the notch, it has been discovered that under increased pressure or vacuum the foam facing will deform within the notch permitting air or gas to leave or enter the bottle up to a predetermined point without the leakage of water there-through.

It has been also discovered that best results are attained when both the width and depth of the notch are progressively increased or decreased between inside and outside surfaces of the bottle.

Therefore, in accordance with this invention, if the contents of the bottle in decomposing liberates a gas, the internal pressures above a predetermined nominal pressure created thereby, can be vented by displacing the foam liner within the notch. Conversely, if a vacuum is created within the bottle, the reduced pressure within the bottle will cause air to be forced into the bottle through notch 26 by deformation of the foam therein.

In accordance with this invention, the thickness of the foam must be proportional to the notch dimensions. Accordingly, it is to be noted that for a given notch size, the pressure at which the valve action or venting will occur increases as the thickness of the foam is increased. Conversely, the pressure at which valve action is made to occur can be decreased by increasing the notch size operating in conjunction with a liner of given thickness. For example a 20 mil notch and a foam liner having a $\frac{1}{16}$ inch thickness has been shown to give satisfactory results; whereas the use of a $\frac{1}{8}$ inch thick foam with a 40 mil notch has proved not to be satisfactory. Therefore, by proper correlation between liner thickness and notch size, the pressure at which the valving action there-between may be made to occur can be varied as may be required by any given set of conditions. According to this invention, the thickness of the liner and the depth of the notch are correlated so that air or gas at low pressure is permitted to travel through the notch 26 while

prohibiting liquid to do so. In using a 1 mm. V-shaped notch, it has been discovered that a foam liner of $\frac{3}{32}$ inch, $\frac{1}{8}$ inch and $\frac{3}{16}$ inch thick has proven to be satisfactory. It will be understood that for varying size caps and bottles, the relative dimensions of the liner and notch may be proportionately increased or decreased for controlling the escape pressure limits.

From the foregoing description, it will be apparent that the pressure differential within and without a sealed container, in accordance with this invention, can be equalized in either direction. That is, the same construction may be used whether an excessive pressure or vacuum is made to exist within a closed container. The foam liner 36 described can be readily adapted for use with a conventional cap structure, and that the only change to be made in the conventional bottle structure is the forming of a notch in the lip of a bottle. The arrangement is such that the pressure release or venting of the container in accordance with this invention is rendered substantially independent of cap tightness on the bottle; and within broad limits the operation is independent of spillage. Further, by proper proportioning of the foam thickness and notch size, release pressures can be controlled.

While a V-shaped notch 26, as above described, has been found to give satisfactory results, the notch may assume other shapes. For example, as shown in FIGS. 5 and 6, the notch 26A or 26B respectively may have either an accurate or channel shape in cross-section. Further, the notches 26, 26A and 26B may be made to slope outwardly, i.e. from inside to outside as shown in FIGS. 1, 5 and 6, or the notches may slope inwardly, that is from outside to inside, as shown in FIG. 4. Experiments have shown that where the notch varies from an inside minimum depth to an outside maximum depth, venting or release of pressure is accomplished without leakage of liquid. If the notch is varied in depth from an outside minimum to inside maximum, leakage is likewise prevented, but at a slightly higher torque. Also it has been determined that variations in width of the notch from inside to outside has no effect upon the performance of the valve, i.e. it functions satisfactorily regardless of variations, so long as the depth varies.

For the most effective results it has been found that the variation in depth of the notch must be continuous in order to prevent leakage. It was also determined that notches 38 and 37, as shown in FIGS. 11 and 12 respectively, can be stepped providing the slope shows continuous variation in depth. Constant width or variation in width showed no correction for leakage when the depth was not varied or stepped.

FIG. 8 illustrates a further notch modification 30 by which the performance of the venting liner can be enhanced. In this form, the notch 30 is formed by angling one side 30A of the notch in the direction in which the cap is twisted (as indicated by the arrow) for sealing. Its other side 30B is vertically disposed. Accordingly, the angle or shape of wall 30A will depend on the depth of the notch desired, which in turn is dependent on the type of foam used for the cap liner. With this construction the foam liner is pressed firmly into the notch when the cap is screwed on the neck 31. As shown in FIG. 8, the notch 30 increases in depth from outside minimum to inside maximum.

The notch 40 of FIG. 9 is similar to that of FIG. 8, but differs in that the notch 40 increases in depth from inside minimum to outside maximum of neck 41.

In the form of FIG. 10, the notch 50 is similar to that of FIG. 8, but is formed with a constant depth between inside and outside surfaces of neck 51.

FIGS. 13 and 15 and FIGS. 14 and 16 illustrate other lip shapes which have proven to be satisfactory to permit venting or release of excessive pressure or vacuum. In either of these forms, lips 60 and 70 of FIGS. 13 and 14 respectively are defined as a sharp edge extending

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about the entire periphery of the mouth opening. In FIGS. 13 and 15 the lip 60 is inclined outwardly of the container, and in FIGS. 14 and 16 the lip 70 is inclined inwardly of the bottle.

While not as satisfactory as the notch constructions hereinbefore described, the V-shape notch 80 of FIG. 7 may be formed with a uniform depth between the inner and outer surfaces of the lip.

While the container construction has been illustrated with but a single notch formed in the lip thereof, it will be understood that several notches may be employed, if desired.

While the instant invention has been disclosed with reference to a particular embodiment, it is to be appreciated that the invention is not to be taken as limited to all of the details thereof as modifications and variations thereof may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. In combination, a container having a walled portion terminating in a circumferential lip defining an opening to said container; a cap for sealing said opening, a liner of foam material fitted on the inside of said cap, and a notch formed in said lip, said notch being shaped for varying the density of the liner within said notch when said cap is disposed in sealing relationship on said lip whereby the variation in the density of said liner permits gases to vent from inside out or from outside into the container depending on the relative pressure within and without said container.

2. In combination, a container having a walled portion terminating in a sealing lip circumscribing the mouth opening thereto, a cap for closing said opening, a resilient liner of foam material fitted inside said cap, said liner being urged into sealing position on said lip when said cap is disposed in sealing position over said walled portion, and means formed in said lip for varying the density of said foam material, said latter means including a notch extending across the entire width of said lip between the inner and outer surfaces of said walled portion.

3. In combination, a container having a walled portion terminating in a sealing lip circumscribing the mouth opening thereto, a cap for closing said opening, a resilient liner of foam material fitted inside said cap, said liner being urged into sealing position on said lip when said cap is disposed in sealing position over said opening, and vent means formed in said lip, said vent means comprising a notch extending across the entire width of said lip between the inner and outer surfaces of said walled portion, said notch varying in depth between the inside and outside surfaces of said walled portions, whereby said notch functions to vary the density of the liner urged thereagainst in the sealed position of said cap so as to render said vent means operative for venting gases and inoperative for venting liquids.

4. The invention as defined in claim 3 wherein the depth of said notch increases from the inside to outside surface of said walled portion.

5. The invention as defined in claim 3 wherein the depth of said notch is increased from the outside surface to the inside surface of said wall portion.

6. The invention as defined in claim 3 wherein said notch is V-shaped.

7. The invention as defined in claim 3 wherein said notch is channel shaped.

8. The invention as defined in claim 3 wherein said notch is arcuately shaped.

9. In combination, a container having a walled portion terminating in a sealing lip circumscribing the mouth opening thereto, a cap for closing said opening, a resilient

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liner of foam material fitted inside said cap, said liner being urged into sealing position with said lip when said cap is disposed in sealing position over said walled portion, and vent means formed in said lip for varying the density of said foam material, said vent means including a notch extending across the entire width of said lip between the inner and outer surfaces of said walled portion, said notch varying in both depth and width in extending between the inside and outside surfaces of said walled portions, whereby said notch functions to progressively vary the density of the liner urged thereagainst in the sealed position of the cap.

10. A container having a wall portion terminating in a circumferential lip defining a mouth opening and a twist cap adapted to close said opening; a resilient liner of foam material fitted in said cap, and vent means formed in said lip for varying the density of the liner in the sealing position of said cap, said vent means including an angled notch extending across the width of said lip; said notch being defined by a perpendicular surface, and a surface inclined relative thereto to define at the junction thereof the apex of said angled notch, said inclined surface being inclined downwardly in the direction said cap is twisted for sealing.

11. The invention as defined in claim 10 wherein the depth of said notch varies between the inside and outside surfaces of said lip.

12. The invention as defined in claim 10 wherein the depth of said notch between said inside and outside surfaces of the lip is constant.

13. In combination, a container having a walled portion terminating in a circumferential lip defining an opening to said container; and a cap for sealing said opening, said cap having a top and a circumferentially extending depending skirt for circumscribing and receiving the walled portion of said opening, a resilient foam liner fitted against the top on the side of said cap, said liner having a cellular surface adapted to be urged against said lip and exposed to the contents of said container in the sealing position of said cap, and a vent means including a notch extending across the entire width of said lip between the inner and outer surface thereof for bilaterally varying the density of the liner urged thereagainst when said cap is disposed in sealing relationship with said lip whereby the bilateral variation of said density permits gases to vent from inside out or from outside into the container depending upon the relative pressures existing within and without said container.

14. The invention as defined in claim 13 wherein the depth of said notch varies between the inner and outer surface.

15. The invention as defined in claim 13 wherein the width of the notch varies between the inside and outside surfaces.

16. The invention as defined in claim 13 wherein both the width and depth of the notch varies between inside and outside surfaces.

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