Dec. 17, 1963 V. H. MONTGOMERY 3,114,467

SELF-VENTING BOTTLE CAP

Filed Aug. 23, 1961

Fig. 1.

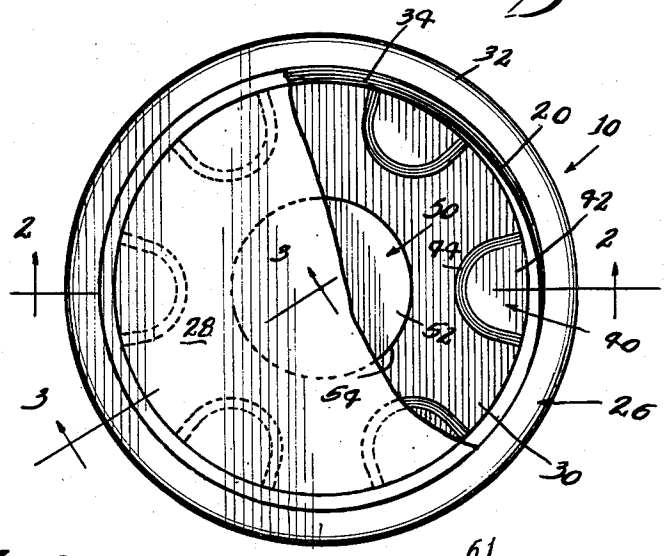


Fig. 2.

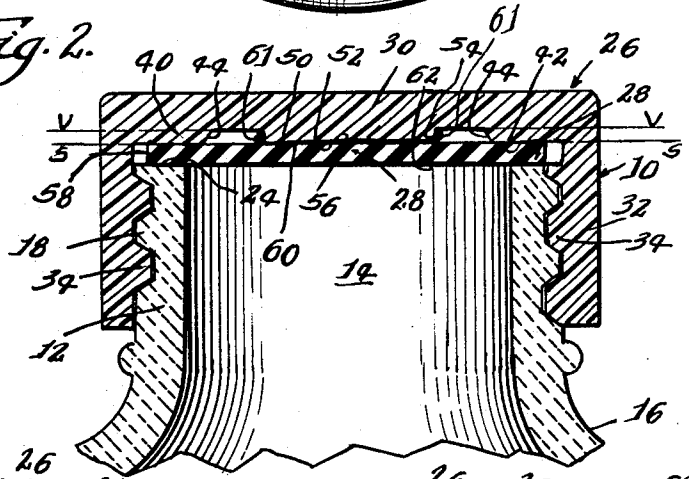


Fig. 3.

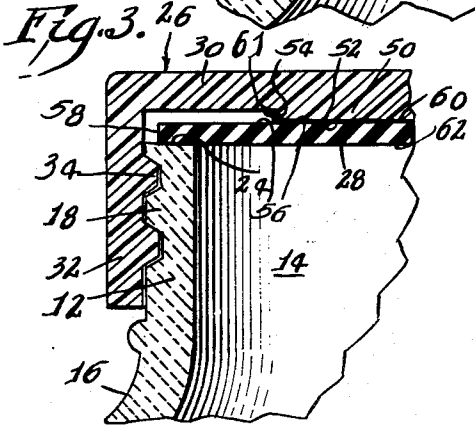
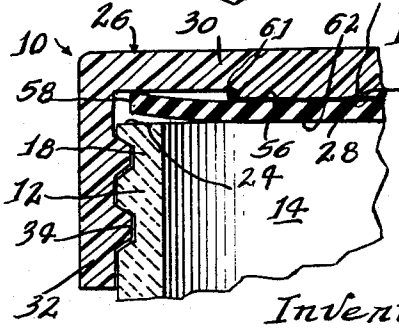


Fig. 4.



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SELF-VENTING BOTTLE CAP

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The present invention relates generally to closures for containers and has particular reference to screw-threaded closure caps for the reduced threaded neck portions of bottles and the like. Still more specifically, the invention is concerned with a self-venting bottle cap which is designed for use in connection with a bottle containing a volatile liquid, for example, a hydrocarbon compound such as a cleaning fluid which is highly volatile and at ordinary room temperatures or at the slightly higher temperatures which it frequently encounters during shipment, storage in warm places, exposure to sunlight, etc., and especially when subject to the agitation incident to handling, builds up internal vapor pressure within the container in which it is confined. A volatile liquid of this character, when confined in a bottle which does not employ a self-venting closure cap, is subject to explosion or might produce the lesser danger of causing the cap to spring a permanent vent or leak.

At the present time, there is on the market a class of self-venting bottle caps of the type wherein the venting feature is incident solely to the construction of the usual bottle cap liner (cardboard or paper pulp disc with a vinylite coating) which overlies the rim of the bottle neck and is clamped thereagainst by the pressure of the crown portion of the cap when the cap skirt is threaded upon the bottle neck. Such type of bottle cap is usually a variation of the basic principle that if a narrow relief area or void is created in the pulp layer of the vinylite-coated or covered liner disc, this area extending radially across the rim of the bottle neck when the cap is threaded on the neck, the inherent elasticity of the vinylite membrane of coating which engages the rim will allow the same to move away from the rim when excessive internal pressures are encountered thereby venting the interior of the bottle into the annular threaded area of the cap and from thence to atmosphere. When the pressure has been thus relieved, the vinylite membrane or coating of the liner of the cap will again assume its normal coextensive sealing relationship with respect to the rim of the neck of the bottle and any subsequent reduction in temperature, or the relieving of other factors contributing toward excessive internal pressure, will develop within the bottle a subatmospheric pressure which will remain effective until an internal pressure exceeding that which gave rise to the original venting is encountered.

Self-venting bottle caps which depend for their venting operation upon the above-outlined principle are subject to certain limitations, one limitation being that special liners having vinylite or other elastic membranes must be employed. Another limitation that is attendant upon the use of such self-venting bottle caps resides in the possibility of clogging of the venting channels which are established by the relief voids. Where a given bottle contains a volatile liquid having a high moisture content, the resultant water vapor which may be created within the bottle and especially in the vicinity of the venting area, may cause swelling of the pulp layer and consequent closure of clogging of the relief void so that the vinylite membrane will have no space for displacement purposes. The effectiveness of the closure for venting purposes is thus permanently destroyed. Yet another limitation associated with such closure caps arises from manufacturing procedure wherein the slitting, grooving or other operations which must be performed upon the liner during the course of its manufacture requires special and expensive machinery. Additionally, due to lack of uniformity in the pulp discs constructed from any given pulp batch, or from different batches, venting pressures cannot be controlled within precise limits. Finally, the fact that composite sealing liners, including both pulp backing discs and vinylite or other elastomeric membranes must be employed, contributes materially to the cost of production.

The present invention is designed to overcome the above-noted limitations that are attendant upon the construction and use of conventional self-venting bottle caps and, accordingly, the invention contemplates the provision of a bottle cap wherein the self-venting features of the cap are incident to the construction of the cap body and are exclusive of the nature of the liner which may be of conventional circular disc-like construction and devoid of deformation such as slitting, grooving, notching or the like. Furthermore, the liner which is employed in connection with the present invention need not be of a composite nature and a conventional one-piece cardboard liner, glazed or otherwise, or a composition liner of various materials, with or without vinyl or other membranes, may be employed in connection with a cap body embodying the principles of the present invention.

Another advantageous feature of the present invention resides in the fact that self-venting bottle caps embodying the principles thereof have cap bodies which are adaptable for use in connection with bottles containing different liquids merely by changing the liners which are associated therewith. For example, certain liquids, such as those containing fluorine, will attack the materials which are employed in the manufacture of most conventional liners so that it is necessary to employ special liners such as wax-coated liners or liners of polytetrafluoroethylene. Liners of this character are not susceptible to modification by conventional standards of slitting or grooving as described above, but they are usable in connection with the present invention inasmuch as the venting feature is exclusive of the liner and is embodied in the construction of the cap body.

A still further operational disadvantage of conventional self-venting bottle caps is incident to the customary practice of gluing or otherwise adhesively connecting the liners to the crown portions of the cap bodies. In the case of slitted liners as described above, the daubs of glue which are applied between the liners and crown portions of the cap bodies, particularly if excessive in bulk, frequently find their way into the venting slits or other voids and clog the same. The present invention also overcomes this limitation in that the cap body is so designed that it affords a collection space for excess glue so that there will be no danger of clogging of the venting areas.

The provision of a self-venting closure cap such as has briefly been outlined above, being among the principal objects of the invention, it is a further and specific object to provide such a cap wherein pressure relief may be controlled within finer limits of tolerable pressure than has heretofore been attainable with conventional self-venting closures.

Numerous other objects and advantages of the invention not at his time enumerated will become readily apparent as the nature of the invention is better understood.

In the accompanying single sheet of drawing forming a part of this specification, one illustrative embodiment of the invention has been illustrated.

In this drawing:

FIG. 1 is an inside or bottom plan view of a self-venting bottle cap constructed in accordance with the principles

of the present invention, certain parts being broken away more clearly to reveal the details of the cap body;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1 and showing the cap applied to the reduced neck portion of a bottle;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 1; and

FIG. 4 is a sectional view similar to FIG. 3, but showing the cap applied to a bottle neck and in venting relationship relative thereto.

Referring now to the drawings in detail, the closure cap of the present invention has been designated in its entirety by the reference numeral 10, and in FIG. 2, the cap has been shown as being applied to the reduced neck portion 12 of a glass bottle 14, the neck portion 12 being connected to the body portion of the bottle by a shoulder portion 16. These parts are cylindrical in horizontal cross section and the neck portion 12 is shown as being provided with a single external helical screw thread 18. The latter is preferably, but not necessarily, continuous from end to end and its leading end 20 fades into the general cylindrical confines of the neck portion 12 at a region near the rim 24 of the neck portion.

The improved self-venting closure cap 10 is comprised of two parts, namely, a cap body 26 and a liner 28. The cap body, in general, is of the conventional screw-thread type in that it includes the usual crown portion 30 and a depending marginal cylindrical skirt 32, the latter being internally threaded as at 34 to provide a counterpart screw thread which is adapted to mate with the external screw thread 18 on the neck portion 12 of the bottle 14. The cap body 12 is preferably formed by a molding operation from a suitable moldable plastic material such as a thermoplastic or a thermosetting resin.

According to the present invention, the inside face of the crown portion 30 is provided with a series of circumferentially spaced protuberances 40, each protuberance providing a flat raised land area 42. The land areas are generally of parabolic configuration and the apices thereof are directed radially inwardly of the crown portion. In the form of the invention selected for illustration, six such protuberances and land areas have been illustrated, but it will be understood that a greater or a lesser number may be employed if desired depending upon the size of the cap. Each land area 42 merges with the adjacent region of the crown portion 30 by way of an inclined or bevelled edge area 44. The wide or blunt ends of the parabolic land areas 42 intersect the inside generally cylindrical surface of the threaded skirt 32. The radial extent of the various land areas 42 is considerably greater than the radial thickness of the rim 24 of the neck portion 12 of the bottle and, in the illustrated form of cap body, these land areas extend inwardly so that the apices of the parabolas lie on a circle having a radius equal to approximately one half the radius of the crown portion 30.

The planar inside face of the crown portion 30 is further provided with a central protuberance 50 presenting a circular land area 52, this land area being connected to the adjacent region of the crown portion 30 by a cylindrical side surface 54.

It is to be noted that the various parabolic land areas 42 and the central circular land area 52 lie in a common horizontal plane which will hereinafter be referred to as the sealing level. The entire trough area, i.e., that area of the inside face of the crown portion 30 between the various land areas, also lies in a common horizontal plane and establishes a second level which will hereinafter be referred to as the venting level. These two levels have been illustrated in FIG. 2 by the broken lines *s*—*s* and *v*—*v*, respectively.

As previously stated, the liner 28 is of conventional construction and it may be in the form of a thin compressible imperforate flat circular disc of treated cardboard or other suitable material. Obviously, the liner 28 will be constructed from liner stock which has been impregnated or otherwise treated with a material which will render the same impervious to moisture, as well as to the particular liquid which is to be stored within the bottle 14, and which also is impervious to gases and not subject to osmosis. It is essential, however, that the liner be possessed of a certain degree of resiliency or flexibility.

The upper face 56 of the liner 28 lies flush against the various parabolic land areas 42, as well as against the circular land area 52, at the sealing level, and the liner completely spans the voids which exist between these areas. The liner is substantially coextensive radially with the inside face of the crown portion 30 and the peripheral edge 53 of the liner is located a small distance radially inwards of the inside face of the cylindrical skirt 32 near its region of juncture with the crown portion 30. A quantity of glue, which has been indicated by the heavy lines designated at 60 in FIGS. 2, 3 and 4, may be interposed between the upper face 56 of the liner and the circular land area 52 to secure the liner bodily as a whole in position within the confines of the cap body 26.

It is to be noted at this point that when the liner 28 is installed within the cap body 26, any excess glue over and above that required for adhering purposes between the land area 52 and upper face 56 of the liner 28 will be squeezed by the application of pressure between these surfaces into the void which exists between the liner and the venting level as indicated by the excess glue shown at 61. By such an arrangement, the void thus functions as a large capacity receptacle for the small amount of excess glue which may be present in any given installation so that the glue will not interfere with the venting function between the liner and cap body as will be described presently.

When the closure cap 10 is applied to the threaded neck portion 12 of the bottle 14 by the usual threading procedure, and when the threads 18 and 34 are tightened sufficiently to establish the desired seal at the rim 24 of the neck portion, the portions of the peripheral region of the liner which directly underlie the downwardly facing land areas 42 and which are in vertical registry with the rim 24 will be clamped between the circular rim 24 of the neck portion 12 and these land areas as shown in FIG. 2. The intervening portions of the peripheral region of the liner between adjacent underlying portions will lie flush against the rim 24 as shown in FIG. 3, but they will not be supported thereabove by any part of the crown portion 30. Under normal internal pressures within the bottle 14 they will exert a sealing function against the rim 24 to prevent egress of liquid or vapor from the bottle due to the fact that the liner 28 is stretched taut across the voids in the regions involved.

When excessive internal pressures are developed within the bottle 14 under the influence of abnormally high temperatures, agitation of the contents of the bottle, or both, the unsupported portions of the liner will yield as indicated in FIG. 4 and these portions will flex upwardly and leave the rim to the extent necessary to bleed or vent the interior of the bottle 14 to atmosphere. Any gas or vapor which may find egress from the bottle radially outwardly across the rim 24 in this manner will find its way to atmosphere by passing downwardly along the threads 18 and 34, which, in the case of commercial containers of the type under consideration, are sufficiently coarse and of such small extent that they do not effect perfect sealing engagement with each other. When normal pressure within the bottle 14 has been restored by such venting action, the inherent resiliency or elasticity of the liner will cause the upwardly displaced portions of the peripheral regions of the liner to be restored to their normal positions of sealing engagement with the rim 24.

In connection with the use of the self-venting closure cap 10, it is to be noted that by varying the extent to which the threads 18 and 34 make engagement with each other, i.e., by varying the machine-applied tightening pressure between these threads at the time the bottles are

sealed at the bottling plant, the tensioning of the unsupported portions of the peripheral region of the liner which span the gaps or voids created by circumferentially spaced land areas **42** may be varied at will to establish different venting pressures. The tighter the threaded engagement between the threads, the greater will be the pressure of the land areas **42** and the rim **24** against the opposite sides of the liner and the greater will be the clamping deformation of the compressible liner at the clamped regions thereof. The greater the clamping deformation, the tighter the intervening portions of the liner will be stretched, and as a consequence, the greater will be the internal pressure which must be attained before any venting action may take place.

The parabolic contour of the various land areas **42** and the circular contour of the land area **52** are of significance in that by thus rounding the edges of the protuberances **40** and **50** at the regions where adjacent protuberances oppose each other, a relatively wide or expansive unsupported area of the underneath face **62** of the liner is exposed to the internal pressure developed within the bottle **14**. By such an arrangement, the liner is sensitive to relatively small changes in internal pressure and control of venting pressure may more readily be attained.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawing or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, while the cap body **26** is stated herein to be formed of a moldable plastic material, it may be formed of metal if desired. Also, the invention is not necessarily limited to use in connection with a bottle cap which is applied to the reduced neck portions of a bottle since, if desired, a closure cap for a wide mouth jar or the like may be constructed according to the principles of the invention. Therefore, only insofar as the invention has particularly been pointed out in the acompanying claim is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

A self-venting closure cap for a container having a threaded neck portion presenting a circular rim, said cap including a cap body having a crown portion and a depending internally threaded skirt designed for threaded engagement with the threaded neck portion of the container, the inside face of said crown portion being planar and provided with a series of circumferentially spaced protuberances in the peripheral regions thereof, the underneath faces of said protuberances being generally parabolic in contour with the parabola axes extending generally radially of the crown portion and with the apices of the parobalae directed inwardly, said underneath faces providing a series of parabolic land areas which lie in a common plane parallel to and spaced downwardly from the plane of said inside face of the crown portion, said inside face also being provided with a centrally disposed protuberance providing an additional land area on its underneath face and which also lies in said common place, said latter land area being circular and being spaced inwardly from the apices of the parabolic land areas, and a thin flat imperforate circular disc-like liner formed of flexible compressible material, nested within said cap body and having the central region of its upper face bearing coextensively against said circular land area and the peripheral regions of its upper face bearing coextensively against said parabolic land areas, said liner bridging the distance between all adjacent land areas, the axial extent of each parabolic land area completely traversing the annular rim-engaging region of the liner and being such that the apex of the parabolic land area lies substantially midway between the circular land area and the threaded skirt.

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