Sept. 8, 1964 G. S. LEPORE 3,147,876

CONTAINERS HAVING CAPS PERMITTING PRESSURE EQUALIZATION OF CONTENTS OF CONTAINER

Filed March 24, 1961

FIG. 1.

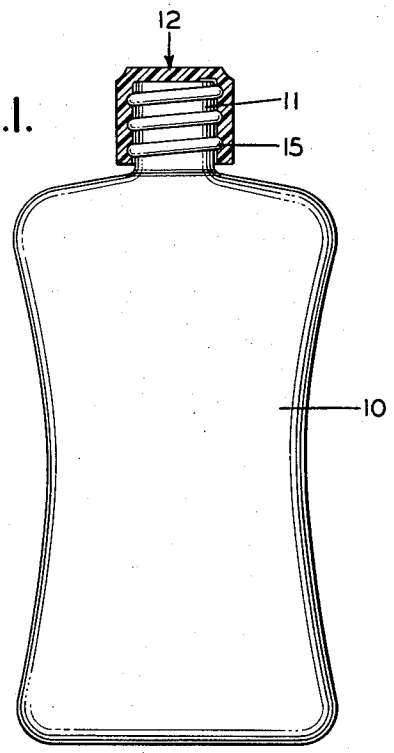


FIG. 2.

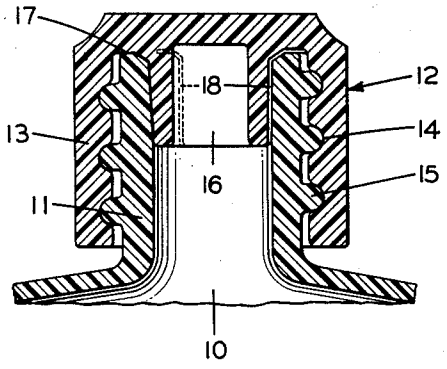
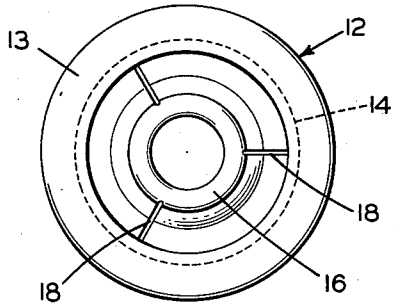


FIG. 3.



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CONTAINERS HAVING CAPS PERMITTING PRESSURE EQUALIZATION OF CONTENTS OF CONTAINER

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This invention relates to improvements in containers or receptacles formed of resilient plastic materials such as polyethylene, propylene and the like, for receiving liquids such as liquid detergents, cosmetics and the like, and it relates particularly to plastic bottles for receiving such liquid compositions and the closures therefor.

Resilient plastic containers or receptacles, such as bottles having resilient walls, frequently are filled with materials at relatively high temperatures and are stored at considerably lower temperatures or may be subjected to varying atmospheric conditions which create a substantial pressure differential between the interior of the container and atmosphere. When, for example, the pressure within the container drops substantially below atmospheric pressure, a flexible container tends to collapse or at least change in shape. Likewise, if the pressure inside the container exceeds atmospheric pressure, the container may bulge and because of the increased pressure therein, may leak.

The present invention relates to an improved form of closure for resilient containers or containers having resilient walls to enable the container to breathe under changing pressure conditions to equalize the pressures inside and outside the containers without allowing leakage of the contents of the container.

More particularly, the closure for the container is provided with one or more grooves which connect the interior of the container to the atmosphere thereby permitting air or other gas to flow from the exterior of the container into the container or vice versa, the groove or grooves, however, being of such dimensions that leakage of the liquid contents of the container is prevented even when the container is disposed with the closure below the level of the liquid in the container.

It has been found that the dimensions of the groove or grooves to achieve the desired results are quite critical and should not exceed about .003 of an inch in depth or be less than about .002 of an inch deep. The width of the groove is less critical but for best results it should not exceed about .005 of an inch or be less than about .002 of an inch.

For a better understanding of the present invention, reference may be had to the accompanying drawings in which:

FIGURE 1 is a perspective view of a typical flexible plastic bottle having a cap thereon of the type embodying the present invention.

FIGURE 2 is a view in cross-section through the cap and neck of the bottle; and

FIGURE 3 is a bottom plan view of the cap removed from the bottle.

As shown in FIGURE 1, the bottle **10** may be of substantially any desired shape suitable for storing and vending a liquid material, such as a detergent, a hand lotion or the like. It preferably is formed of a resilient plastic, such as, for example, polyethylene or polypropylene or other similar, relatively inert, flexible plastic material. The bottle **10** is provided with a threaded neck **11** for receiving an internally-threaded closure cap **12** which may be formed of material similar to the container or a more rigid material, such as polystyrene, phenol-formaldehyde resin, or the like.

Referring to FIGURE 2 of the drawings, it will be seen that the skirt **13** of the cap **12** has internal threads **14** for engagement with the threads **15** on the neck **11** of the bottle and is also provided with a centrally-located plug **16** of solid or hollow formation which engages in the pouring opening in the neck of the bottle to close and seal it. Also, the cap **12** has a transversely-extending, generally annular inner surface **17** which engages the end of the neck **11** of the bottle when the cap is screwed fully on the neck. With the arrangement described, if the bottle is subjected to different external and internal pressures, the bottle would tend to collapse partially or to expand partially.

In accordance with the present invention, the cap **12** is modified to permit the bottle to breathe so that the pressures inside and outside of it are equalized. To that end, the cap **12** has one or more grooves **18** formed in it extending lengthwise of the plug **16** and across the annular extending portion **17** so that the interior of the bottle is connected to the exterior atmosphere. In the cap illustrated, three grooves **18** are provided. Air can flow freely between the outside of the neck **11** and the skirt **13** of the closure cap to the outer end of the groove or grooves **18**, for the reason that the skirt and neck are spaced slightly apart and a helical passage exists between the turns of the threads on the neck and cap. While axially and radially arranged grooves **18** are illustrated, they can be arranged tangentially or at any other angle across the laterally-extending surface **17** of the cap and spirally around the plug **16**, or in any other desired way. Moreover, more or fewer than three grooves may be provided.

A critical feature of the invention is the depth of the groove or grooves **18**. The grooves are shown in exaggerated size in FIGURES 2 and 3, but it has been determined that the grooves should not exceed .003 of an inch in depth and should not be less than .002 of an inch in depth in order to permit flow of gas or air along the grooves between the outside and the inside of the bottle, and, at the same time, prevent the liquid contents of the bottle from leaking when differential pressures exist between the interior and exterior of the bottle and the bottle is disposed so that the pouring opening is below the level of the liquid contents of the bottle. Tests have demonstrated that bottles of the kind embodying the invention as described herein can be filled with liquid having a temperature of 100° F. and then chilled to 40° F. without causing them to collapse. Even when the bottles are stored in an inverted condition, leakage of the liquid is completely prevented. When the depth of the grooves is increased to .005 of an inch, leakage occurs. When the depth of the grooves is decreased below .002 of an inch, the bottles do not leak but they tend to collapse when their contents are cooled from 100° F. to 40° F.

The width of the groove or grooves **18** is preferably on the order of .005 of an inch, but the width of the grooves may, if desired, correspond to the depth of the grooves so that a groove having a depth of .002 of an inch may also have the same width. Liquid does not leak from the bottle when the cap is provided with grooves **18** .0025 of an inch deep and .005 of an inch wide. Depending upon the viscosity of the liquid packaged in the container, some variation in the dimensions of the grooves is possible. With more viscous liquids, the groove sizes can be increased and with less viscous materials, the groove dimensions should be decreased. However, for liquids such as concentrated detergents used for dishwashing or laundering, a depth of .002 to .003 of an inch is satisfactory. The widths of the grooves do not appear to be as critical as their depth, possibly for the reason that the cap compresses slightly when it is screwed onto the container

thereby decreasing the dimensions of the groove and keeping the dimensions of the groove within a critical range.

It will be understood that the invention is susceptible to modification. Thus, if the neck of the bottle can be molded with precision to include grooves of the dimensions indicated above, the lip and internal surface of the neck may be grooved rather than the opposing surfaces of the closure cap. Moreover, when the cap does not include a plug 16, the grooves may be formed in the surface or surfaces of the closure cap which engages the neck of the bottle to effect a seal therewith.

Accordingly, the form of the invention illustrated herein should not be considered as limiting and the invention should be considered as limiting only by the terms of the following claims.

I claim:

1. A container comprising a receptacle for liquid having a resilient wall and a pouring opening surrounded by a lip, a closure cap having a portion engaging said lip for closing said opening in liquid-tight relation, and at least one groove between said portion and said lip to allow inflow and outflow of gas therebetween when said opening is closed in liquid-tight relation by said portion, said groove being between .003 of an inch and .002 of an inch deep to prevent leakage of liquid therethrough.

2. A container for liquids comprising a receptacle for liquid having a resilient wall, and a neck containing a pouring opening, a closure cap fitting on said neck, a plug on said cap engageable in said pouring opening and at least one groove between the exterior of said plug and the interior of said neck extending lengthwise thereof and connecting the interior of the receptacle to atmosphere outside of said receptacle, said groove being between about .003 of an inch and .002 of an inch deep to permit gas to flow into and out of said receptacle and prevent leakage of liquid from said receptacle when said plug is engaged in said pour opening.

3. A container comprising a receptacle for liquid having a resilient wall and an externally-threaded neck having a pouring opening therein, a closure cap having internal threads for engagement with said externally-threaded neck and a plug engaging in said pouring opening for closing it in leak-proof relation, said cap having at least one groove extending lengthwise of the exterior of said plug to connect the interior of said receptacle to atmosphere exterior of said container, said groove being between about .002 and .003 of an inch deep and between about .002 and .005 of an inch wide to permit flow of gas and prevent flow of liquid along said groove when said opening is closed by said plug.

4. A container comprising a receptacle for liquid having a resilient wall and a neck containing a pouring opening and having exterior threads thereon; a closure cap fitting on said neck; a skirt on said cap having interior threads thereon engageable with said neck threads, said skirt being in spaced relation to said neck with a helical passage between the turns of the threads on said neck and said skirt; a plug on said cap engageable in said pouring opening and at least one groove between the exterior of said plug and the interior of said neck extending lengthwise thereof and connecting the interior of the receptacle to the atmosphere outside of said receptacle through said helical passageway, said groove being between about .003 of an inch and .002 of an inch deep to permit gas to flow into and out of said receptacle and prevent leakage of liquid from said receptacle when said plug is engaged in said pouring opening.

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