Jan. 1, 1963 F. G. PELLETT ET AL 3,071,276

VENTED CLOSURE

Filed Aug. 23, 1960

FIG. 1

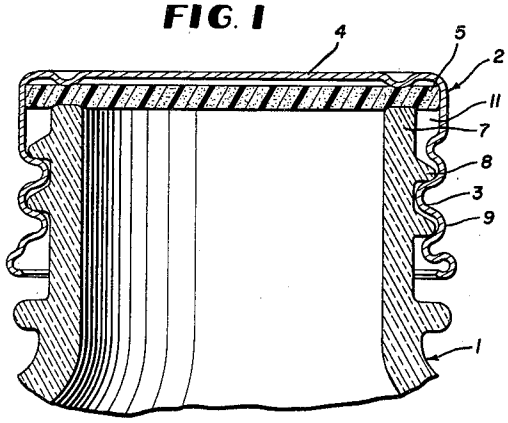


FIG. 1A.



FIG. 2

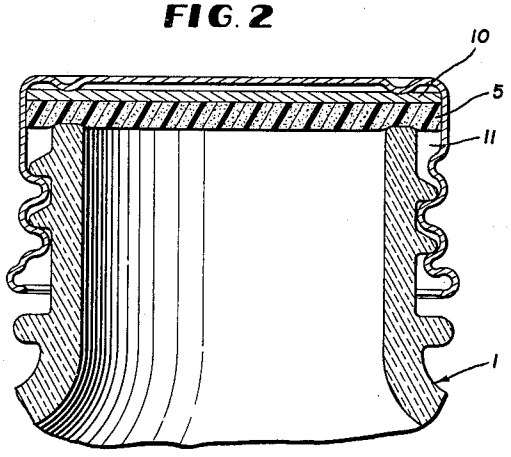


FIG. 2A

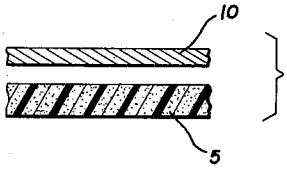


FIG. 3

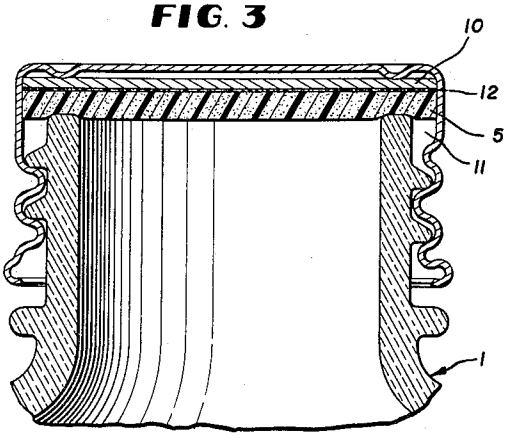
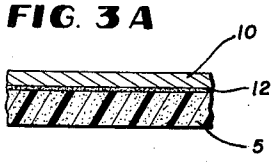


FIG. 3A



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VENTED CLOSURE

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The present invention relates to a closure for a container such as a bottle, jar, can or the like and more particularly to a so-called venting closure capable of releasing gaseous pressure occurring in said container.

It is known that certain products such as bleaching or hypochlorite solution when sealed in a container decompose giving off a gaseous by-product which tends to create a pressure within the container. This pressure can prove very dangerous in that it can reach explosive proportions, particularly if the container should be stored in a warm place, such that a glass container can be shattered with serious results. In certain instances the pressure may not reach such proportions as to rupture the container but will give rise to a potentially dangerous situation wherein a slight blow against the bottle, as in normal handling, will cause the bottle to explode and cause serious accidents. Attempts have been made to provide a container with a cap which would continuously relieve the pressure in the container. However, such attempts have resulted in caps which have had one or more serious limitations such as reduced sealing efficiency whereby leakage of the liquid occurs or excessive cost. Accordingly it would be most beneficial and desirable to the bottle cap art to provide a new type of cap which would be free of the aforementioned shortcomings of presently used vented closures.

It is, therefore, an object of this invention to provide a vented closure for containers which tend to accumulate gaseous pressures.

A further object of this invention is to provide a vented closure which will permit the escape of gas from a container but inhibit the entrance of moisture.

A further object of this invention is to provide a vented closure which will permit the escape of gas from a container but prevent the exit of the liquid contents of the said container.

A further object of this invention is to provide a vented closure which will prevent the build up of dangerous gaseous pressures in a container whose contents is normally a liquid or solid but subject to liberating (spontaneously or under mild conditions of temperature) gaseous by-products such as oxygen, carbon dioxide, sulfur dioxide, and the like.

These and other objects are attained by the construction shown in the accompanying drawing wherein for purposes of illustration an embodiment of the invention is shown and wherein:

FIG. 1 is a vertical section of a neck of a bottle and a venting closure made in accordance with this invention;

FIG. 1A is a fragmentary vertical section of the porous plastic layer shown in FIG. 1;

FIG. 2 is a view similar to FIG. 1 but of a preferred modified construction;

FIG. 2A is a vertical fragmentary section of the layers underlying the cap of FIG. 2;

FIG. 3 is a view similar to FIG. 2 but of a further modification; and

FIG. 3A is a vertical fragmentary section of the several layers underlying the cap of FIG. 3.

Referring now more particularly to the drawing, there is shown the upper part of a container 1 having a neck 7 with screw threads 8 and adapted to engage the screw lugs 9 of venting closure 2 having a cap or cover 4 and a depending skirt 3. Positioned within the skirt and under the cap of the closure is a liner 5 of microporous plastic. By employing the cap of FIG. 1 it has been found that the gaseous products generated in the container will permeate the plastic liner 5 and escape to space 11 and thence to the air along the threaded portions where the cap engages the neck of the bottle thereby preventing the build up of dangerous pressures within the container.

FIG. 2 represents a modification in which a porous backing liner 10 or porous disc of paper board has been used with the layer or liner 5 of microporous plastic or facing.

FIG. 3 represents a further modification in which an adhesive layer 12 has been placed between the paper board and microporous plastic layer. In both FIG. 2 and FIG. 3 the gases liberated in container 1 permeate the various layers and escape to the air by way of openings existing between the screw threads of the cap and lugs of the neck bottle which in effect form a continuous channel for the liberated gas to escape.

It has been found that the size of the micropores in the plastic layer can range from 1 to 50 microns with 1 to 15 microns being the preferred range. In general a lower range of 1–5 microns and less will be preferred with those highly penetrative liquids of a non-viscous nature. On the other hand a pore size of 10–15 microns and higher will prove satisfactory with most gas liberating liquids, viscous liquids, and solids. Microporous plastics suitable for this purpose have recently become available (see U.S. 2,794,753) and include polyvinyl chloride, polyvinylidene chloride, nylon, polyethylene, polypropylene, styrene, acrylonitrile, methylmethacrylate, cellulose acetate plus derivatives and polymeric mixtures thereof.

The thickness of the microporous plastic layer can reach a maximum of about .1 inch in the case of the FIG. 1 modification and from about 25–30/1000 inch to less than 1/1000 inch in the case of the FIG. 2 and FIG. 3 modifications. Although in FIG. 2 the plastic liner is shown as being thicker than the paperboard backing, usually the converse will be true as shown by the following examples which illustrate the effectiveness of the cap construction of the present invention in preventing pressure build up in containers having gas liberating materials and yet maintaining a leak proof condition with respect to the materials.

Example I

Pint bottles of bleach solution (hypochlorite) were sealed with conventional caps and caps of the type shown by FIG. 3. After conditioning upright at 70° F., the bottles were turned on their sides and leakage observed after 24 hours. Any detectable amount of leakage was considered unsatisfactory. The results are tabulated below using microporous polyethylene having openings from 8–12 microns.

Liner		Number tested	Venting of gas headspace pressures		Leakage of liquid	
Backing	Facing		Range, p.s.i.g.	Average, p.s.i.g.	Number tested	At 70° F., 1 day
.035 in. paperboard	.012 polyethylene	12	0–2	1.8	6	0
.040 in. paperboard	Al foil coated with vinyl plastic	12	47–100+	89.0	6	0

The venting test consisted of filling 30 cc. bottles with the bleach solution to a 4 cc. headspace. Two 6-penny iron nails were added to accelerate pressure build up, caps were applied at 18 inch-lbs. torque, and bottles stored at 70° F. for 18 hours. At the end of this period, the headspace pressure was measured with a puncture needle attached to a calibrated puncture gage.

Example II

In a venting test similar to Example I involving a commercially available solid effervescent salt consisting substantially of sodium bicarbonate and tartaric acid the results were as follows:

Liner	Total thickness	Number tested	Venting of gas headspace pressure	
			Range, p.s.i.g.	Average, p.s.i.g.
.025 paperboard plus .012 polyethylene (micropores 8 to 12 microns)	.037	5	0–0	0
Paperboard made impervious by varnish	.035	5	25–81	70

In the above table, the pressures were read after 3 days storage at 125° F. No leakage was observed which was expected due to the solid state of the salt.

The manner in which the microporous plastic particularly prevented the build up of excessive and dangerous pressures within the containers will be evident from the foregoing tables. In addition no leakage occurred although this was not unexpected in the case of Table II.

In the case of solids which tend to liberate gases upon standing, the novel venting closure of the present invention also appears to have the salutary effect of inhibiting the inflow of moisture from the air since no caking or moisture absorption is observed to take place with the effervescent salt of Example II. This can be explained and attributed to the tendency of the liberated gas as it escapes to force back the entrance of the surrounding atmospheric gas. However, ultimately an equilibrium between outflow of liberated gases and inflow of surrounding atmosphere is probably reached.

It will be apparent that various modifications can be made in the present invention without departing from the spirit thereof. For example, threaded caps have been shown in the drawings and examples but the invention is equally applicable to the well known crown or bottle cap in which the depending skirt of the cap is simply crimped against the side of the container or bottle neck (see U.S. 2,327,454 by way of example). Moreover, the reference to the use of the caps of the present invention for bleaching solutions is merely illustrative since other solutions which tend to give off gases and which can be bottled with the vented closures of this invention include hydrogen peroxide and molasses.

The adhesive layer **12** shown in FIGURE 3 is preferably porous in nature. However, for certain applications a non-porous adhesive can be employed whereby edge transmission through the porous facing member is utilized to allow the gas to escape. In addition a non-porous adhesive can be applied in strips so that a discontinuous layer of adhesive holds the porous plastic layer to the paper board or other similar backing.

It is further understood that the vented closure of the present invention can be used as a cap for bottles used to contain powders which liberate gaseous products during storage such as effervescent salts and bleaching powder ($CaOCl_2$). Although with powders there is no problem of leakage, it is still highly desirable to prevent the build up of dangerous pressure in glass containers which can result in the actual explosion of the containers.

From the foregoing description it will be apparent that applicants have provided a controlled venting of a container without leakage of the liquid (or solid) therein by employing a closure liner which is micro-porous. This in turn depends upon the well known phenomenon that whether or not a liquid will pass through a given micro opening will depend upon the size of the opening, the interfacial tension between the liquid and the solid in which the micro opening occurs and the pressure difference tending to force the liquid through the micro opening. By employing the micro-porous plastic described above applicants have succeeded in allowing the gaseous decomposition by-product to pass through but in checking the passage of the liquid, for example, bleaching solution (hypochlorite) without the development of any substantial pressure within the container.

While the illustrative embodiments of the invention have been described hereinbefore with particularity, it will be understood that various other modifications will be apparent to and can readily be made by those skilled in the art without departing from the scope and spirit of the invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the examples and description set forth herein but rather that the claims be construed as encompassing all the features of patentable novelty which reside in the present invention including all features which would be treated as equivalents thereof by those skilled in the art to which the invention pertains.

We claim:

1. In combination a container filled with a liquid material containing a volatile component, said container having a neck portion with a rim and dispensing opening, and a closure cap engaging the neck of said container in a pervious relationship and having an impervious cover portion overlying the opening rim, a flat liner disc interposed between said cover portion and said rim, said rim contacting the liner about the peripheral edge thereof and clamped thereagainst by said closure cap, said liner consisting of a microporous plastic material, the pores of which are of such size as to prevent the escape of the material therethrough while accommodating the passage of the volatile component liberated by said material.

2. The combination of claim 1 wherein the pores are 1–50 microns in size.

3. The combination of claim 1 wherein the pores are 1–5 microns and less in size.

4. The combination of claim 1 wherein the pores are 10–15 microns in size.

5. The combination of claim 1 wherein the pores are 1–15 microns in size.

6. The combination of claim 1 wherein the closure is of the crown cap type.

7. The combination of claim 1 wherein the closure is of the threaded type.

8. The combination of claim 1 wherein the cover portion is metallic.

9. The combination of claim 1 wherein a further porous liner is interposed between said cover portion of said cap and said microporous plastic liner.

10. In combination a container filled with a liquid material containing a volatile component, said container having a neck portion with a rim and a dispensing opening, and a closure cap engaging the neck of said container in a pervious relationship, said closure cap having an impervous cover portion overlying the opening rim, an interposed liner in contact with said cover portion and said rim, said rim contacting the liner about the peripheral edge thereof and clamped thereagainst by said closure cap, said liner consisting of a flat disc of a microporous plastic material, the pores of which are of such size that the interfacial tension between the plastic material and the liquid material is sufficiently high to prevent the escape of the

liquid material while accommodating the passage of the volatile component liberated by said liquid material.

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