Aug. 15, 1967 A. J. CASTRO 3,335,897

CLOSURE AND METHOD OF FORMING SAME

Filed May 5, 1964

FIG. 1

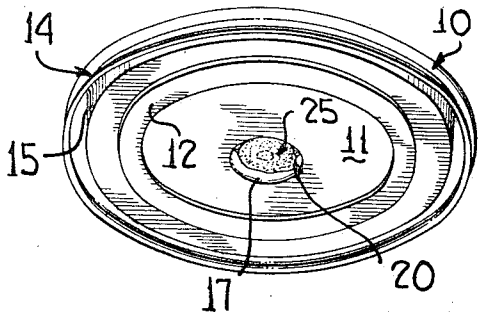


FIG. 2

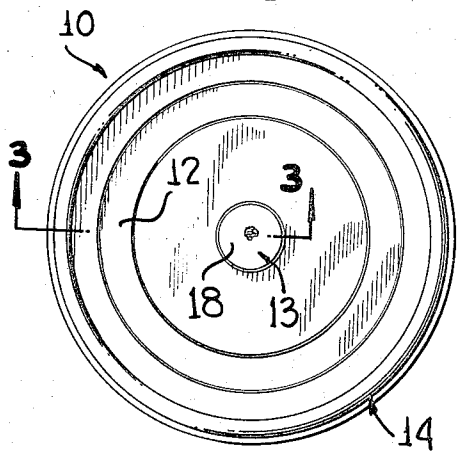


FIG. 3

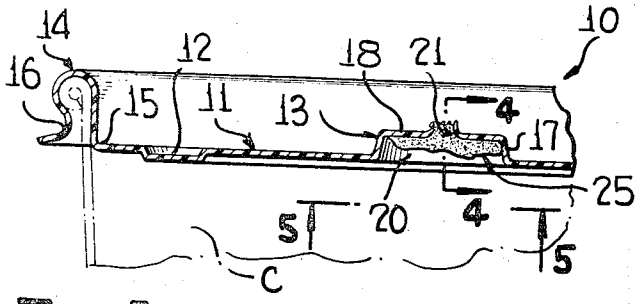


FIG. 4

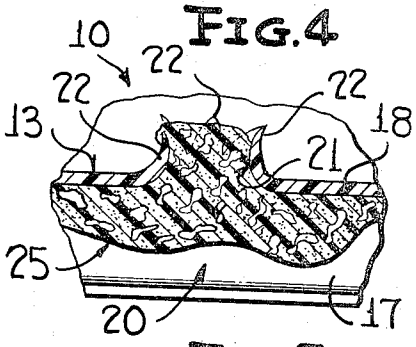


FIG. 5

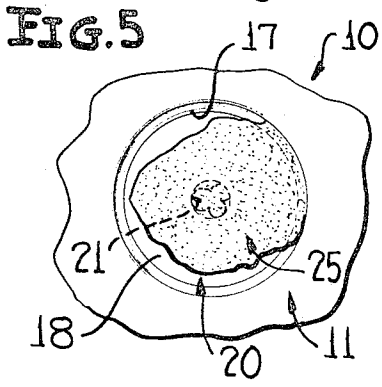


FIG. 6

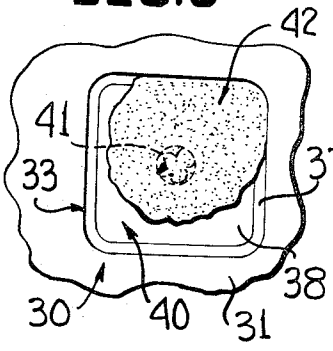


FIG. 7

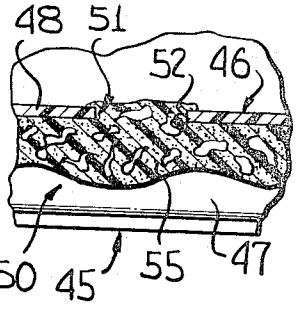
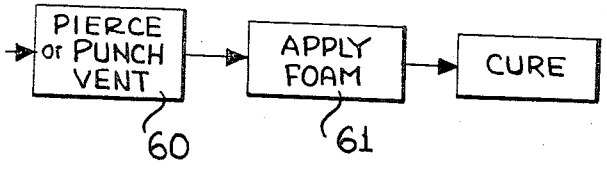


FIG. 8



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CLOSURE AND METHOD OF FORMING SAME

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16 Claims. (Cl. 220—44)

This invention relates to a novel closure, and in particular to a novel closure of the type particularly adapted for venting gas, such as steam, from a cup or similar liquid retaining vessel without permitting the passage of liquid therethrough.

There are many conventional closures or lids of the type which are particularly adapted for sealing the mouths of containers into which is customarily placed hot drinks, such as soup, coffee, tea, etc. For example, a conventional one of such closures includes an end wall which is outwardly or upwardly offset to form an interior recess or chamber opening toward the interior of a cup to which the closure is attached. A small vent hole or opening is formed in the wall portion of the offset portion and a barrier of treated sheet material is adhesively secured to the bottom of the closure to close the recess. The barrier is generally constructed from very thin paper which is impregnated with a liquid repellent material and which is generally attached to the closure wall by a suitable adhesive.

While such conventional closures are generally satisfactory for most purposes, the same include many inherent disadvantages overcome by the novel closure of this invention as will appear more fully hereafter. For example, conventional adhesives which are used to secure the barrier to the closure tend to weaken when subjected to the hot liquid contained in a cup or similar container upon which the closure is secured. A breakdown in the adhesive creates a gap between the closure wall and the barrier which permits the escape of liquid from the interior of the cup through the vent opening.

The water repellent nature of conventional barriers also tends to break down the longer the barriers are in contact with the liquid retained in cups to which these conventional barrier-type closures are secured.

The manufacture of the type closures described above is also relatively expensive due to the separate formation of the closure (absent the barrier), the separate formation of the liquid repellent, and the attachment of the barrier to the wall of the closure. Thus, conventional closures not only possess structural shortcomings but are also relatively expensive to manufacture.

In accordance with the above it is an object of this invention to provide a novel closure having a wall portion in which is formed a vent opening closed to the passage of liquid while permitting the passage of gas therethrough by a plastic material foamed in situ on the wall portion thereby eliminating the inherent disadvantages of costly manufacture and structural unreliability of prior art closures.

A further object of this invention is to provide a novel breathable closure having a closure wall terminating in a peripheral bead for securing the closure to a container of the type having an upper curl, an axial central portion of the closure wall being upwardly offset, the offset central portion defining a chamber, a vent opening in a chamber defining wall of the chamber, and foam plastic means foamed in situ in the chamber for closing the opening in the chamber wall to liquid, permitting the passage of gas therethrough and also securing the foam plastic means to the closure.

A further object of this invention is to provide a novel breathable closure of the type immediately above set forth in which the chamber is defined in part by a peripheral wall for confining the plastic foam means to a limited area overlying the vent opening during the in situ foaming thereof.

A further object of this invention is to provide a novel method of forming a breathable closure including the formation of a vent opening in a wall portion of a closure, the application thereto of foamable plastic material to at least a limited area of the wall portion, and thereafter, the curing of the material to close the opening to liquid but permit the passage of gas therethrough.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawing.

In the drawing:

FIGURE 1 is a bottom perspective view of a novel breathable closure constructed in accordance with this invention, and illustrates hydrophobic foam plastic material in a central offset portion of a wall of the closure.

FIGURE 2 is a top plan view of the breathable closure of FIGURE 1, and illustrates a pierced vent opening in the offset portion of the closure wall.

FIGURE 3 is an enlarged fragmentary sectional view taken along line 3—3 of FIGURE 2, and more clearly illustrates the offset central portion, the vent opening therein, and the hydrophobic foam plastic material in a chamber or recess defined by the offset portion.

FIGURE 4 is a highly enlarged fragmentary sectional view taken along line 4—4 of FIGURE 3, and illustrates the hydrophobic foam plastic material beneath, in and beyond the pierced opening of the breathable closure.

FIGURE 5 is a bottom view of the closure taken along line 5—5 of FIGURE 3, and illustrates a portion of a peripheral wall defining the offset portion confining the plastic material in the chamber.

FIGURE 6 is a fragmentary bottom view of an offset portion of another breathable closure constructed in accordance with this invention and illustrates a relatively square chamber set off by a peripheral wall of the offset portion.

FIGURE 7 is a highly enlarged fragmentary sectional view of another breathable closure taken along a line similar to line 4—4 of FIGURE 3, and illustrates a vent opening defined by a smooth cut surface portion of the closure wall and hydrophobic foam plastic material foamed in situ beneath, through and above the opening.

FIGURE 8 is a flow diagram of three steps for producing the breathable closures of FIGURES 1 through 7 of the drawing.

A novel breathable closure constructed in accordance with this invention is illustrated in FIGURES 1 through 5 of the drawing and is generally designated by the reference numeral **10**.

The closure **10** includes an end wall or panel **11** which is of a generally planar nature, as is best illustrated in FIGURE 3 of the drawing. A generally circular portion **12** of the wall **11** between an axial, central, upwardly offset portion **13** and a downwardly opening peripheral securing bead **14** is recessed beneath the plane of the wall **11** (FIGURE 3). The circular recess portion **12** is integrally joined by a radius **15** near the downwardly opening bead **14**. An annular portion **16** of the bead **14** is directed radially inwardly for snap seating beneath a curl (unnumbered, FIGURE 3) of a container such as a cup C, with which the closure **10** is associated. The container C is preferably constructed from plastic material, as is the closure **10**, but may be formed from paper or similar material.

The central offset portion **13** is generally of a circular configuration (FIGURE 2) and includes a generally

peripheral wall **17** tapering upwardly toward a top or chamber wall **18**. The peripheral wall **17** and the chamber wall **18** define therebetween an extremely shallow truncated conical chamber or recess **20** opening toward the interior of the cup C.

The chamber wall **18** is provided with opening means **21** in the form of a pierced opening defined by relatively irregular, ragged upwardly directed portions **22**. The vent opening **21** can be formed by any relatively sharp pointed instrument by piercing the chamber wall **18** in a manner apparent in the FIGURE 4 illustration.

Hydrophobic foam plastic material **25** is housed in the chamber **20** of the closure **10**, as is best illustrated in FIGURES 3 through 5 of the drawings. The foam material or structure **25** is of an open cell construction which is sufficient to allow the passage of gas, such as steam emitted by hot liquid contained in the cup C from the chamber **20** through the vent opening **21** to atmosphere. The cell structure is, however, sufficiently small to prevent the liquid retained in the cup C from passing through the foam structure **25**, the vent opening **21** and outwardly of the closure **10**. Plastic foam materials which fullfill these requirements are polyurethane foams, vinyl foams, silicone rubber foams, natural rubber foams and similar plastic foam material.

The plastic foam material **25** is preferably applied to the interior of the chamber wall **18** of the breathable closure **10** and permitted to cure or foam in situ in a manner to be described more fully hereafter. However, during such in situ foaming of the plastic material **25**, the same not only overlies the interior of the chamber wall **18** but passes outwardly through the vent opening **21** and between the irregular pierced portions **22**. When the plastic material **25** has cured, it is secured to the closure **10** by bonding action between the chamber wall **18** and the foam material, bonding action between the foam material and the irregular portions **22**, and the engagement between the foam material and the gaps or slots (unnumbered) between the projections **22**, as is best shown in FIGURE 4 of the drawing. The expansion of the plastic material in a radial direction in the vent opening **21** also places this material in intimate engagement with the portions **22** of the closure, thus insuring effective and efficient securing action between the wall **11** and the hydrophobic material **25**.

Another closure constructed in accordance with this invention is partially illustrated in FIGURE 6 of the drawing and is generally designated by the reference numeral **30**. The closure **30** is preferably constructed from plastic material and includes an end wall or panel **31** which peripherally terminates in elements identical to elements **12**, **13**, **15** and **16** of the closure **10**. The wall **31** of the closure **30** includes a central, axial, upwardly offset portion **33** which is similar to the offset portion **13** of the closure **10**. The offset portion **33** defines a downwardly opening interior recess or chamber **40** of a generally rectangular or square configuration set off by a generally upwardly tapering peripheral wall **37**, which is substantially square in outline, and a top or chamber wall **38** having a vent opening **41** identical to the vent opening **21** of the breathable closure **10**. Hydrophobic foam plastic material **42** foamed in situ in the chamber **40** prevents the passage of liquid through the vent opening **41** in the manner heretofore discussed in the consideration of the closure **10**.

As is readily apparent from a comparison of FIGURES 5 and 6 of the drawing, the closure **10** differs from the closure **30** in that the former includes a generally circular offset portion while the latter includes an offset portion which is generally square or rectangular in outline. The purpose of these configurations is to permit alternate circle-square packing thereof to avoid jamming or locking between adjacent closures of either a square-square or circle-circle configuration. For example, in the case of a pair of closures **10** nested or stacked together the peripheral walls **17**, **17** thereof would bind and frictionally lock the closures to each other. This is true of similarly nested closures **30**. However, relatively little binding between the peripheral wall **17** and **37** of alternately nested closures **10** and **30** will occur, thus avoiding handling and dispensing problems of these closures.

Another breathable closure is partially illustrated in FIGURE 7 of the drawing and is generally designated by the reference numeral **45**. The closure **45** is formed from plastic material and includes an end wall (not shown) having an upwardly, central, axial, offset portion **46**, corresponding to the offset portions **13** and **33** of the respective closures **10** and **30**. The offset portion **46** includes a peripheral wall **47** which tapers upwardly relatively gradually (not shown) and which is preferably circular or square in outline. The peripheral wall **47** terminates in a top or chamber wall **48** and defines therewith a downwardly opening interior recess or chamber **50**.

A vent opening **51** defined by a relatively smooth continuous punched or cut surface portion **52** is formed in the offset portion **46**. Hydrophobic foam plastic material **55** is foamed in situ in the manner discussed in the consideration of FIGURE 4 to underlie the chamber wall **48**, project into the vent opening **51** and beyond to secure and maintain the foam material or structure **55** in the chamber **50**. The foam structure **55** is, of course, identical in structure and composition to the foam structures **25** and **42**, and thus prevents liquid from passing through the vent opening **51** from a cup upon which the closure **45** is secured.

Any one of the closures **10**, **30** and **45** are manufactured in a manner which will be best understood by referring to FIGURE 8 of the drawing, to which attention is now directed. The closures are preferably vacuum-formed with either the circular or rectangular contoured offset portions and thereafter transported in an inverted position by a conveyor, turret mechanism, or similar conventional mechanism to an overhead reciprocal piercing mechanism or punching mechanism **60** (FIGURE 8). Actuation of the conventional piercing mechanism produces the vent opening **21** of FIGURE 4 while a punching mechanism produces the vent opening **51** (FIGURE 7). In either case, the size of the vent opening is preferably approximately between $\frac{1}{16}$ to $\frac{3}{16}$ of an inch in diameter.

The pierced or punched closures are then advanced to an applicating mechanism, such as a conventional overhead nozzle or a plurality of nozzles which dispenses or inserts the foam material into the chambers of the closures. The foam material may be first formed and then placed into the offset portions, but in the case of such materials as polyurethane and silicone rubber, the foam ingredients are preferably mixed, applied and permitted to foam in situ in the offset portions. Any conventional foam applying mechanisms **61** (FIGURE 8) such as the nozzles heretofore noted can be employed to apply the foam to the closure.

Thereafter the closures are cured to complete the fabrication thereof.

The completed closures as well as the various portions or components thereof may vary depending upon the containers with which the closures are associated, the particular size of the containers, the particular material or liquid which is to be retained in such containers, etc. Depending on such variables, modifications in the disclosed closures, though not specifically set forth herein are deemed a part of this invention. For example, the vent opening **51** in the closure **45** need not be circular and if circular, could fall beneath or above the range heretofore set forth. Thus, various dimensions are preferred but not necessary for a successful practice of this invention. However, the offset portions **13** and **33** are preferably each respectively approximately $\frac{1}{2}$ inch in diameter and $\frac{15}{32}$ inch square, and each chamber **20** and **40** has an axial depth of approximately $\frac{1}{8}$ of an inch.

From the foregoing, it will be seen that novel and ad-

vantageous provision has been made for carrying out the desired end. However, attention is again directed to the fact that variations may be made in the example breathable closures disclosed herein, as well as the method of forming these closures, without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A closure comprising a wall portion, opening means in said portion, and means foamed in situ on said portion closing said opening means to liquid and permitting the passage of gas therethrough.

2. A closure comprising wall means, opening means in said wall means, and foam plastic means foamed in situ on said wall means for closing said opening means to liquid and permitting the passage of gas therethrough.

3. A closure comprising a wall portion, opening means in said wall portion, foam plastic means foamed in situ on said wall portion for closing said opening means to liquid and permitting the passage of gas therethrough, and means confining said plastic means to a limited area overlying said opening means.

4. A closure comprising a wall portion, a surface portion of said wall portion defining an opening therethrough and foam plastic means foamed in situ on said wall portion and in said opening for closing said opening to liquid, permitting the passage of gas therethrough and securing said foamed plastic means to said wall portion.

5. A closure comprising a wall, an opening in an offset portion of said wall, said offset portion defining a chamber, and foam plastic foamed in situ in said chamber for closing the opening in the offset portion to liquid and permitting the passage of gas therethrough.

6. A closure comprising a closure wall, said closure wall terminating in peripheral bead means for securing the closure to a container of the type having an upper curl, an axial central portion of said wall being offset, said offset central portion defining a chamber, said chamber being set off by a peripheral wall portion joined to the closure wall and a chamber wall offset from the plane of said closure wall, an opening in said chamber wall, and foam plastic means foamed in situ in said chamber for closing the opening in the chamber wall to liquid and permitting the passage of gas therethrough.

7. A closure comprising a closure wall, said closure wall terminating in peripheral bead means for securing the closure to a container of the type having an upper curl, an axial central portion of said wall being upwardly offset, said offset central portion defining a chamber, said chamber being set off by a peripheral wall portion joined to the closure wall and a chamber wall offset from the plane of said closure wall, an opening in said chamber wall, said opening being defined by a smooth continuous peripheral surface, and foam plastic means foamed in situ in said chamber for closing the opening in the chamber wall to liquid and permitting the passage of gas therethrough.

8. A closure comprising a closure wall, said closure wall terminating in peripheral bead means for securing the closure to a container of the type having an upper curl, an axial central portion of said wall being upwardly offset, said offset central portion defining a chamber, said chamber being set off by a peripheral wall portion joined to the closure wall and a chamber wall offset from the plane of said closure wall, an opening in said chamber wall, said opening being defined by a discontinuous ragged peripheral surface formed by the piercing of said chamber wall to form said opening, and foam plastic means foamed in situ in said chamber for closing the opening in the chamber wall to liquid and permitting the passage of gas therethrough.

9. The closure as defined in claim 7 wherein said foamed plastic means passes through said opening to the side of said chamber wall opposite said chamber.

10. The closure as defined in claim 8 wherein said foamed plastic means passes through said opening to the side of said chamber wall opposite said chamber.

11. A method of forming a breathable closure comprising the steps of forming an opening in a wall portion thereof, applying foamable plastic material to at least a limited area of the wall portion, and thereafter curing the material to close the opening to liquid but permit the passage of gas therethrough.

12. A method of forming a breathable closure comprising the steps of providing a closure having a recessed chamber defined by a wall portion, piercing the wall portion to form a vent opening therein defined by irregular pierced portions of the wall, applying foamable hydrophobic plastic material in said chamber, and permitting said material to foam in situ in said chamber closing off said vent opening to liquid but not to gas.

13. A method of forming a breathable closure comprising the steps of providing a closure having a recessed chamber defined by a wall portion, cutting the wall portion to form a vent opening therein defined by smooth, uninterrupted surface portions of the wall, applying foamable hydrophobic plastic material in said chamber, and permitting said material to foam in situ in said chamber closing off said vent opening to liquid but not to gas.

14. Nested closures comprising first and second nested closures having wall portions defining respective first and second chambers, vent openings in each wall portion, means foamed in situ in each chamber closing said vent openings to liquid and permitting the passage of gas therethrough, and said first chamber being loosely received in said second chamber.

15. A closure comprising a wall portion, opening means in said portion, means on said portion for closing said opening means to liquid and permitting the passage of gas therethrough, said means having a surface formed in substantially the exact mirror image of an opposing surface of said wall portion.

16. A method of forming a liquid-impermeable gas-permeable structure comprising the steps of forming an opening in a structural element, applying foamable hydrophobic plastic material to at least a limited area of the element contiguous the opening, and thereafter curing the material causing the latter to foam in situ whereby the foamed material is effective to preclude the passage of liquid through the opening while permitting the passage of gas therethrough.

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