Nov. 19, 1968 G. V. MUMFORD 3,411,649

CLOSURE FOR REDUCING HEAT TRANSFER
TO PRODUCT DURING PROCESSING
Filed Sept. 19, 1966

FIG. 1

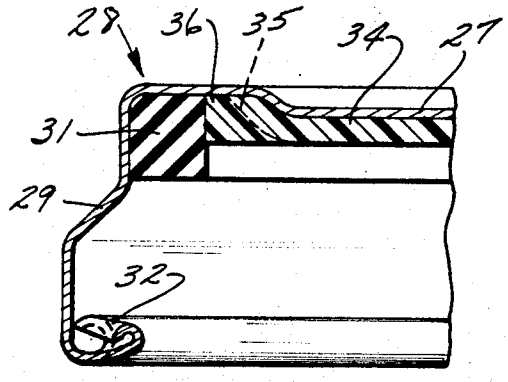


FIG. 2

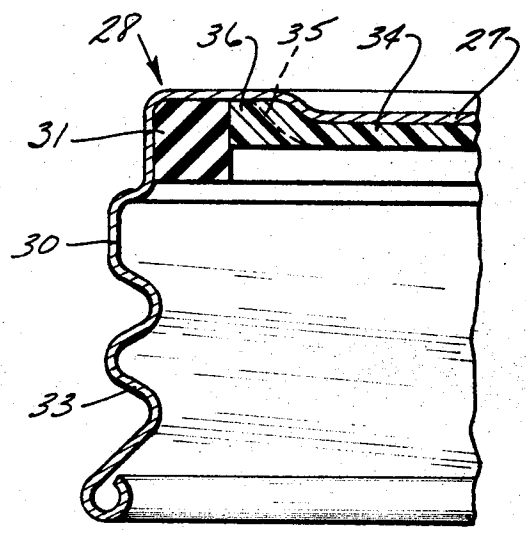


FIG. 3

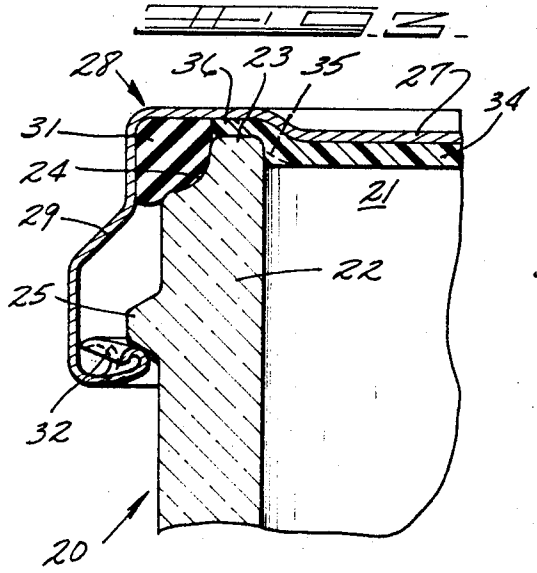
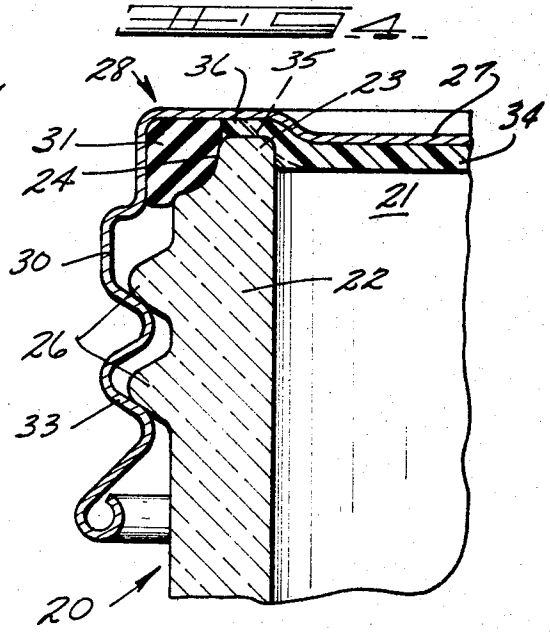


FIG. 4



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CLOSURE FOR REDUCING HEAT TRANSFER TO PRODUCT DURING PROCESSING

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ABSTRACT OF THE DISCLOSURE

A thermal barrier of plastic for closures to reduce axial heat transfer through the closure to a packaged heat sensitive product. The thermal barrier is attached to the internal closure panel surface and covers the mouth opening of the container to which the closure is applied. The barrier has a preferred axial thickness dimension of from 0.010 to 0.065 inch and a maximum thermal conductivity of 0.02 B.t.u. per hour per square foot per Fahrenheit degree per foot.

This invention relates to closures for bottles and jars, and more particularly to a closure of the shell type, containing a sealing medium, and adapted to telescopically engage a glass container at the rim of its mouth opening to provide a hermetic seal thereon, said closure being used in conjunction with a container having packaged therein a heat sensitive product which must undergo further thermal processing.

In the packaging of heat sensitive materials, the manufacturer must take extreme care to insure that the final product is of a high quality. For example, during thermal processing of the material, the various process parameters must be controlled within the proper limits to insure that thermal degradation of the product does not proceed to such an extent as to make the final product unsuitable for its intended use. Another similar problem occurs when there has been only a localized or partial thermal deterioration of the product; this type of deterioration while not so extensive as to make the product unsuitable for its contemplated used, may, for example, cause a localized precipitate or partial discoloration of the product. Even this latter type thermal deterioration will affect the marketability of the material because of its adverse psychological impact on the consumer. The problem of thermal deterioration and its adverse impact on the consumer is especially acute in the processing and packaging of certain comestibles, such as egg yolk, custard and infant formula.

Summarily, the processing of these comestibles comprises the steps of filling the container with the product, at a temperature of 40–50° F., and transporting the filled container to a capper, where the headspace in the container is purged with steam and the hermetic sealing closure is applied. Subsequent to the purging and capping operation, the container is supplied to pressure cookers or autoclaves which are maintained, for purposes of sterilization and further cooking, at a temperature of about 260° F. and provide a retention time for the container of 15–30 minutes. The inventor has found that, during this last processing step, there is a tendency for foods containing protein and carbohydrates, to undergo a partial quality deterioration. This deterioration, while not being of such a degree as to make the material unwholesome for consumption, is generally characterized by the occurrence of small amounts of a discolored mass, having a viscosity which is higher than that of the product itself. These discolored, viscous masses are especially troublesome in the case of infant formula, because they become lodged in the nurser nipple, through which infant formula is normally dispensed.

More specifically, the deterioration results from certain portions of the product being subjected to a longer and

higher time-temperature cycle than is the bulk product. During the transporting and positioning of the container into the pressure cookers, the handling is such as to cause a splashing of the product within the container. This splashing results in small quantities of product coming into contact with the internal portion of the aluminum or tinplate closure; because of the coaction of viscosity and surface tension forces, these quantities remain attached to the internal panel portion during the cooking cycle. Since the panel adhering material is subjected to much lower thermal resistance path than is the bulk product, that is, it is in contact with a metallic thermal barrier which has a much higher thermal conductivity than does the container which thermally isolates the bulk product, and because the mass of this material is small relative to bulk contents, the former of necessity absorbs more heat per unit weight per unit time than will the normal bulk contents. Hence, the splashings are effectively subjected to a higher average temperature for a longer time, which hastens their decomposition, causing the discoloration.

Accordingly, it is an object of this invention to provide for a more marketable food product, containing protein and carbohydrates, by minimizing the occurrence therein of objectionable discolored matter.

It is another object of this invention to prevent the product splashings, attached to the inner panel of the closure from undergoing a sterilizing time-temperature cycle which exceeds that undergone by the bulk product.

It is an important object of this invention to minimize heat transfer through a metallic closure to packaged comestibles containing protein and carbohydrate foods some of which will adhere to the internal panel surface of the closure applied in sealing engagement on the container.

In the achievement of the foregoing, and other objects, the invention contemplates using a thermal barrier during the sterilization-cooking cycle, said barrier being preferentially related to the closure as an internally disposed component of substantial thickness and possessing a low thermal conductivity.

As used herein, the term "plastisol" is generic of compositions essentially consisting of dispersions of synthetic resins in a non-volatile plasticizer. The resins are generally insoluble in the plasticizer, or at least have only limited solubility, at room temperature; at elevated temperatures however, these resins are practically soluble in their entirety. Consequently, when these resin-plasticizer mixtures are heated, for example to about 200° F., solvation of the resin results; upon further heating to 300–400° F. a solution is obtained which, when cooled produces a tough, permanent mass having desirable coating properties.

The synthetic resin used in these plastisols is preferentially polyvinyl chloride although other thermoplastic materials, for example copolymers of vinyl chloride and vinyl acetate, copolymers of vinyl acetate, vinyl buterate, vinyl alcohols, and vinylidene chloride, may also be used. Typical nonvolatile plasticizers which are suitable for producing vinyl plastisols are: 2-ethyl hexyl di-phenyl phosphate; di-hexyl adipate; di-octyl sebacate; acetyl tributyl citrate; di-2-ethyl hexyl phthalate and di-isooctyl phthalate.

In addition to the above components, the plastisols preferably include stabilizers, and foaming or blowing agents. The stabilizers are used to prevent degradation of the polymer resulting from either thermal or light sensitivity and may include salts of the higher fattey acids, such as calcium or zinc stearate. Blowing or foaming agents are used to produce a cellular structured plastisol, more commonly termed a 'foamed plastisol'; typical agents which may be used are sodum bicarbonate, ammonium bicarbon-

ate, or dinitrosopentamethylenetetramine. These cellular plastisols are particularly suitable for the practice of this invention because they have low thermal conductivities; the low conductivities are the result of a plastisol structure having gaseous voids dispersed within the solid mass.

Since this invention contemplates contact between the food product and the innermost portion of the thermal barrier, the materials comprising said barrier must be non-toxic and have F.D.A. approval. Additionally, the material employed must have sufficient strength and stability to insure that they do not crack or chip, and thereby contaminate the product. Also, the composition employed must not allow seepage of the product through it to the metal inner surface of the closure panel. A suitable material may be selected from several compositions commercially available generally having the plastisol characteristics hereinbefore noted. As one preferred example, a commercially available foamed plastisol manufactured and sold by the Dewey & Almy Chemical Division of the W. R. Grace & Company of Chicago, Ill., as their Number 3763 has been successfully used in the practice of this invention.

The foregoing objects and others, will become apparent by reference to the appended drawings, of which:

FIGURE 1 is a fragmentary sectional view of a lug-type closure illustrating an embodiment of this invention.

FIGURE 2 is a fragmentary sectional view of a continuous thread type screw closure illustrating another embodiment of the invention.

FIGURE 3 is a fragmentary sectional view showing the closure of FIGURE 1 assembled in sealing relation on a glass container.

FIGURE 4 is a fragmentary sectional view showing the closure of FIGURE 2 assembled in sealing engagement on a glass container.

It should be noted, these drawings are exemplary and, while they illustrate this invention with relation to screw-thread and lug-type closures of the known side-seal type, the invention is equally applicable to press-on caps and various other caps providing either top or side seals.

In the drawings, a glass container **20** is shown having a cylindrical neck **22** terminating in an annular rim **23** at the open mouth **21** of the container. The container also possesses a sealing finish surface **24**, which is outwardly of and immediately beneath the rim **23**. FIGURE 3 shows the container provided with lugs **25** outwardly extending from the neck, and beneath the sealing finish **24**, to provide for attaching engagement with a telescopic closure **28**. In the container form shown on FIGURE 4, the neck **22** is provided with screw threads **26** just beneath the sealing finish for locking the closure on the container mouth.

The closure **28** is formed of a metal, such as aluminum or tinplate, and comprises a top panel **27** and a depending annular attaching skirt, **29** and **30**, shown in FIGURES 1 and 2, respectively. FIGURES 1 and 3, show the skirt **29** with an internally disposed lug **32** existing at its lower margin, said lug being adapted to lockingly engage the corresponding lug **25** of the container. Similarly, FIGURE 4 shows a skirt **30** which is formed with screw-threads **33** for mating with the threads **26** of the container and thereby providing a locking relation therebetween. At the juncture of the panel **27** and the skirts, the portion indicated as **29** and **30**, respectively in FIGURES 1 and 2, there is a corner recess receiving a conventional annular sealing ring or gasket **31**. Inwardly disposed from the sealing gasket and the panel portion of the closure, the thermal barrier member **34** is affixed so as to engage the rim **23** of the container and is coaxial with the mouth **21** defined by rim **23**. This thermal barrier member functions to isolate the container contents from contact with the metal panel of the closure. As shown in the drawings, the thermal barrier member **34** completely covers the internal portion of the closure panel inwardly of the gasket **31** installed therein.

In an alternate embodiment, as represented by the dotted line **35** in FIGURES 1 and 2, the thermal barrier member **35** is coaxially disposed with the container mouth extends radially over the rim **23**, at least partially outwardly of its width, and terminates along the underside of closure top panel **27** in a spaced relation to gasket **31**, the barrier member being sufficient to cover the container mouth opening; the barrier thereby isolates the container contents from contact with the interior surface of the metal closure panel. The member **35** comprises a layer of the barrier material of substantial thickness and is so disposed in the closure panel to provide an annular radial portion **36** of the closure that is uncoated. This latter annular portion is disposed internally of the sealing gasket between it and the radial extremity of the barrier member **35**. However, it is important that the material of the barrier member **35** extend across the mouth of the container to the rim surface **23** of the container.

In order to retard the heat transfer through the metallic closure to a sufficient degree to prevent thermal deterioration of the packaged food products during sterilization and cooking, it is important to provide a thermal barrier having a low thermal conductivity and a substantial axial thickness. Virtually all deleterious heat eflects may be eliminated by using a composition having a thermal conductivity of less than .02 B.t.u. per hour per square foot per °F. per foot and applied as a barrier member having a thickness of .010–.065 inch. Such a material may be applied, for example, as a foamed vinyl plastisol. One such plastisol is commercially available from the Dewey & Almy Chemical Division of the W. R. Grace and Company as their Number 3763.

Plastisols or other thermal barriers may be applied to the internal panel surface of the closure by any of several conventional techniques. They may be preformed into a disc-like member, subsequently applied and adhesively secured to the internal panel; butadiene-acrylonitrile rubber lacquers, for example, may be employed as the adhesive between the inner panel surface and the preformed barrier member. Alternatively, the barrier material may be formed and bonded directly in place by known flow-in nozzle techniques. With the latter method the plastisol, for example Dewey & Almy Number 3763 as mentioned earlier, is applied as a paste at a temperature of 100° F. to the center of the internal panel of the metallic closure. Subsequent to, or simultaneous with the application of this paste, the closure is subjected to a spinning cycle on a suitable turntable device, whereby the plastisol paste is caused to flow radially from the center of the panel and results in the paste forming a concentric, and essentially uniform thickness, barrier member with the internal surface of the closure panel **27**. This paste configuration is identical to the configuration of the final thermal barrier shown by number **34**, and the alternative embodiment **35**, in FIGURES 1 and 2. It is important that the quantity of plastisol paste added by sufficient to produce a final thermal barrier having a thickness of .010–.065 inch, and that the spinning cycle be carried out over a sufficient period of time to allow the plastisol paste to be distributed at a radial distance from the closure center such that when the closure is applied in its relation over the container rim, the plastisol will be at least coaxially coextensive with the container mouth defined by the rim surface **23**. Subsequent to the spinning and paste application, the plastisol is foamed and fluxed, to produce the final thermal barrier by heating it to 300–400° F. and holding it at this temperature for several minutes.

I claim:

1. A package for containing a heat sensitive product, comprising a container provided with a rim defining its mouth opening, said rim having a sealing surface, and a means formed exteriorly on said container adjacent said rim adapted to engage a closure for attaching the latter in covering said mouth, a closure having a top panel portion and an annular attaching skirt depending therefrom, means on said closure skirt for engaging said means on

the container when said closure is in telescopic relation on the open mouth of said container whereby the closure is attached on said container, a gasket disposed intermediate the closure and said mouth opening sealing the container upon attachment of said closure, and a thermal barrier member attached to the closure panel portion covering said mouth opening of the container, said member being comprised of a low thermal conductivity plastic composition of an axial thickness of .010–.065 inch, said thermal barrier providing a maximum thermal conductivity of 0.02 B.t.u. per hour per square foot per Fahrenheit degree per foot, thereby insulating heat transfer axially through the closure.

2. The package of claim **1**, wherein the plastic composition is a foamed plastisol.

3. The package of claim **2**, whererin the foamed plastisol is a foamed polyvinyl chloride plastisol.

4. The package of claim **1**, wherein the plastic composition is a foamed plastisol containing a synthetic resin, said resin being a member of the group consisting of polyvinyl chloride, copolymers of vinyl chloride and vinyl acetate, copolymers of vinyl acetate, vinyl buterate, vinyl alcohols and vinylidene chloride.

5. A package for comestibles, containing proteins and carbohydrates, comprising a container having a generally cylindrical neck terminating in an upper annular rim defining the open mouth thereof and a corner sealing finish surface disposed adjacently beneath the rim and including means beneath said sealing finish exteriorly on said container adapted to engage a closure for attaching the latter to cover said open mouth, a closure having a top panel portion and an annular attaching skirt depending therefrom, means on said closure skirt for engaging said means on the container when said closure is in telescopic relation on the open mouth of said cointainer whereby the closure

is attached on said container, a gasket positioned at the juncture of the closure panel and its depending skirt sealing the container upon attachment of said closure, and a thermal barrier of plastic composition concentrically attached to the internal panel surface of the closure having an axial thickness of .010–.065 inch and a maximum thermal conductivity of 0.02 B.t.u. per hour per square foot per Fahrenheit degree per foot, for decreasing axial heat transfer through the closure, said thermal barrier extending radially to be at least in annular contact with the container rim when the closure is attached in telescopic relation on the container.

6. The package of claim **5**, wherein said thermal barrier on the internal panel surface of the closure extends radially outwardly to overlie at least a portion of the rim, and the outer radial periphery of said thermal barrier is spaced radially inwardly of said sealing gasket in the closure.

7. The package of claim **5**, wherein the thermal barrier is a foamed plastisol of a copolymer of vinyl chloride and vinyl acetate.

8. The package of claim **5**, wherein the thermal barrier concentrically attached to the internal panel surface of the closure completely covers the internal surface of the closure panel disposed inwardly of the sealing gasket positioned therein.

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