

[54] METHOD OF SEALING PLASTIC CONTAINERS

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[51] Int. Cl. .... B65d 51/18

[58] Field of Search ..... 215/38 R, 40, 37 R; 156/69

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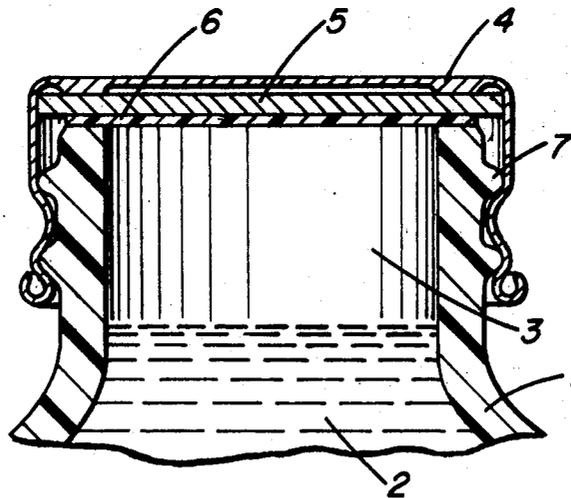
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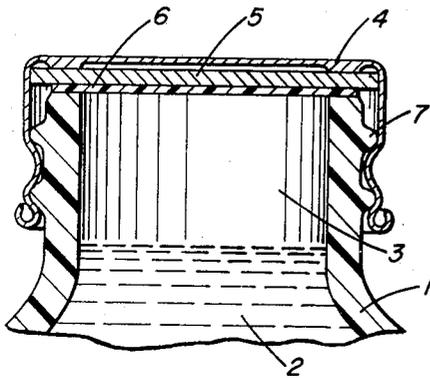
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[57] ABSTRACT

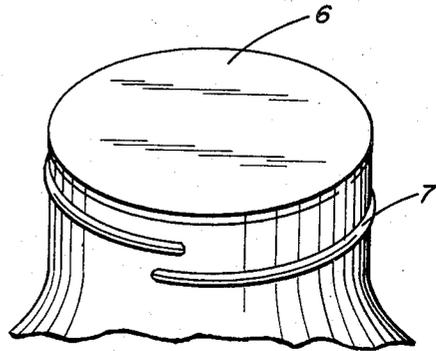
A method of sealing plastic containers so as to prevent wall collapse thereof or bubble development in or around the contents thereof wherein a thin film of stretchable plastic is sealed over the mouth of the container and a breathable closure is fitted over said film and the resultant container per se, are disclosed.

10 Claims, 4 Drawing Figures

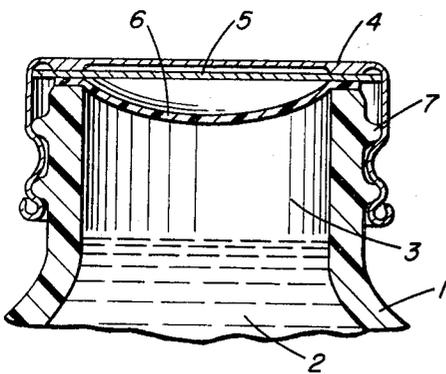




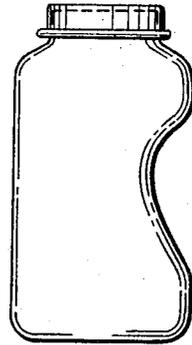
*FIG. 1*



*FIG. 2*



*FIG. 3*



*FIG. 4*

## METHOD OF SEALING PLASTIC CONTAINERS

## BACKGROUND OF THE INVENTION

The packaging of products, especially foodstuffs, in plastic containers has become increasingly more prevalent in recent years. Specialty packaging materials and systems have consequently been developed to accommodate the increased demands therefor.

With the increased usage of such plastics as packaging materials, there developed a series of problems attendant to these materials which were not common to glass containers. Two of the most important of the problems relative to the usage of plastic containers are (1) wall collapse of the container due to (a) permeation or (b) volume contraction of its contents caused by temperature change and (2) bubble formation in the contents and/or at the interface between the container and the contents caused by excessive vacuum within the container headspace.

The result of container wall collapse, other than detracting from the aesthetic value of the container, is that the collapsed wall may stress craze at the edges of the collapsed area with resultant structural failure of the container and, of course, leakage of the contents.

Bubble formation in or around the contents of the container is less serious from the standpoint of the freshness or continued usefulness of the contents, however, it detracts from the overall appearance of the packaged goods and therefore results in decreased sales.

## SUMMARY

I have now found that the problems of container wall collapse and/or bubble formation of or around the contents of plastic containers can be overcome by sealing a thin film of a stretchable plastic over the mouth of the container after filling and before closing the container with a breathable closure. The result of the thin film over the container neck is that any permeation or volume contraction of the contents which occurs and would usually cause wall collapse of the container causes collapse of the thin film instead. As a result, the walls of the container remain intact and the film, being flexible, is allowed to distort, deflect, collapse etc. until the container is opened by the ultimate consumer of the contents and the film is broken. Similarly, the distortion of the flexible film seal upon vacuum formation in the headspace prevents bubble formation in the container contents and at the interface between the container and the contents.

FIG. 1 is an enlarged semi-diagrammatic view of a closed container showing the seal of the present invention before deflection.

FIG. 2 shows the container of FIG. 1 covered by the seal of this invention after removal of the screw cap.

FIG. 3 is an enlarged semi-diagrammatic view of a closed container showing the seal of the present invention after deflection.

FIG. 4 shows a standard container, the wall of which has collapsed due to the reduction of internal pressure, the container not being equipped with the seal of the instant invention.

## DESCRIPTION OF THE INVENTION INCLUDING PREFERRED EMBODIMENTS

As mentioned briefly above, I have now discovered a method of preventing wall collapse in plastic containers, specifically, jars, jugs, bottles, tubs etc., or bubble development in and/or around contents packaged in such containers. My novel method comprises sealing the mouth or neck of such a container with a 1-10 mil thick film of a flexible plastic which deflects under small differential pressures i.e. 1 pound per square inch or more, is capable of stretching without rupturing i.e., accommodates said deflection and is substantially impermeable to gases and vapors, i.e. air, water vapor etc. After the film is sealed to the container, the resultant package is then covered with a breathable closure over the sealed film. Although the film may have a thickness of 1-10 mils, it is critical that the thickness of the film be less than the thinnest section of the container so that the film rather than the container will deflect or collapse.

I have found that any plastic film which exhibits the above-enumerated properties may be used in my invention. Among the materials found useful for this purpose are the nylons i.e., polyamide resins; polymers of vinyl chloride such as polyvinyl chloride and copolymers of vinyl chloride with up to about 45 percent by weight, of a comonomer known to copolymerize therewith such as vinyl acetate, styrene, acrylonitrile, methyl acrylate etc.; polymers of the  $\alpha$ -olefins such as polyethylene, polypropylene, and copolymers of ethylene and propylene with one another and with other copolymerizable monomers such as vinyl acetate, methyl methacrylate, etc. including oriented and cast polypropylene and high density and low density polyethylene; polyvinylidene chloride and copolymers of vinylidene chloride; fluorohalocarbon polymers such as homopolymers and copolymers of chlorotrifluoroethylene, ionomers, i.e. various polymers which have been reacted at their available carboxyl groups with metal ions; polyesters such as those produced from terephthalic acid and ethylene glycol; polycarbonates, polyisoprene hydrochloride and the like. A more specific discussion of materials useful as the thin film in the present invention can be found in Modern Plastic Encyclopedia, Volume 44, No. 74, pages 129-154, July 1971, which article is hereby incorporated herein by reference.

Additionally, laminated films wherein two or more films are bonded together with a laminating agent; heat or co-extruded films wherein two or more layers of polymers are extruded simultaneously and brought together while still in an amorphous and semi-molten stage etc. can also be used as the sealed film in my novel containers.

The plastic film may be sealed to the plastic container by any appropriate means including art recognized methods such as heat sealing by direct pressure heat; sonic sealing by a mechanical high frequency field; heat sealing by high frequency induction field (100 KHz-2 MHz); adhesion sealing by precoating the film or lip of the container with an adhesive to create a torque pressure seal as the closure is installed and the like.

The film can be applied to the neck or mouth of the container as a flexible, preferably tamperproof, single or multilayer barrier secured to the lip of the container inside the breathable closure. The barrier film may be

installed prior to the closure application or may be incorporated within the closure design so that merely applying the closure and sealing, such as by high frequency induction, creates the finished container. Furthermore, vacuum or pressure formed inner liners with radial flexible rings which indent for pressure equalization which are sealed as above; folded, metallic inner seals which open downward for pressure equalization and sealed as above; straight, rigid diaphragm seals which contact a straight necked wall for pressure equalization by slipping and spin welded, co-injected systems applied by a mechanical slip clutch within the neck of the container and the like can also be used. In any case, the closure area above the barrier film is equilibrated with the outside atmospheric pressure since the closure breathes and the pressure therefore acts upon the barrier film to deflect it into the container rather than on the container itself.

Any type of material may be used for the breathable closure, i.e., plastic, metal, composites, foil etc. without detracting from the scope of the instant invention. Metal closures are preferred and generally are used threaded and fitted with permeable, unwaxed paperboard liners. These closures enable the film to be heat sealed with a radio-frequency field, as described above, wherein the heat from the metal closure induced by the field transfers to the plastic film by conduction to seal the film to the container.

By "breathable" is meant that vapors, gases etc. can pass through the closure either due to the fact that the closure is produced from a material which is permeable thereto or because the closure can be modified so as to prevent it from creating an air-tight seal with the container to which it is applied.

Any type of plastic container which has a tendency to be susceptible to wall collapse or bubble formation in or around the contents thereof may be sealed according to my novel method. Containers manufactured from any of the above specified plastics including polyvinyl chloride, polyethylene, polypropylene, rubber modified polystyrene etc. can be used in my inventive process to produce my novel containers. One plastic material which is preferably used to produce containers which may be sealed according to my invention is that comprising a blend of (1) a terpolymer of methyl methacrylate, styrene and acrylonitrile and (2) polybutadiene grafted with methyl methacrylate, styrene and acrylonitrile. This material is well known in the art and is further described in U.S. Pat. No. 3,524,536 as are containers made therefrom, said patent hereby being incorporated herein by reference.

FIG. 1 shows the neck of a container of the instant invention wherein plastic container 1, having contents 2 therein, such as mayonnaise, and possessing headspace 3, is sealed across its mouth with a film of plastic 6 which conforms to the physical requirements set forth above. The container is capped with closure 4 which has threads thereon adapted to engage with threads 7 on the container. The closure contains a breathable liner 5 composed of, for example, a vapor-permeable cardboard.

The plastic film 6 is shown in FIG. 2 affixed to the container mouth, closure 4 having been removed from threads 7.

After the filled, sealed container 1 has been stored over a period of time sufficient to cause a vacuum or pressure reduction in the headspace 3, plastic seal 6

will deflect, as shown in FIG. 3, due to the equalization of the pressure in the headspace with the atmospheric pressure around the container. Since the film 6 is thinner than the container wall, collapse of the wall, as shown in FIG. 4, is avoided and deflection of the seal occurs instead.

Examples of types of foodstuffs which generally tend to cause wall collapse in plastic containers in which they are packaged due to their tendency to either contract during temperature changes or absorb or otherwise take up oxygen include mustard, mayonnaise, semi-solid salad dressings and the like. Examples of foodstuffs which are susceptible to the formation of bubbles therein while packaged in plastic containers include jelly, jam, hot fill, non-carbonated fruit drinks, marmalades, fruit butters and the like.

The following examples are set forth for purposes of illustration only and are not meant to be construed as limitations on the present invention except as set forth in the appended claims. All parts and percentages are by weight unless otherwise specified.

#### EXAMPLE 1

To a gallon bottle of 10 mil minimum wall thickness produced from a blend of a terpolymer of methyl methacrylate, styrene and acrylonitrile (71/19/10) and polybutadiene rubber grafted with methyl methacrylate, styrene and acrylonitrile (7/2/1) and containing 20 percent rubber is added a full compliment of mayonnaise. A threaded metal closure is then fitted with a vapor permeable, unwaxed paperboard liner over which is placed a 2 mil film of a commercially available three-layer film of polyvinylidene chloride having polyethylene adhered to both sides thereof. The breathable closure is screwed onto the container which is then subjected to a radio frequency field of 600 KHz. The resultant packaged material is then stored at varying temperatures 55°-75°F. for 6 months. The closure is then opened. The walls of the container are not collapsed to any degree but the multilayer film is deflected into the container about 1 inch. After breaking the film, the mayonnaise is tested and judged fresh.

A similar bottle containing the same mayonnaise but having no three-layer film over the mouth thereof, stress cracks after wall collapse in 5 weeks. The contents of the container are judged inedible.

#### EXAMPLE 2

The procedure of Example 1 is again followed except that the 2 mil film is produced from a copolymer of vinyl chloride and vinyl acetate (95/5). Again, a fresh mayonnaise is recovered after 6 months storage. The container has not exhibited any wall collapse.

#### EXAMPLE 3

Again following the procedure of Example 1 except that the 2 mil film is produced from high density polyethylene, similar results are achieved.

#### EXAMPLE 4

The film of Example 1 is replaced by a similar film produced from polypropylene. Again, excellent results are observed.

#### EXAMPLE 5

The film of Example 2 is replaced by a similar film of a commercially available polyamide resin. No con-

tainer wall collapse or spoilage of contents is recorded.

EXAMPLE 6

A film produced from a copolymer of chlorotrifluoroethylene and ethyl acrylate (90/10) is substituted for the film of Example 1. Similar results are achieved.

EXAMPLE 7

The procedure of Example 5 is again followed except the 2 mil film is produced from a commercially available ionomer and the bottle is made of polyethylene. Again, wall collapse of the bottle is prevented and the mayonnaise is determined to be fresh.

EXAMPLE 8

A commercially available polyester film (terephthalic acid and ethylene glycol) is substituted for the 2 mil film of Example 3 and sealed to the lip of the bottle with an available polyester adhesive. Pressure closing of the breathable closure seals the film to the bottle such that no wall collapse of the bottle occurs and the packaged contents (mustard) shows no loss of potency or flavor after 3 months storage.

EXAMPLE 9

A 6 oz. jar (12 mil wall thickness) produced from the packaging material of claim 1 and containing blackberry jam is sealed at the mouth thereof with a 3 mil film of commercially available polycarbonate resin in a threaded metal closure as set forth in said claim. After 4 months of storage at room temperature, no bubble formation is observed in the jam. Upon opening the jar it is noticed that the carbonate film has deflected three-fourths inch into the jar. The contents of the jar are judged fresh after breaking the film seal.

A similar jar devoid of said carbonate seal develops bubbles in the jam after 2 weeks.

EXAMPLE 10

The procedure of Example 1 is again followed except that the packaged content is salad dressing. Similar results are observed.

EXAMPLE 11

Jelly is substituted for the jam of Example 9. Again no bubbles are observed after 4 months storage.

EXAMPLE 12

The procedure of Example 1 is again followed except that the container is in the form of a tub and the content is fruit butter. The film deflects one-eighth inch after 3 months storage. No wall collapse or bubble formation occurs.

EXAMPLE 13

The procedure of Example 2 is again followed except that the closure is produced from polyvinyl chloride as is the bottle. The film is sealed to the bottle with a commercially available adhesive composition. No wall collapse of the bottle occurs after 6 months storage at the specified temperatures.

EXAMPLE 14

The procedure of Example 9 is again followed except that the jar is produced from a high impact rubber modified polystyrene and marmalade is packaged therein. Again no bubble formation occurs upon 4 months storage at room temperature.

We claim:

1. A method of preventing wall collapse of a plastic container or bubble development in or around contents packaged in such container which comprises sealing the neck of such a container with a 1-10 mil film of a plastic which is substantially vapor impermeable, flexible, deflects at at least 1 lb./in.<sup>2</sup> pressure and stretches without rupturing as it deflects and placing a breathable closure over said seal.

2. A method according to claim 1 wherein said container is composed of a blend of (1) a terpolymer of methyl methacrylate, styrene and acrylonitrile and (2) polybutadiene grafted with methyl methacrylate, styrene and acrylonitrile.

3. A method according to claim 1 wherein said film is heat sealed to said container.

4. A method according to claim 1 wherein said film is adhesion sealed to said container.

5. A method according to claim 1 wherein said film is a polymer or vinyl chloride.

6. A method according to claim 1 wherein said film is polyvinylidene chloride having polyethylene coated on each side thereof.

7. A plastic container having a neck sealed with a 1-10 mil film of a plastic which is flexible, deflects at at least 1 lb./in.<sup>2</sup> pressure, is substantially vapor impermeable and stretches without rupturing as it deflects and a breathable closure over said seal.

8. A container according to claim 7 wherein said container is produced from a blend of (1) a terpolymer of methyl methacrylate, styrene and acrylonitrile and (2) polybutadiene grafted with methyl methacrylate, styrene and acrylonitrile.

9. A container according to claim 7 wherein said film is a polymer of vinyl chloride.

10. A container according to claim 7 wherein said film is polyvinylidene chloride having polyethylene coated on each side thereof.

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