SHOCK-PROOF CONTAINER AND METHOD FOR MAKING SAME

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Field of Search 206/46 FC, 524; 229/14 C; 220/9 F; 264/45; 53/14, 16, 17, 18, 36

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ABSTRACT

An improved shock-proof container comprising two hollow shells having mating surfaces adapted to encapsulate an article for storage or shipping. A foamed cellular polymer fills the space within each of the shells to provide rigidity and a shock absorbing capacity. Additionally, an integral locking structure for locking the two shells together about the article is disclosed as well as preferred means for making the container.

11 Claims, 13 Drawing Figures
SHOCK-PROOF CONTAINER AND METHOD FOR MAKING SAME

CROSS-REFERENCE
This is a continuation-in-part of application Ser. No. 237,194, filed Mar. 22, 1972, now abandoned.

BACKGROUND OF THE INVENTION
This invention relates to a shock absorbing storage and shipping container. More specifically, it relates to containers for shipping fragile or other products which must be delicately handled.

THE PRIOR ART
Containers for such purposes have previously taken the form of an exterior shell such as a cardboard or wooden box with a shock absorbing material surrounding the article within the shell. As indicated by the article entitled "More Economies in Foam-In Place" appearing in the magazine, Modern Packaging, at pages 48 and 49, dated Feb. 1972, the application of the shock absorbing material is facilitated by in-situ plastic foam molding. Additionally, U.S. Pat. No. 3,389,195, issuing to S. Gianakos on June 18, 1968, suggest the utilization of two outer sheets of stretchable material which enclose a foam product expanded therein to form a container.

These prior art containers, although acceptable for many purposes, remain deficient in certain respects. In those cases in which the exterior shell is formed of cardboard or wood, the outer shell is either weak and hence not resistant to punctures, or if so, the container is relatively expensive. Additionally, where in-situ foaming within such shells takes place, problems remain in protecting the article to be packed from the foamed polymer such that it will not adhere thereto. With respect to the Gianakos patent, such appears to relate primarily to a relatively flexible package, and the method of making same does not appear amenable to quality control in terms of external or internal dimensions of the container. Too, additional means of locking this container in a closed position must be provided. Finally, U.S. Pat. No. 3,618,287 which issued to Gobhai et al on Nov. 9, 1971 discloses the use to two matching shells, filled with a foamed cellular composition. Each shell has a body which is vacuum formed and covered with a flexible web attached thereto by a mastic. The article is merely placed upon the web with the shell closed about it. The shells are then sealed together by an adhesive or heat with foam being expanded with the shell to encapsulate the articles. Thus, this disclosure requires several distinct manufacturing steps to obtain the desired package configuration.

SUMMARY OF THE INVENTION
In order to overcome disadvantages of the prior art and to provide a more economical container, the instant invention utilizes two hollow integral shells which may be joined by a hinge design which mate with one another and close about an article. Each of the shells are made of a polymeric material which preferably has a high tensile and impact strength. The shells may have a box shape appearance with external walls preferably of a thickness of less than 25 mils. At least one surface of each of the shells is modified so as to permit sealing engagement with the other shell, and define an article containing space for enclosing an article. Additionally, each shell contains a foamed polymer therein to provide a sufficient shock-proof characteristic and to inherently form a lock and/or between the two shells so as to provide a closed container.

Accordingly, it is an object of the instant invention to provide a most economical shock-proof container for fragile articles which is light, and upon forming, inherently produces a locking and sealing structure so as to preclude the admission of moisture and other contaminants into the container. Another object is to provide a shock-proof container which is fire suppressing, puncture-proof, and extremely resistant to stress cracks, but yet economical and efficient to manufacture in mass volume. Additionally, the container is designed to conform its article containing cavity to the configuration of the article so as to firmly encapsulate the article and preclude its movement within the container. Too, it is an object to provide a container in which the position of the article therein is specifically defined and spaced from the seal and external surface of the container so as to enhance the container's sealing and protection characteristics. Finally, it is an object of the instant invention to provide a process for making such containers.

DESCRIPTION OF THE DRAWINGS
The manner in which the objects of this invention are attained will be made clear by a consideration of the following specification and claims when taken in conjunction with the drawings in which:

FIG. 1 is a perspective view of the exterior of a preferred embodiment;
FIG. 2 is an exploded view in perspective of the two halves of this embodiment;
FIG. 3 is a side elevational view of this embodiment taken in section along the lines 3—3 of FIG. 1;
FIG. 4 is a perspective view of the locking and sealing mechanism for the instant embodiment;
FIG. 5 is an exploded perspective view of a mold utilized in making this embodiment;
FIG. 6 is an elevational view taken in section along the lines 6—6 of FIG. 5 of the upper portion of the mold;
FIG. 7 is a symbolic view of one apparatus and method of forming the shell of this embodiment within the mold of FIG. 5;
FIG. 8 is an exploded perspective view of the two shells of this embodiment prior to closing;
FIG. 9 is a side elevational view in section of the lower shell of the embodiment taken along the lines 9—9 of FIG. 8;
FIG. 10 is a side elevational view in section of a complete container taken along the lines 10—10 of FIG. 3;
FIG. 11 is an elevational view in section of another embodiment of the instant invention;
FIG. 12 is an elevational view in section of a third embodiment of the instant invention; and
FIG. 13 is a perspective view of the embodiment of FIG. 12 prior to the closing of the container.

DETAILED DESCRIPTION
As depicted in the preferred embodiments of FIGS. 1 through 4, the instant invention utilizes two shells of a polymeric material which will produce the desired characteristics of high tensile strength and toughness. The two shells so formed are adapted to mate with one another about the fragile article which is to be shipped.
As explained, the container is completed by placing an expandable liquified foam in the interior of each of the shells which provides, upon expanding, a shock-absorbing, rigid cellular character to the package. Additionally, this liquified foam upon expanding will provide a self-locking characteristic.

The ultimate container is depicted in FIG. 1 which represents a container formed of upper and lower shells 12 and 14 which have been joined or locked together by in-situ plastic foam molding as hereinafter explained. Each of the mold shells may take the form of a hollow rectangular box having four sides 16, an exposed surface 18 which may be either the top or bottom of the container, and a mating surface 20. This mating surface may be formed so as to define a first flat surface 21 extending around the periphery of an article containing space, a sealing channel 24 of semi-circular configuration and a second flat surface 25. Appropriately located on the surface 25 are article containing spaces 22 which have a general configuration of the article to be contained. As depicted, these spaces 22 are semi-cylindrical in shape, and define article containing cavities 26 when the upper and lower shells 12 and 14 are locked together at the mating surfaces 20. The semi-circular sealing channel 24 which circumscribes the cavities 26 will define a circular channel around this space upon mating of the two shells. Additionally, it will be observed that apertures 30 are formed, preferably, within the channel 24, so as to permit the interior of each of the shells 12 and 14 to communicate with one another. Thus, just prior to joining the shells together about an enclosed article, a liquified foam plastic is to be injected through these apertures and into the hollow shells. The subsequent rapid expansion of such foam will fill the space within the two shells with a rigid cellular composition 40. As the foam 40 expands through the apertures 30 and solidifies, it will integrally lock the two shells together about the article within cavity 26 so as to form a self-locking, tamper-proof, self-sealing closure means 44 which is appropriately depicted in FIG. 4. Thus, expanding foam 40 will completely fill the sealing channel 24 so as to form a cylindrical sealing means 46 extending about the enclosed articles, with extensions 47 extending inwardly into each of the other shells and forming a solid lock. To facilitate opening of the container and to insure that the seal remains intact with one of the shells, the apertures 30 in one shell may be reduced in number or offset with respect to the apertures in the shell to which the seal is to remain attached. Additionally, if the material forming the shell has a reduced thickness or flexibility in the cavity defining areas the expansion of the foam will cause the cavity to conform to the article therein.

Preferably, the exterior shell is formed of a polymeric material which has a high tensile and impact strength, which is relatively rigid and resistant to punctures. Suitable materials for forming such a shell would include such polymers as polybutylene terrepthalate which is marketed under the trademark VALOX by General Electric Company, Inc. and having a sales office at One Plastics Avenue, Pittsfield, Mass. or any fluorohalocarbon material such as TFELO. These materials are most appropriate when a fire-resistant container is desired. Other polymers which provide desirable exterior packaging characteristics may be found acceptable. For example, polyethylene, polyurethane or polycarbonate polymers may be utilized if desired. With respect to the foam composition, polyethylene or polyurethane foams are generally employed, but any plastic which is capable of forming a cellular structure and provides the desired rigidity for the container is acceptable.

A preferred method of manufacturing such a container is depicted in FIGS. 5 through 10. The hollow shells 12 and 14 are preferably formed through a rotational molding process. Thus, a plastic charge of the polymer material which forms the shell is placed inside a hollow mold 50 which is then rotated about two axes at predetermined speed ratios within an oven so as to subject the mold and the polymeric material to heat. During the rotational and heating process, the powder contacting the heated metal surfaces will melt to form a film thereon which solidifies through a subsequent cooling process.

With reference to FIG. 5, a suitable mold for each of the shells is identified by the numeral 50 and includes an upper mold half 52 and a lower mold half 60. The lower mold half 60 is merely a rectangular metal box taking the general configuration of the external portion of the shell, and has forward side 62 and a bottom side. Prior to the rotational molding process, the polymer material is placed within the lower half 60 with the upper half 52 being placed thereon. The upper mold half is designed as a flat plate 53 with core forming elements 54 extending downwardly to define the article containing spaces 22 within the finished container. As indicated, the elements 54 are of a substantially thicker cross-section than the remainder of the upper mold half for purposes hereinafter described. Additionally, a core forming element 56, having a general semi-circular configuration extends around the periphery of plate 53 so as to form the sealing channel 24. Finally, plugs 57 of a thermally non-conducting material (such as a phenolic resin) extend through the plate and the core forming elements 56 at selected points for purposes hereinafter described. Thus, the upper mold half has an interior surface contoured so as to define a shell having the configuration identified in FIGS. 1 through 4. If desired, one mold might be utilized to make both shells with a hinge interconnecting them.

To manufacture the shells, the polymeric material is placed within the lower mold half 60 with the upper mold being closed thereon. Subsequently, this mold and the material therein is clamped to a rotational molding unit identified symbolically in FIG. 7. This rotational molding element is designed to rotate the mold within a heating unit about two different axes so as to insure a relatively uniform distribution of polymer material about the interior of the mold. Accordingly, a primary drive shaft 72 suitably journaled within an appropriate supporting means (not shown) is rotatably driven by an electric motor or other means 74 so as to rotate a yoke 76 about the axis of this primary shaft. A means of carrying the mold may include two shafts 78 suitably journaled within the yoke so as to permit rotational motion of the mold in a second direction which is generally perpendicular to the axis of the primary drive shaft 72. To effect rotation in the second direction, the primary drive shaft 72 is provided with an extension 79 carrying a gear 81 for driving a chain 82. This chain is then coupled with a second gear 84 on a secondary drive shaft 85 which is rotationally supported by an appropriate means (not shown). At the distant end of the secondary drive shaft 85 is a bevel...
gear 89 which meshes with the drives a pinion gear 90 constrained for rotation with the shaft 78. Thus, this apparatus is capable of rotating the mold in at least two directions of varying speeds so as to cause the polymer material in contact with the metal to melt about the mold forming a completed shell 12 or 14. However, since the phenolic plugs do not conduct heat, powder falling on them will not melt and apertures 30 in the sealing channel 24 will result. Alternatively, these apertures may be formed after molding by boring operations. After the shell has been rotationally molded within the oven (not shown), the mold 50 is then permitted to cool thus solidifying the shell such that it may be removed.

As indicated in FIG. 8, two of the two shells are appropriately placed side by side, and fragile articles 100 which are to be shipped are placed upon the article defining surfaces 22 of the shell 14. Subsequently, a liquified polymer foam is injected into the apertures 30 of each of the shells 12 and 14 by any conventional in-situ foaming process. As herein depicted, the liquid foam is to be injected by nozzles 105 of a conventional foam console-ejector gun through the apertures 30 into the shells. Alternatively, other apertures might be provided for the injection process. After the liquid foam has been injected, the top shell 12 is placed over the lower shell 14 to encase the fragile article 100 at which time the two shells may be placed in a compression chamber (not shown) during the expansion and solidification of the foam such that they will maintain their shape. Alternatively, the shells may adequately support themselves without distortion during such expansion. As the liquified foam expands and solidifies within each of the shells, such will fill the upper and lower shells 12 and 14 and pass through the apertures 30 so as to provide an integral connection between the foam within two shells to lock them together about the article 100, such locking effect resulting from the mechanical interlocking of the foam and from the adhesive character of the foam adhering to the surfaces of the sealing channel.

Finally, one other favorable characteristic is designed to take place during the foam in-place operation. As previously mentioned, the core members 54 of the upper mold section 52 has a much thicker metallic cross section than the remainder of the upper mold section. This increased cross section results in less heat transfer to the interior surface of the mold adjacent the spaces 22. Thus, less material will melt on these surfaces and accordingly, the shell thickness adjacent the article to be enclosed will be much thinner in cross-section and less rigid. The purpose of this flexibility is explained with reference to FIGS. 9 and 10. When the article 100 are placed onto the article containing surface 22, it may not completely fill the space as originally molded and voids 99 between the article 100 and the cavity may result, permitting the article some freedom of movement. However, during the in-situ foaming process, the expanding foam will act with sufficient force against these thinned areas of the article defining cavity 22 so as to cause same to move upwardly and rigidly encapsulate the article 100 so as to preclude any movement thereof.

FIG. 11 depicts another modification of my invention which includes a bottom shell 14 similar to that previously described. However, a different closure 104 is illustrated. This closure may take the form of a flat sheet of plastic material, wood, or container board which is provided with a peripheral sealing groove 105. After the material is placed into the space 26, the foam 40 is injected into the bottom shell 14 and expands into the annular sealing channel 24. In this instance, the seal and lock between the top 104 and the shell 14 is one of adhesion desired, and the surfaces of the channels 105 and 24 may be provided with different textures so as to vary the strength of the adhesive lock.

Finally, FIGS. 12 and 13 illustrate another embodiment of my invention, and comprises two shells similar to that of the embodiment of FIGS. 1-4. However, the apertures 30 are omitted with the foam being inserted through other openings (not shown). Upon the closing of the two shells about an article within space 26, another shot of foam may be injected through an aperture 111 formed through on or both the sealing surfaces 21. Here, the foam in-place feature of my invention relates to the sealing and adhesive locking characteristics of the foam. Thus through a single application of expandable foam solution, a moisture proof, sealed and locked container can be obtained.

Accordingly, it should be clear that applicant has proffered a tamper-proof container containing locking characteristics for rigidly encapsulating an article in a shock-proof manner. Too, a process for making same is included, and both the process and the container may take many forms. Too, the in-situ foaming may be accomplished by any one of several known procedures, some of which are referred to in U.S. Pat. No. 3,618,287 referred to above. Such foaming can be used for simultaneously filling the shell and sealing or for sealing alone.

I claim:
1. An improved container comprising two hollow shells each constructed of one-piece polymeric material, a surface of one shell mating with a surface of the remaining shell, said mating surfaces defining therebetween a container interlocking as well as parting area, said surfaces having apertures therein for permitting communication between the shells, an article containing space between said surfaces, and cellular plastic material filling each of said shells and interlocking said shells together across said area through said apertures to protectively encapsulate an article within said article containing space while permitting said shells to be parted across said parting area for the removal of an article from said article containing space.

2. The container as defined in claim 1 wherein said surfaces are more flexible than the remainder of each shell.

3. The container as defined in claim 1 wherein said surfaces are each of a smaller cross-sectional dimension than the material forming the remainder of each shell.

4. The container as defined in claim 1 wherein the number of apertures in said shells are different.

5. The container as defined in claim 1 wherein at least one of said surfaces includes continuous uninterrupted channel means circumscribing said article containing space, and said apertures are in communication with said channel mean.

6. The container as defined in claim 1 wherein both said surfaces include channel means circumscribing said article containing space, and said apertures are in communication with said channel means.
7. The container as defined in claim 1 wherein at least one of said surfaces includes channel means circumscribing said article containing space, and said apertures are in communication with said channel means.

8. The container as defined in claim 7 wherein said surfaces are more flexible than the remainder of each shell.

9. The container as defined in claim 7 wherein said surfaces are each of a smaller cross-sectional dimension than the material forming the remainder of each shell.

10. A process of containerizing an article comprising the steps of providing two hollow one-piece shells having apertured mating surfaces having therebetween a container interlocking as well as parting area, placing an article between said surfaces, and introducing expandable liquefied plastic foams in said shells and positioning said mating surfaces contiguous each other whereby said foams upon expansion will interlock the shells to each other through the aperture thereof.

11. The process as defined in claim 2 including the step of circumscribing the article with the introduced expanded liquefied plastic foams.

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