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PROCESS FOR FORMING AN INSULATED CONTAINER

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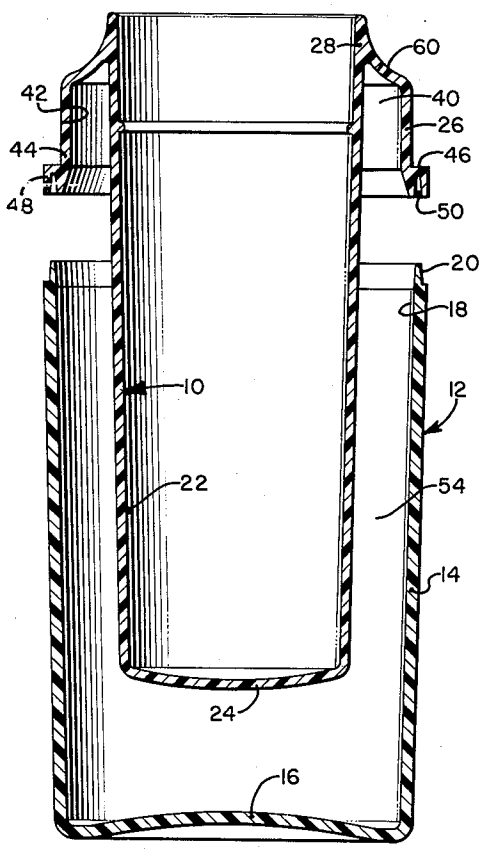


FIG. 1.

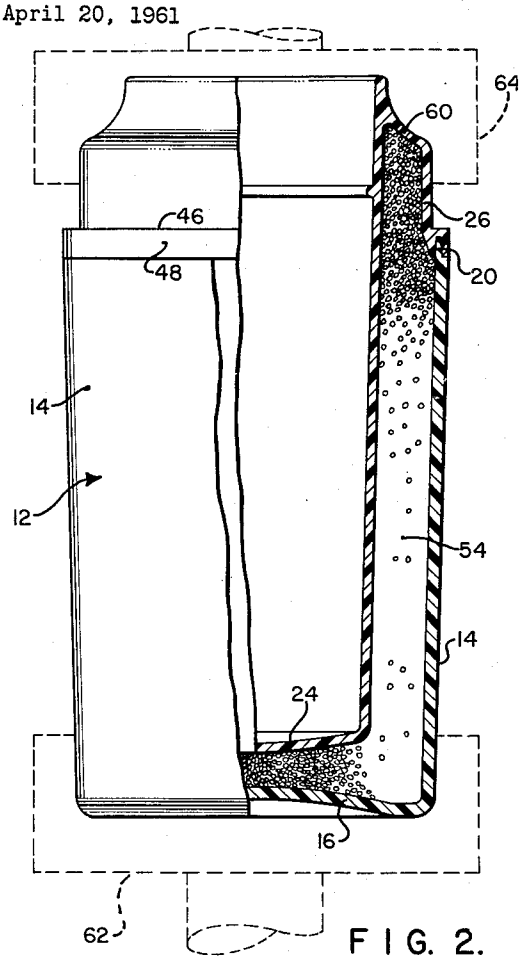


FIG. 2.

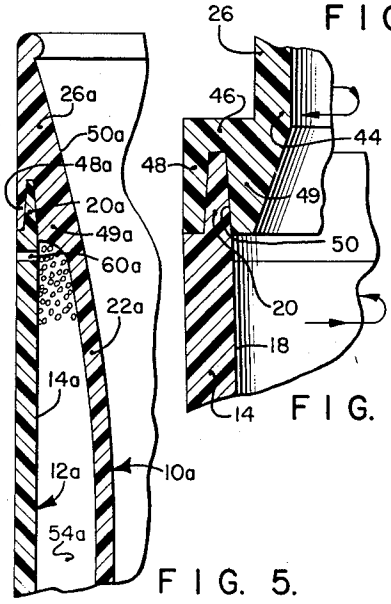


FIG. 5.

FIG. 3.

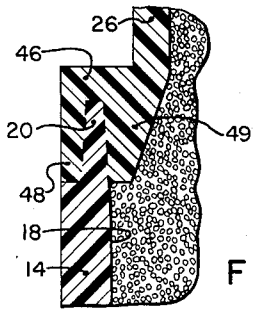


FIG. 4.

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PROCESS FOR FORMING AN INSULATED CONTAINER

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This invention relates to a process of forming an insulated container and particularly to such a process and article wherein a pair of telescoping elements formed of a thermoplastic material are spin-welded together to form a unitary structure, said structure having foamed plastic insulating material substantially filling the cavity formed by the telescoping elements.

It is an object of the present invention to provide a process for forming an insulated container wherein a liner is telescopically received in a shell to form an insulating space therebetween and sealed thereto by spin-welding to prevent subsequent leakage or breakage at the seal.

It is a further object of the present invention to provide such a process wherein the space between the liner and shell is substantially fully filled with a foamed plastic insulating material.

It is another object of the present invention to provide such a process whereby an insulated container may be readily and economically manufactured.

Yet another object of the present invention is to provide a process whereby an insulated container formed of thermoplastic material which may be subjected to considerable abuse and excessive temperatures without breaking is manufactured.

These and other objects and advantages of the present invention will be readily apparent, it is believed, from the following detailed description of preferred embodiments thereof when taken in connection with the accompanying drawings in which—

FIG. 1 is a vertical exploded sectional view of the telescoping elements prior to assembly;

FIG. 2 is a vertical sectional view, partially in section, of one form of the completed insulated container;

FIG. 3 is an enlarged partial sectional view of the juncture of the elements prior to spin-welding;

FIG. 4 is an enlarged partial sectional view, similar to FIG. 3, after spin-welding;

FIG. 5 is an enlarged partial sectional view of the juncture of the liner and shell.

In general, the process of the present invention includes the forming of a liner adapted to be telescopically received within a shell, said liner and shell being formed of a thermoplastic material, placing a selected foamable plastic material into the cavity of the shell and spin-welding the shell to the telescopically received liner while simultaneously allowing the foamable material to fill the space between the liner and shell to complete the insulated container.

Referring now to the drawings, the insulated container includes a liner 10, telescopically received within a shell 12. The liner and shell may be generally cylindrical in form, each having a common longitudinal axis. The shell 12 includes a generally cylindrical wall 14 and a base 16. The top portion 18 of the wall 14 is provided with a generally V-shaped rim 20.

The liner 10 includes a liner wall 22, a liner base 24 and a bonnet 26. The liner wall 22 may be generally cylindrical in form, and may be tapered, having a progressively decreasing cross sectional area from the top 28 to the liner base 24. The bonnet 26 is formed integrally with the top 23 and projects downwardly to form a space 40 between the wall 22 and the inner periphery 42 of the bonnet 26. The lower extremity 44 of the bonnet 26 includes a flange 46, a skirt 48 and a support ring 49. The skirt 48 and support ring 49 define a generally V-shaped annular groove 50 adapted to receive the rim 20. The rim 20, when inserted into the groove 50, may make frictional contact with the skirt 48, an inner support ring 49 or the flange 46. Preferably, the frictional contact between the rim 20 and the bonnet 26 is against either the support ring 49 or the skirt 48.

When the liner 10 is telescopically received within the shell 12 and the rim 20 is frictionally seated within the annular groove 50, the liner and shell define a substantially uniform space 54 therebetween. This space 54 and the space 40 may be filled with any insulating material having a low heat transfer coefficient. For example, foamed plastics, such as polystyrene and the like may be preformed and inserted into the shell and the liner thereafter positioned. As thus assembled, a complete insulated container is formed.

As a part of the present invention it has been determined that the liner and shell may be sealed together without the use of adhesives or the like by forming both the shell and liner from the same thermoplastic material and spin-welding the elements together. Any thermoplastic well known in the art may be used. Examples of such materials are polyethylene, polyvinylchloride, polyvinylacetate, polystyrene, polytetrafluoroethylene, polytrifluorochloroethylene, polymethylmethacrylate, polypropylene, the acrylics, nylons and other similar addition and condensation polymers of the thermoplastic group. While any thermoplastic may be used, the preferred material should be selected from those having good heat resistance, low thermal transfer coefficient and high impact strength. Linear polyethylene and polypropylene are quite satisfactory materials from which to form the liner and shell.

In order to achieve a uniform seal between the liner 10 and the shell 12 it is necessary that the rim 20 and groove 50 be so formed as to permit the rapid rotation of the shell with respect to the liner when the rim 20 frictionally engages one of the surfaces defining the groove 50. The rapid spinning while a surface of the shell frictionally engages a surface of the liner generates sufficient heat to melt the thermoplastic at the frictional interface. Thus, as seen in FIG. 4, the rim 20 becomes in effect a physical part of the bonnet 26, there being substantially no visible separation between the engaging friction surface of the rim 20 and the engaged friction surface of the bonnet 26.

While it is possible to preform an insulating material, insert the same into the shell 12 and assemble the shell and liner 10, as a further part of the present invention it has been determined that the spaces 54 and 40 may be readily and conveniently filled by utilizing a foamable plastic material such as, for example, polyurethane which is foamed in situ during the spin-welding operation. Thus, prior to inserting the liner 10 into the shell 12, a predetermined amount of unreacted plastic with a suitable catalyst and foaming agent is placed in the bottom of the shell 12. Prior to the foaming reaction taking place the shell and liner are assembled, the frictional surfaces of the rim 20 and elements defining the groove 50 engaged, and then, during the course of the foaming reaction the shell is spun with respect to the liner. The spinning accomplishes two purposes. As above described, it causes the shell to be welded to the liner. In addition, the forces caused by the rotation of one element with respect to the

other causes the foaming material to be thoroughly mixed prior to expansion through the spaces 40 and 54.

Since, in many cases, welding is accomplished prior to the completion of the foaming reaction, bonnet 26 is provided with a small hole 60 to allow air entrapped in the space 40 to escape during the foaming reaction.

The quantity of foamable plastic to be used will be determined by the volume of the spaces 54 and 40 defined by the joined shell and liner. While the resulting volume of foamed material can be controlled quite accurately, in order to provide reasonable manufacturing tolerances the base 16 is preferably concave, while the base 24 is preferably convex. By so forming the respective bases a reasonable variation in quantity of foamable plastic may be accommodated since the bases 16 and 24 may now be forced outwardly and inwardly respectively to allow for slight excesses of the foamed material.

The minimum lateral distance between the outer surface of the wall 22 and the inner surface of the wall 14 should be on the order of at least ⅛ inch in order to permit ready flow of the foaming plastic throughout the spaces 40 and 54. If this distance is substantially less than approximately ⅛ inch, friction between the foaming plastic and the walls 20 and 22 may prevent the foaming material from completely filling the spaces 40 and 54.

Any plastic material capable of being controllably foamed may be used as the insulating material. Thus, the polystyrenes and polyurethanes and the like readily adapt themselves for use in this process. The resulting unicellular material effectively thermally insulates the wall 22 of the liner 10 from the surrounding environment.

The following specific example is illustrative of the process of forming the insulated container:

A liner and shell as above described and as illustrated in FIG. 1 was formed of linear polyethylene. Approximately 10 grams of a Voracel A formulation 2 foamable polyurethane was placed inside the shell 12. This material is described in the Dow Chemical Company Bulletin VR–1 entitled Polyethers in Rigid Urethane Foams and includes a mixture of toluene diisocyanate, a polyether, monofluorotrichloromethane, triethylene diamine and a silicone compound. The ratios of these materials were approximately 49.0 parts by weight toluene diisocyanate, 0.25 part by weight silicone compound, 37.5 parts by weight of a polyether, 13.0 parts by weight monofluorotrichloromethane, 0.25 part by weight triethylene diamine.

The shell 12 was held in a chuck, illustrated in phantom at 62 in FIG. 2. The liner 10 was placed in a chuck, illustrated in phantom at 64, and the shell and liner joined by frictionally engaging the rim 20 in the groove 50. The chuck 62 was rotated by suitable means (not shown), having a slip clutch thereon. As the foam reaction commenced, the shell was spun with respect to the liner at a speed of approximately 3000 r.p.m. After several seconds the shell was welded to the liner, rotation ceased and rotation taken up by the slip clutch (not shown). The completed container was removed and carefully cut in half along its vertical axis. An examination of the device showed that the seal between the rim 20 and the elements defining the groove 50 was substantially uniform across the interface and that the polyurethane foam completely filled the spaces 40 and 54.

A second container was foamed by the above process, removed from the chucks and allowed to cool. The container was then filled with ice water (32° F.), covered with a plastic cap (not shown) and set aside for one hour. The temperature of the water in the container was then taken and shown to be approximately 39° F. The container was then emptied and subjected to a temperature of 180° F. for twenty minutes, then tumbled and otherwise subjected to abuse and the weld examined. The weld was uniform throughout the friction surface between the rim and the elements defining the groove.

It will be apparent that any other thermoplastic material may be substituted for the linear polyethylene illustrated in the above example. It will be further apparent that other polyurethane foams, either rigid, semirigid or flexible, varying in density approximately from 1 pound to 40 pounds per cubic foot or any other foaming plastic material may be substituted for the polyurethane foam set forth in the above example.

The quantity of foaming material to be used will of course be determined by the volume of space to be filled which in turn will be determined by the relative sizes and form of the shell and liner. For example, the container illustrated in FIG. 1 is in the form of an insulated bottle or jug. A modified form of the insulated container is illustrated in section in FIG. 5.

This container may be in the form of a tumbler wherein the upper lip 26*a* of the liner 10*a* is relatively thicker than the lower portion of the liner 10*a*. The skirt 48*a* and support ring 49*a* define an annular groove 50*a* adapted to receive the rim 20*a* of the shell 12*a*. The wall 22*a* of the liner 10*a* tapers inwardly from the upper lip 26*a* so as to define a space 54*a* between the liner 10*a* and the shell 12*a*. The wall 14*a* of the liner 12*a* is provided with a hole 60*a* below the rim 20*a* and adjacent the upper lip 26*a*. By this construction an insulated tumbler may be formed in the manner above described. Such a tumbler was manufactured by the above described process using polypropylene to form the liner and shell and the above described polyurethane as insulating material. The insulated tumbler was satisfactory in all respects.

Having fully described our invention, it is to be understood that we do not wish to be limited to the details set forth, but our invention is of the full scope of the appended claims.

We claim:

1. A process for forming an insulated container comprising the steps of: forming a shell and a liner from a selected thermoplastic, said liner being adapted to be telescopically received in said shell to define a space therebetween, said shell and said liner each having an annular surface adapted to be frictionally engaged one with the other upon axial telescoping movement of the liner with respect to the shell; placing a foamable plastic into said shell, inserting said liner into said shell to engage said surfaces; and spinning said shell with respect to said liner while maintaining said surfaces in frictional contact and simultaneously permitting said plastic to foam and fill said space whereby said liner is welded to said shell and the insulated container is formed.

2. A process for forming an insulated container comprising the steps of: forming a shell and a liner from a selected thermoplastic, said liner having a lower and an upper portion, said lower portion being adapted to be telescopically received in said shell to define a space therebetween, said upper portion having means defining an annular groove, said shell having an upper annular rim adapted to be received in said annular groove upon axial telescoping movement of the liner with respect to the shell, placing a foamable plastic into said shell; inserting said liner into said shell to frictionally engage said rim with said means defining said annular groove; and spinning said shell with respect to said liner and simultaneously permitting said plastic to foam and fill said space whereby said insulated container is formed.

3. A process as claimed in claim 2 wherein said thermoplastic is linear polyethylene and said foamable plastic is polyurethane.

4. A process for forming an insulated container from a liner telescopically received within a shell to define a space therebetween, the shell and liner being formed from a selected thermoplastic and each having a surface adapted to be frictionally engaged, one with the other, upon axial telescoping movement of the liner with respect to the shell, comprising the steps of: placing a foamable plastic into said shell, inserting said liner into said shell to engage said surfaces and spinning said shell with respect to said liner and simultaneously permitting

said plastic to foam and fill said space whereby said insulated container is formed.

5. A process for forming an insulated container comprising the steps of: forming a shell and a liner from a selected thermoplastic, said liner having a lower and an upper portion, said lower portion being adapted to be telescopically received in said shell to define an annular space therebetween, the lateral distance between the outer surface of said lower portion and the inner surface of said shell being on the order of at least one-eighth inch, said upper portion being provided with a bonnet and means defining an annular groove carried by said bonnet, said shell having an upper annular rim adapted to be received in said annular groove upon axial telescoping movement of the liner with respect to the shell; placing a predetermined amount of a foamable plastic into said shell, inserting said liner into said shell to frictionally engage said rim with said means defining said annular groove; and spinning said shell with respect to said liner and simultaneously permitting said plastic to foam and fill said space whereby said insulated container is formed.

6. A process as claimed in claim 5 wherein said thermoplastic is polyethylene and said foamable plastic is polyurethane.

7. A process as claimed in claim 5 wherein said thermoplastic is polypropylene and said foamable plastic is polyurethane.

8. A process for forming an insulated container comprising the steps of: forming a shell and a liner from a selected thermoplastic, said liner having a lower and an upper portion, said lower portion being adapted to be telescopically received in said shell to define an annular space therebetween, said upper portion being provided with a skirt and a support ring which define an annular groove, said shell having an upper annular rim adapted to be received in said annular groove upon axial telescoping movement of the liner with respect to the shell; placing a predetermined amount of a foamable plastic into said shell, inserting said liner into said shell to frictionally engage said rim with said annular groove; and spinning said shell with respect to said liner to form a uniform continuous seal between said shell and said liner and simultaneously permitting said plastic to foam and fill said space whereby said insulated container is formed.

9. A process as claimed in claim 8 wherein said thermoplastic is polyethylene and said foamable plastic is polyurethane.

10. A process as claimed in claim 8 wherein said thermoplastic is polypropylene and said foamable plastic is polyurethane.

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