April 17, 1962 H. EVERS 3,029,963

BOTTLE

Filed Jan. 21, 1959

FIG. 2

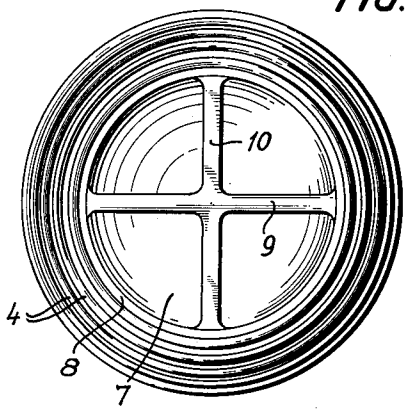
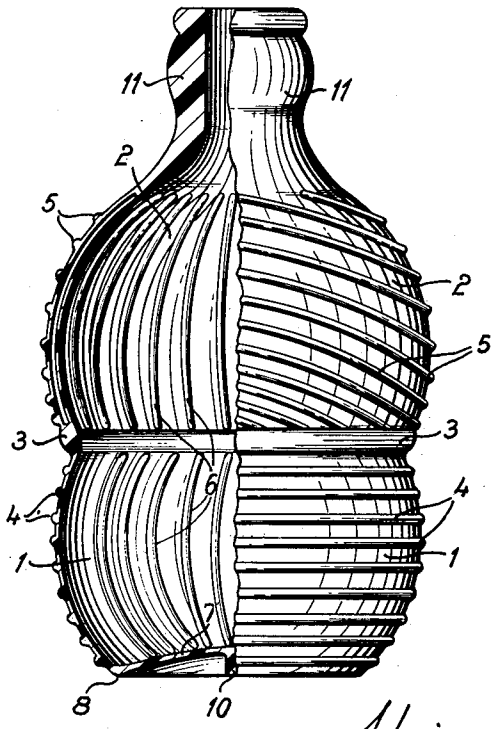


FIG. 1



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3,029,963

BOTTLE

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5 Claims. (Cl. 215—1)

This invention relates to containers for beverages and, more particularly, to a disposable container for gas containing beverages, such as beer, carbonated beverages and the like.

For some time, it has been the practice to bottle beverages, including beer and carbonated beverages, in reusable glass bottles. The bottles are filled with the beverage and capped or sealed at the bottling works and are then transported to a retail outlet where they are sold to the consumer. After the contents of the bottle have been used, the consumer returns the empty bottle to the retail outlet who, in turn, returns it to the bottling plant where it is stored and, later, cleaned, sterilized and refilled. This practice requires a large number of bottles to assure an adequate supply for bottling at the plant. In addition to the inventory of empties at the plant for bottling, the supply of bottles must be sufficient to provide for the lapse in time for the travel of the filled bottle from the bottling plant to the retail outlet, from the retail outlet to the consumer, and the return of the empties from the consumer to the retail outlet and, finally, to the bottling plant. In addition to the large inventory, both the bottling plant and the retail outlet must tie up valuable storage facilities with empty bottles.

The reusable glass bottle is relatively thick and heavy to withstand repeated handling in reuse and represents a substantial investment on the part of the bottler. Hence, such bottles are packaged and distributed in protective cases or cartons. These cartons are of wood or heavy corrugated paper board which will withstand rough and abusive treatment and prevent breakage of the bottles. Like the bottles, these cases represent a substantial investment on the part of the bottler and increase the storage problem for the bottler as well as the retailer. The retailer, in addition to providing storage space for the returned empty bottles, must also provide storage facilities for the empty cases awaiting return of the bottles from the consumer.

Because of the investment involved, it is the practice of most bottling companies to require a deposit on the bottle, as well as the case, at the time of purchase. When the beverage is purchased from the retailer by the consumer, the retailer requires the consumer to place a deposit on the bottles and, if the purchase is made by the case, an additional deposit on the case. These deposits are refunded at the time the empty bottles and case are returned. Not only is this an inconvenience and nuisance to all parties concerned, but also creates an accounting problem for the retailer as well as the bottling plant.

In an attempt to overcome some of these problems, more recently no-return or one-way bottles and cans have been employed. While these containers are less costly than the returnable bottle, their use has increased beverage costs. In most instances, this cost has been passed on to the consumer who, to avoid the inconvenience of deposits and return of the empties, pays a premium to purchase in the no-return container. Because the no-return container, whether a no-return bottle or can, is sold at a premium, consumer demand has forced many bottlers to continue to package a portion of their production in returnable bottles.

The manufacture of no-return bottles and cans requires special manufacturing facilities. Such bottles and cans are purchased in quantity by the bottling plant and stored until used. While the storage facilities may not be as large as those required for the reusable bottles, substantial storage areas must still be provided. In addition to occupying valuable storage area, the no-return containers must be processed by the bottler prior to use. To eliminate contaminants and, at the same time, fulfill health requirements, such containers are sterilized immediately prior to use or are heated to a pasteurizing temperature after refilling.

Although thermoplastic materials have found wide use as containers for many types of fluid materials and provide many advantages insofar as durability, weight, manufacture and the like are concerned, such materials have not found use as containers for gas containing beverages, such as carbonated beverages, beer and the like. This, to a large extent, is due to the tendency of such materials to buckle and change their shape, especially when subjected to internal pressure. Beer and carbonated beverages are saturated with carbon dioxide. That is, there is considerably more carbon dioxide dissolved in the liquid than would be contained therein at ambient pressure and temperature. This, of course, results in a pressure in the container. For example, commercial beer at a temperature of 30° C. has a partial carbon dioxide pressure of 1.75 atu. In some instances, to increase the carbon dioxide content, beverages are cooled to a relatively low temperature under pressure prior to bottling. After the bottle is filled and sealed, the ambient air heats the contents of the bottle to room temperature, creating in the sealed bottle a pressure in balance with the contents of dissolved carbon dioxide in the beverage. Another practice sometimes followed in bottling is to heat the beverage, prior to filling, to the pasteurizing temperature, for example 145° F. The bottles are then filled with the hot liquid at a pressure which may be as high as 12 atu. In other instances, after the bottle has been filled and sealed, the bottle and its contents are heated to the pasteurizing temperature. Obviously, in all of these instances, the walls of the bottle or container are subjected to a wide variation of pressures and temperatures. Once the bottle has been capped or sealed, changes in the temperature of the container and its contents result in changes in pressure on the walls of the container, the internal pressure increasing and decreasing as the temperature of the container and its contents are increased and decreased.

Under the instant invention I have discovered that, by forming the container in a special shape, thermoplastic materials can be used to form containers for gas containing beverages such as beer and carbonated beverages. When formed in accordance with the teaching of my invention, the thermoplastic bottle may expand with changes in pressure without appreciable change in shape or appearance of the bottle. The bottle is much lighter than reusable and no-return containers presently in use and, due to its resilient nature, can be shipped and handled without damage even in the absence of a heavy protective carton or case. In addition, since only a relatively limited amount of forming equipment is required, the thermoplastic containers of the invention may be made in the bottling plant as the containers are needed. Thus, storage space requirements are greatly curtailed.

The drawing shows diagrammatically one embodiment of the invention, in which

FIG. 1 is an elevation of a bottle made in accordance with this invention, partly in section and partly in view,

FIG. 2 is a view from below on the bottle according to FIG. 1.

The body of the bottle consists of two ball zones 1, 2, the edges of which are connected by a strengthening seam

3 which extends circumferentially for forming a reinforcing and circular ring or hoop. Under inside pressure, each hollow body tends to assume the shape of a ball. The bottle shown therefore experiences a certain expansion depending on the elasticity modulus of the material and according to the formula

$$\epsilon = \frac{\sigma}{E} \times 100\%$$

ϵ extension (percent)
E elasticity modulus kg./cm.^{2}
σ tensile stress kg./cm.^{2},

but the shape is not changed. Therefore, no bending stresses are created in the bottle, but only tensile stresses.

The strengthening seam 3 prevents a departing of the two ball zone edges from one another. Its cross section is of such a dimension that within the seam the same tensile stress occurs as does within the wall of the ball-zones 1, 2 and it thus experiences the same precentage of expansion. Apart from the stability of shape, the ball-formed shell of mantle has the advantage that, at a given inside diameter d and σ an inside over pressure p it has the lowest wall thickness δ of all hollow bodies, corresponding to the formula

$$\delta = \frac{d \times P}{4 \times \sigma} \text{ admissible}$$

σ admissible=admissible tensile stress (kg./cm.^{2})

in comparison to a cylinder:

$$\delta = \frac{d.P}{2 \times \sigma} \text{ admissible}$$

The bottle mantle surface is suitably provided with ribs which enlarge the heat transferring surface and the resistance. So the lower ball shape 1 is provided with outside ribs extending horizontally around it, whilst the upper ball shape 2 of the bottle has helically wound outside ribs 5. The cross section of the ribs and their longitudinal formation, are of subordinate importance. The enlargement of the heat transfer surface is important in particular in cases where in a hot racking process the beer after closing the bottles is cooled down to cellar temperature in a cooling bath. Apart from a surface enlargement, the ribs create a turbulent boundary layer or film by which the heat transfer factor is increased.

As a result of the increased flow resistance, the duration of the cooling medium on the bottle surface is longer, whereby the latter is better utilized.

The ribs may extend either transversely, longitudinally, obliquely or helically or may have another special form to fulfil the above described purpose.

Also the inside wall of the bottle mantle 1, 2 may be equipped with ribs 6 to generate a turbulence at the inner boundary layer or film between the bottle content and bottle wall. This is of advantage in particular where the bottle is arranged in a heat exchanger device which moves the bottle, for instance a cooling drum (sieve drum). So the bottle shown in FIGS. 1 and 2 is provided with inside vertically extending ribs 6.

The bottom plate 7 is concave in order to increase its strength so that a circumferentially extending supporting edge 8 is formed, which preferably has an increased wall thicknesses. The concave bottom plate 7 of the bottle is in addition provided with two vertically extending through-running webs 9, 10 which, in downward direction at the highest extend to the height of the supporting edge 8. These webs 9, 10 increase likewise the resistance of the bottom plate 7.

In upward direction, the upper ball portion 2 is defined by a bottle neck 11, the wall thickness of which is likewise increased in comparison to that of the ball portions 1 and 2 in order to support the upper end of the ball portion 2.

The bottle may as well be formed with only one ball

zone. It is, however, also possible to provide several ball zones instead of only one or two. In general, the provision of two or more ball zones will prove to be most recommendable, because in this way the vertical extension of the bottle is increased.

The bottle of thermoplastic material offers the advantage that all known closing methods, including welding of the bottle, may be applied.

By the ribs 4, 5, 6 provided on the bottle mantle at the same time an increased rigidity of the form is achieved, and the ribs on the surface provide for an especially good gripping capacity.

Where carbon dioxide containing beverages are involved that are not to be pasteurized, the surface ribs may be eliminated. The bottles may be manufactured by injection molding, die-casting or a drawing process, but preferably by a flowing process and may also be made from thermoplastic derivatives depending upon the wishes of the consumers concerning the physiological characteristics of the bottles.

The thermoplastic material for making the bottle may be selected in particular from polyethylene, polypropylene and polyamides. The bottle made from polyethylene or polypropylene, i.e. a thermoplastic material, should preferably be made by a blowing process, whilst the bottle made of a polyamide is preferably produced by injection molding or die-casting processes.

What I claim is:

1. A resilient, hollow bottle of thermoplastic material for bottling beverages comprising a neck portion open at its upper end and adapted to receive a cap thereon, a mantle joined at one of its ends to the lower end of said neck portion and extending downward therefrom, a plate extending across the opposite end of said mantle and forming a fluid tight closure therewith, a support seam extending circumferentially around said plate at the marginal edge thereof and joining the lower end of said mantle to said plate, said seam forming a supporting surface for said bottle, said mantle being in the form of a plurality of axially aligned, vertically disposed, hollow, truncated spherical bodies having a substantially uniform wall thickness, a seam intermediate said spherical bodies extending circumferentially around said mantle and forming a fluid tight connection therebetween, said neck portion and said support seam having a wall thickness greater than the wall thickness of said truncated spherical bodies, said intermediate seam having a wall thickness proportioned to the thickness of the walls of said truncated spherical bodies so that the tensile strength of the walls of said spherical bodies and said seam are substantially equal when said bottle is subjected to internal pressure, the tensile strength of said plate being greater than the tensile strength of said walls.

2. In a bottle as recited in claim 1 in which the wall thickness of said support seam and said neck portion are each so proportioned to the thickness of the walls of said truncated spherical bodies and said intermediate seam that the tensile strength of the walls of said support seam and said neck portion each exceed the tensile strength of said spherical bodies and said intermediate seam when said bottle is subjected to internal pressure.

3. In a bottle as recited in claim 2 in which said plate extending across the lower end of said mantle is concave projecting upward into said mantle and a plurality of reinforcing ribs extending downward from said plate, said ribs and said supporting seam joining at the marginal edge of said plate to form a supporting surface for said bottle.

4. In a bottle as recited in claim 3, said truncated spherical bodies having vertically disposed ribs extending vertically along their inner walls.

5. In a bottle as recited in claim 4, said mantle having a plurality of ribs on its outer surface.

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CERTIFICATION OF CORRECTION

Patent No. 3,029,963 April 17, 1962

Heinz Evers

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 11, for "refilling" read -- filling --; line 64, after "curtailed." insert the following as a new paragraph:

It is an object of the present invention to provide a thermoplastic container for gas containing beverages.

column 3, line 21, for "of" read -- or --; line 64, for "thicknesses" read-- thickness --.

Signed and sealed this 11th day of September 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents