United States Patent

[11] 3,598,270

[72] Inventors Domas Adomaitis
Chicago;
Howard M. Turner, Oak Forest, both of, Ill.

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[73] Assignee Continental Can Company, Inc.
New York, N.Y.

[54] **BOTTOM END STRUCTURE FOR PLASTIC CONTAINERS**
8 Claims, 17 Drawing Figs.

[52] U.S. Cl. ... 215/1 C, 220/70
[51] Int. Cl. ... B65d 1/02
[50] Field of Search ... 215/1.5; 150/.5; 220/70

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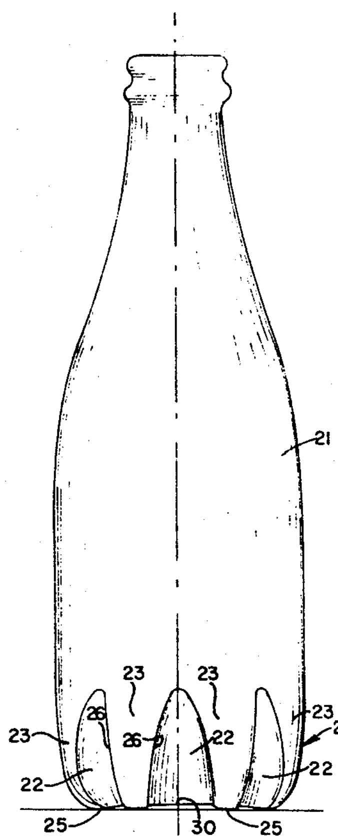
Primary Examiner—Donald F. Norton
Attorneys—George E. Szekely, Joseph E. Kerwin and William A. Dittmann

ABSTRACT: This disclosure relates to a plastic container, particularly a bottle suitable for carbonated beverages. The bottom end of the container comprises portions conformed to meridian elements of a hemisphere with a downward pole and a plurality of hollow legs terminating in feet in a plane below the pole of the hemisphere. In blow-molding the bottle, the mold halves pinch the bottom end of the parison closed along an arcuate weld line constituting the midportion of a semicircular element of a hemispherically contoured portion of the bottom.



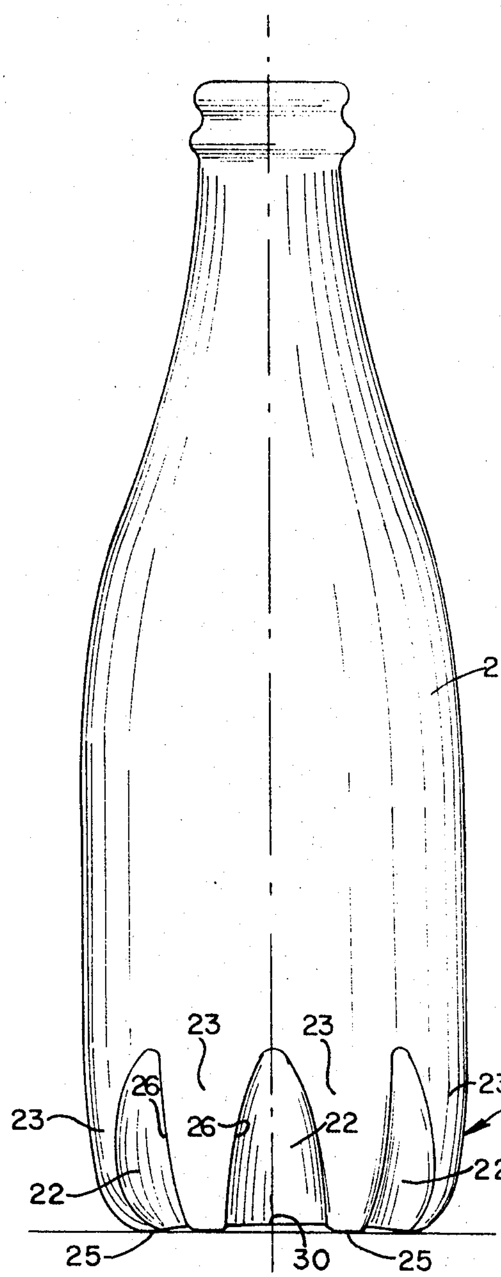


Fig. 1.

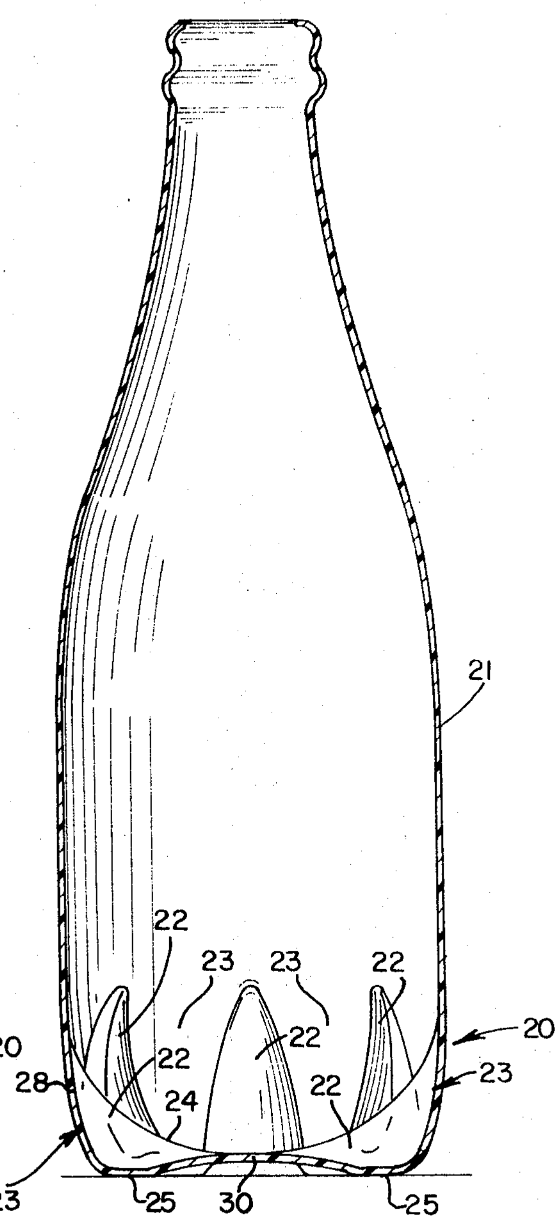


Fig. 2.

INVENTORS
DOMAS ADOMAITIS
HOWARD M. TURNER

BY George E. Szekely ATT'Y.

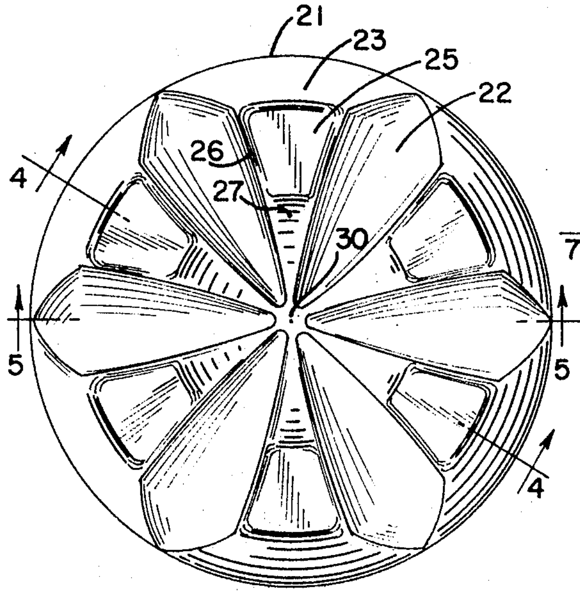


FIG. 3

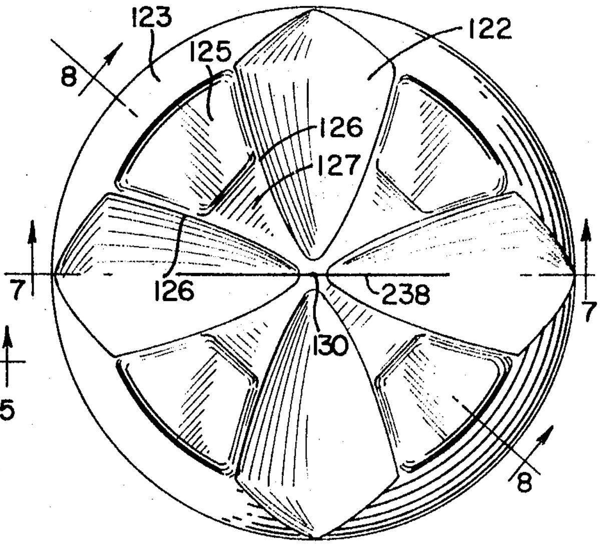


FIG. 6

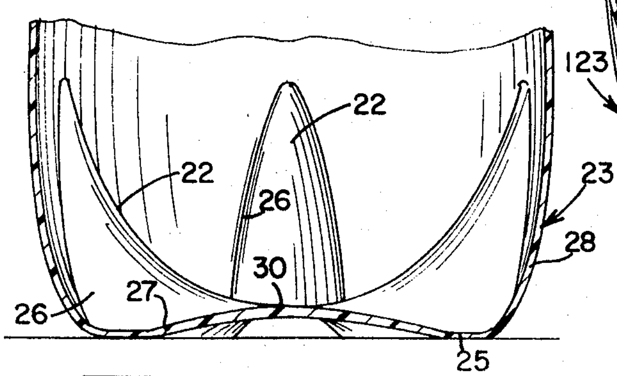


FIG. 4

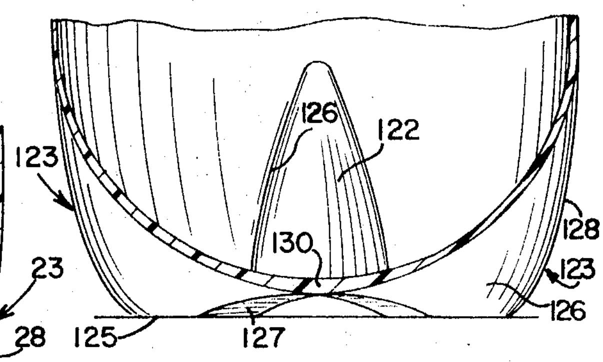


FIG. 7

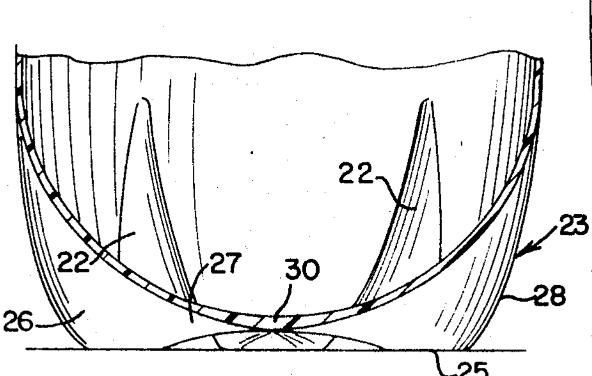


FIG. 5

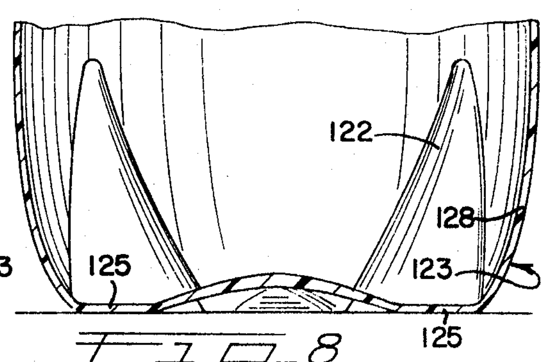


FIG. 8

INVENTORS
DOMAS ADOMAITIS
HOWARD M. TURNER

BY George E. Szekely ATT'Y.

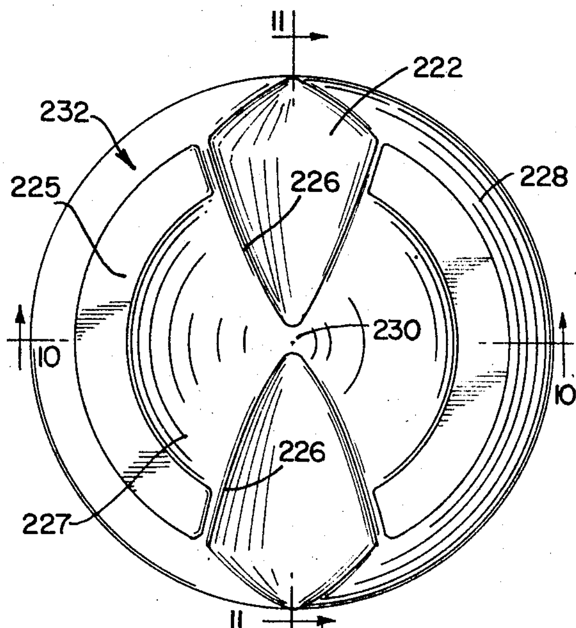


Fig. 9

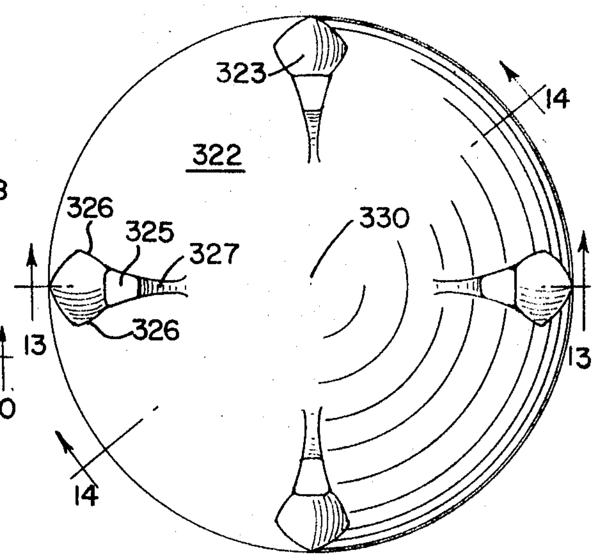


Fig. 12

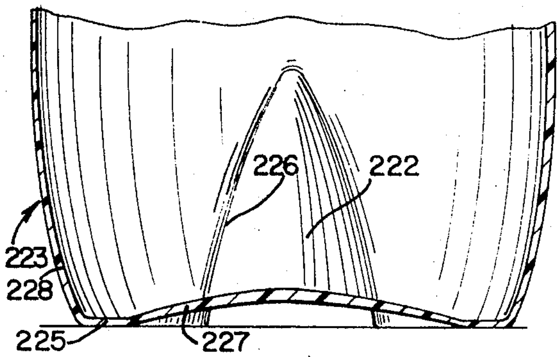


Fig. 10

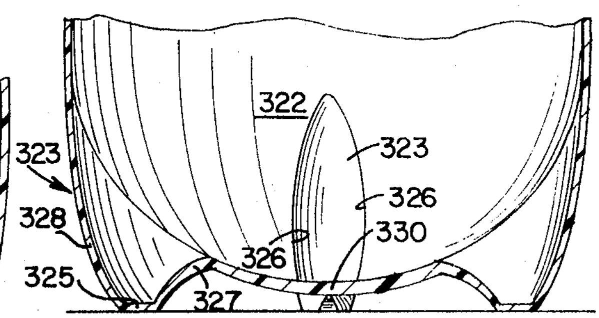


Fig. 13

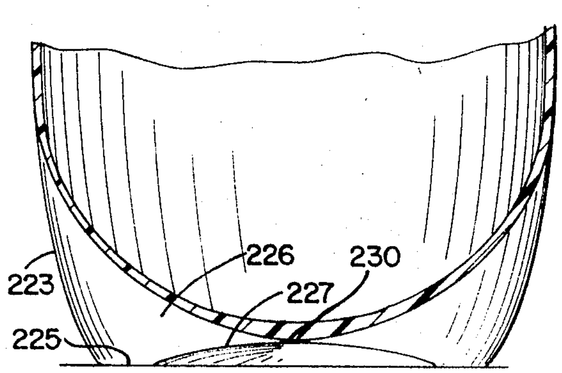


Fig. 11

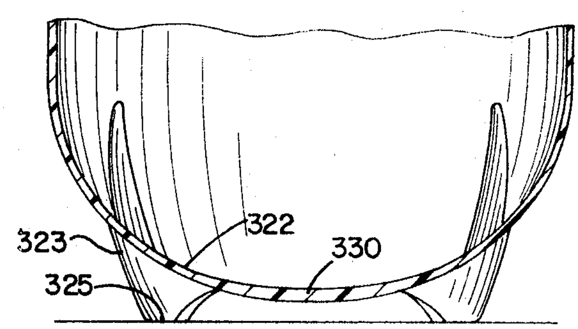


Fig. 14

INVENTORS
DOMAS ADOMAITIS
HOWARD M. TURNER

BY

George E. Szekely ATT'Y.

FIG. 15

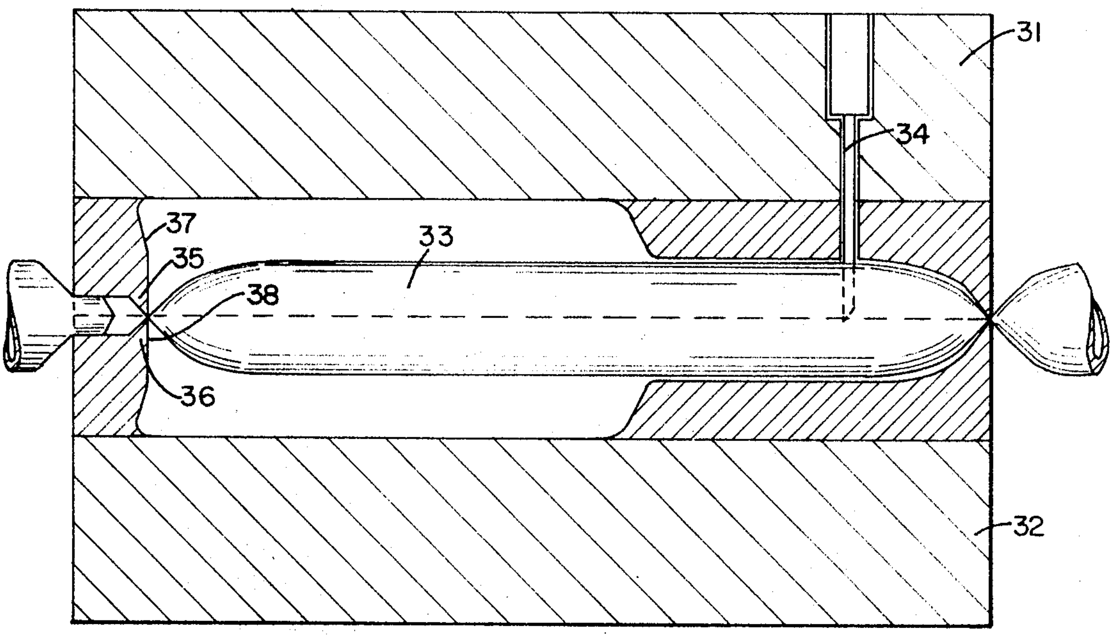


FIG. 16

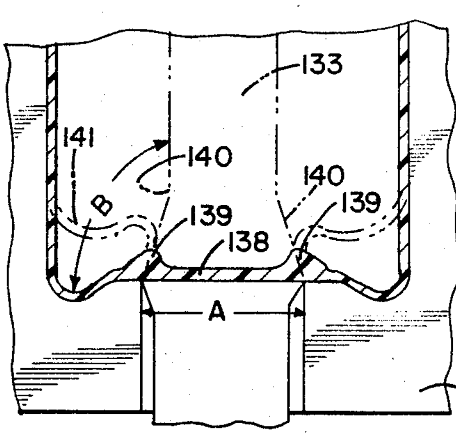
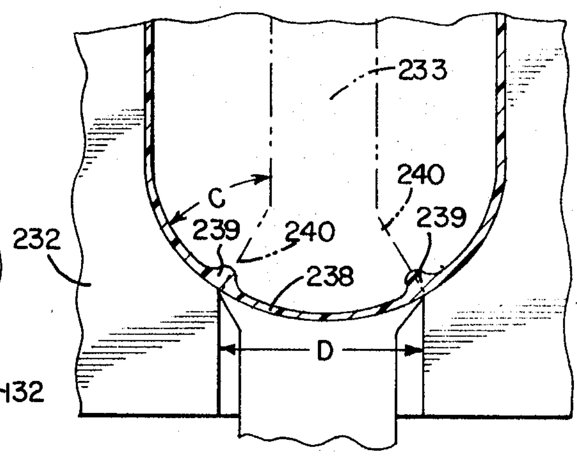


FIG. 17



INVENTORS
DOMAS ADOMAITIS
HOWARD M. TURNER
BY George E. Szekely
ATT'Y.

BOTTOM END STRUCTURE FOR PLASTIC CONTAINERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to plastic containers, more particularly bottom end structure thereof suitable for beer and beverage containers.

2. The Prior Art

It has been proposed that plastic bottles be used for beer and carbonated soft drinks and the like. Plastic compositions have been developed which are suitable for such use from the standpoint of product potability and general mechanical requirements. However, plastics of suitable grades are generally fairly expensive per unit volume as compared to glass, and in comparable wall sections are subject to substantial deformation and creep. Therefore, practical adaptation of plastic materials to food and beverage use on a commercial scale cannot usually be achieved merely by duplicating glass bottles or jars in plastic. Generally, plastic materials are competitive with glass only where a satisfactory container can be produced with a somewhat lower volume of plastic than the volume of glass used for a comparable container.

The cost problem is particularly acute in the case of bottles for substantial internal pressure, as with bottles for carbonated beverages. Such bottles must be able to withstand fill pressures on the order of 40 p.s.i., and up to 100 p.s.i. or more in storage, when exposed to the sun, in warm rooms, car trunks and the like. Generally the weakest part of the bottle is the bottom end, if of the usual flat or concave configuration with a support rim. When such a bottle is made of acceptable plastic material of economical quantity per bottle it has been found that the bottom will bulge or blow out or split at the juncture with the sidewall or, if blow-molded, will split at the parison weld line. These weaknesses cannot be overcome merely by making the bottom thicker, as in glass bottles, first of all because the requisite addition of material increases material cost to an uneconomic level, and secondly because sufficient localized thickening cannot be practicably achieved in blow molding, which process is generally the one most satisfactory from the standpoint of low cost mass production.

It has been proposed to form plastic beverage bottles with convex bottoms, to provide resistance to bulging and bursting, and therewith to provide bottle support, in the form of a jacket or coaster of plastic, paper or the like. However, manufacturing the additional piece and adhering or otherwise attaching the support piece to the body of the bottle, involve additional costs such that the resultant bottle cannot be competitively priced, even accounting for factors advantageous to the use of plastic. The multiple or laminar construction is mechanically unsatisfactory in many respects, as well as of doubtful acceptability to consumers. Furthermore, such structures are not readily adaptable to a variety of bottle configurations in an economical manner.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a one piece, self-supporting container of light weight having a bottom highly resistant to deformation, particularly deformation or bursting by bulging outward.

It is another object of this invention to provide in a plastic beverage bottle suitable for internal pressurization, a bottom end so configured that the material is principally under tension when subjected to internal fluid pressure.

It is yet another object of this invention to provide in a plastic container a membranate bottom end which is generally outwardly convex having wall portions generally conformed to portions of a hemisphere and hollow leg portions with feet for supporting the container in upright position.

It is still another object of this invention to provide a plastic beverage bottle suitable for blow molding by a method wherein the parison is pinched along an arc to form a bottom, wherein a bottom weld line is the midportion of a semicircular wall section of the fully blown bottom end, thereby minimizing weakness and overstress at the ends of the weld line when the bottle is internally pressurized.

The foregoing objects are achieved according to this invention by providing membranate bottom end structure, comprising end wall portions generally conformed to meridian elements of a hemisphere with downward pole, and other wall portions defining legs terminating in feet below the polar portion. The meridian portions are petaloid, and extend from the polar portion. The feet are generally in the form of pads constituting portions of a common annulus around the end. The feet are two or more in number but preferably an even number, symmetry facilitating manufacture in partible molds by an extrusion blow molding process. In preferred form, each leg is defined by sidewalls diverging upwardly and outwardly relative to the polar portion and an outer wall curving upwardly and outwardly to blend into the bottle sidewall. In blow molding a container having a bottom end according to this invention, the parison is pinched closed along an arc which is the midportion of the semicircle formed by petaloid portions of the end when the parison is blown. The seam is then subject only to tension when the bottle is pressurized, there being no bending or shear stress along the seam or at the termini of the weld line. Also, the material is substantially free of flaws or locked-in stresses at the ends of the weld line, since there is no reverse bending of the parison wall at the juncture of the fold lines and the weld line when blowing the parison to form the bottom wall. Due to the moderate distension involved, the bottom wall is not excessively thinned and there is no abrupt change in thickness adjacent the weld line.

Further objects, advantages and features of the invention will be apparent from the ensuing description read in association with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevation of a bottle having a bottom end according to this invention;

FIG. **2** is a vertical section through the bottle shown in FIG. **1**;

FIG. **3** is a bottom view of the bottle shown in FIG. **1**;

FIG. **4** is a partial vertical section on line **4–4** of FIG. **3**;

FIG. **5** is a partial vertical section on line **5–5** of FIG. **3**;

FIGS. **6**, **7**, and **8** are views respectively corresponding to FIGS. **3**, **4**, and **5** showing a modification;

FIGS. **9**, **10**, and **11** are views respectively corresponding to FIGS. **3**, **4**, and **5**, showing yet another modification of the invention;

FIGS. **12**, **13**, and **14** are views respectively corresponding to FIGS. **3**, **4**, and **5**, showing yet another modification of the invention;

FIG. **15** is a schematic sectional view of a blow mold showing a parison clamped therein preparatory to blowing a bottle;

FIG. **16** is a schematic partial plan view of the bottom end of the lower half mold shown in FIG. **15**, illustrating the pinchoff and formation of a container bottom blown and configured according to the prior art;

FIG. **17** is a schematic partial plan similar to FIG. **16**, illustrating the pinchoff and formation of a container bottom blown according to this invention.

DESCRIPTION OF PREFERRED EMBODIMENT

FIGS. **1** and **2** show a bottom end structure according to this invention as incorporated in a representative bottle suitable for carbonated beverages. Although such bottles represent a principal application of this invention, it will be understood that the invention is adaptable to containers generally.

The bottom end is generally indicated by reference numeral **20**. End **20** blends smoothly into the sidewall **21**. In the elevational aspect of FIG. **1**, end **20** has an evenly cusped configuration, constituted by inward petaloid wall portions **22**, alternating with outwardly projecting wall portions in the form of legs **23**. The sectional view of FIG. **2** is taken from the same position as that of FIG. 1, from which it will be seen that wall portions 22 and 23 form parts of a membranate bottom end structure with only moderate thickness variation. Preferably and as later described, the bottle is blow molded from a tubular parison. The several portions then vary somewhat in wall thickness according to the degree of material distension involved in blowing the parison to the final configuration in the mold.

At their innermost surfaces the quadrant wall portions 22 together define the semicircle 24, with all the portions 22 extending out from the polar wall portion 30. The leg portions 23 extend downwardly of the polar portion 30 to flat wall portions or pads 25 in a common lowermost plane on which the bottle thus will rest upright.

Further details of the bottom end 20 are best seen in the somewhat enlarged views of FIGS. 3 to 5 inclusive. As seen in FIG. 3 there are six legs 23 alternating with six petaloid portions 22, with six feet 25 of generally trapezoidal shape, constituting sectors of a common annulus. The sides of the feet 25 are defined along the generally radial lines by leg sidewalls 26 which extend upward from the feet 25 to join the petaloid portions 22. As best seen in FIG. 4, wall portions 27 extend upward and inward from the feet 25, blending into petaloid portions 22 at the polar portion 30. Outer leg wall portions 28 extend upwardly and outwardly from feet 25 to a blend with sidewall 21. This sloping of wall portions 28 and 26 obviates sharp corners at the juncture of these wall portions with foot wall portions 25. The configuration described provides feet of substantial total area around the periphery of the bottom, with corresponding good stability of the container in all directions. The majority of the entire membranate wall is constituted by the hemispherically contoured portions 22 and the generally axial walls of legs 23, an overall configuration which is highly burst and creep resistant, when formed as a relatively thin membrane from plastic material such as polyethylene. The economy of material, together with the facility of manufacture by an economical blow molding process conduces to good overall economy of the finished article. The disposition of gussets 27 insures contact of the support surface by the feet 25 and minimizes tendency of the container to rock, as well as compensating for some bulging which may occur under internal pressure. The section of FIG. 5, taken midway between opposite pairs of feet 25, most clearly shows the continuous semicircular contour defined by the pair of oppositely extending portions 22, the configuration which obtains in all sections between opposite pairs of feet.

MODIFICATIONS

The six-foot configuration above described has been found particularly satisfactory for a carbonated-beverage bottle of 12 oz. capacity in the general shape of FIGS. 1 and 2. However, the bottom end structure according to this invention is adaptable to a variety of particular configurations for bottles or containers of various capacities, shapes and service conditions. Representative variants are hereafter shown as embodied in a bottom end structure of the same overall diameter as that of FIG. 3, being so represented for purposes of comparison.

FIGS. 6, 7 and 8 show a four-foot bottom end, reference numerals for corresponding parts being the same as in FIGS. 1—5, with the addition of 100. The total areas of feet 25 and petaloid portions 122 are substantially the same for a given overall container diameter as for the corresponding areas of the six-foot form shown in FIG. 3. The somewhat less sharply undulated membrane of the four-foot pattern conduces to good molding fidelity with some of the less plastic materials, or in forming containers of smaller diameter, for less severe service conditions and the like. In other respects, the form of FIGS. 6—8 is substantially like that previously described, including legs 123 defined by walls 126 and 128, gussets 127, polar portion 130. Pairs of petaloid portions 122 oppositely extending from polar portion 130 conform to meridians of a common hemisphere, as best seen in FIG. 7.

The dual foot form of FIGS. 9, 10 and 11 is configured with a somewhat larger area in each foot 225, leg wall 226 and gusset portion 227 as compared to the forms previously described.

There are two petaloid portions 222 extending in opposite directions from the polar portion 230. Each leg portion 223 is bounded by widely diverging walls 226 and the upwardly and outwardly sloping outer wall 228, which blend into circular body wall 221 in the plane at the tips of the petaloid portions 222. The two feet 225 together provide a flat support surface around somewhat more than half of a common annulus well outward of the container axis, providing food stability, yet with substantial flexibility to accommodate slight unevenness of support surface. The design of FIGS. 9, 10 and 11 is particularly suitable for containers in which manufacturing or service conditions dictate the use of somewhat greater wall thickness, a laminate, or the like, or the blow molding of material of relatively low plasticity, in which cases the somewhat less intricate configuration is advantageous in manufacture.

FIGS. 12, 13 and 14 show a configuration of a container bottom end according to this invention which affords an exceptionally high degree of burst resistance. The broad petaloid portions 322 and extensive polar portion 330 together constitute a hemisphere interrupted near its girth only by four relatively small legs 323 terminating downwardly to form small feet 325. Leg sidewalls 326 are of correspondingly small area. Gusset portions 327 are proportionately short and narrow. The outer walls 328 extend upwardly and outward from corresponding feet 325 along a curve similar to the corresponding outer walls of the other forms previously described.

The configuration of FIGS. 12, 13 and 14 is particularly suitable for forming bottoms with relatively thin walls, or from low-strength materials, since stresses due to internal pressure are born almost entirely in tension on the spherically contoured portions of the membrane, with only minor bending or shear stress in the leg and foot wall portions.

MOLDING

Containers having bottom ends according to this invention can readily be formed by any of several methods, vacuum forming, injection molding, injection-blow molding or blow molding, according to the general configuration of the container, the choice of material, and other considerations of performance and economy. However, in the case of beverage bottles as above described, extrusion blow molding is most economical and satisfactory for quantity production. In addition to the performance advantages above described, the container bottom end according to this invention has significant manufacturing advantages, particularly for blow molding.

FIG. 15 is a schematic representation of a bottle mold designed for extruded parison blow molding. The view is a section perpendicular to the parting plane, which is indicated by the broken line. Closing mold halves 31 and 32 about a length of tubular parison 33 pinches the parison closed at both ends, clearance along the pinch line being such that the parison is clamped along the pinch line with sufficient pressure to weld the material therealong. When the parison 33 is pinched and clamped as shown in FIG. 15, air is introduced into the parison through a blow needle 34, expanding parison 33 to conform to the cavity formed in halves 31–32, in the shape of the desired bottle. The bottom pinch or weld line 38 is formed between edges 35 and 36 on a line along mold bottom surface 37 in the plane of the mold part.

FIG. 16 shows the effects of pinchoff and blowing of the parison to form a container having a bottom configured as in the prior art, that is, a substantially flat, slightly recessed bottom panel with a peripheral bead. The view is a fragmentary plan of the bottom half 132 of a blow mold similar to that of FIG. 15, showing the fully blown parison in full lines and the parison before and during blowing in broken lines. The pinched-off portion 138 constitutes a straight weld line in the flat bottom panel. Teardrops **139** are formed by squeezing out excess material at the juncture of the weld line with the parison fold edges **140**, formation of such teardrops being characteristic of pinching a parison in the manner shown.

Upon blowing parison **133** the portion of the parison axially inwardly of the weld line **138** distends and folds outwardly to form the portion of the bottom outwardly of the weld line **138**, whose linear extent is indicated by the dimension A. The general course of this bottom forming material is indicated in broken lines in an intermediate stage. The extent of parison distension is indicated by the angle B. Because the total distension of material constituting the bottom end is somewhat greater than that of expansion to the container diameter alone, and because of resistance to outward folding due to restraint along the weld line **138**, the parison material forming the bottom is the last to become fully blown and is thus subject to greater chilling during formation than other parts of the container. The effect of this excessive chill, combined with the severe bending and stretching at the ends of the weld line **138**, is to develop flaws and locked-in stresses of substantial magnitude in the vicinity of the tear drops **139**, and to excessively thin the material beyond the ends of the weld line. The flawing and stressing are aggravated by relatively poor knitting of the material at the ends of the weld line due to working of chilled material, and attendant embrittlement. When blow molded plastic bottles having bottoms formed as shown in FIG. **16** are subjected to internal pressure, the bottom tending to dish outward imposes severe bending stresses which compound with the locked-in stresses and flawed conditions, concentrated in the thin wall at the ends of the weld line to cause rupture at the weld line substantially below the theoretical failure point of an otherwise equivalent flat bottom.

FIG. **17** shows the arrangement for pinching the parison in a blow mold similar to that of FIG. **15** and **16**, but arranged for forming a bottom end according to this invention. Corresponding parts are designated by the same numerals as in FIG. **15**, with the addition of **200**. The illustration is a plan view of the bottom half **232** of the blow mold with the fully blown bottom portion of the container in solid lines. The mold is parted in a plane corresponding to the section plane through hemispherical meridian portions of the bottom end, as on line **7–7** of FIG. **6**. Thus, the cavity bottom contour in the parting plane is a semicircle, with the parison pinch and weld line **238** on the semicircle. When the mold is closed on the parison **233**, the weld line **238** is thereupon constituted as a completed midelement of the semicircle with the fold lines **240** of the unblown parison extending generally radially of the weld line. With this relative disposition of the fold lines and the weld line there is virtually no tendency to incipient flawing or distress at the ends of the weld line **238** by the squeezing out of excess material in the form of the teardrops **239**, since the material is squeezed almost directly along the fold line substantially normal to the weld line. In the prior art formed described in connection with FIG. **16**, the acute angularity of the fold lines **140** to the weld **130** introduces shear and bending stresses at the ends of the weld line **138** upon pinchoff, and corresponding incipient flaws which are "locked-in" as the parison cools, the material being constrained against plastic flow to such extent that there is no substantial relieving reformation upon blowing the parison.

Referring again to FIG. **17**, the blowing of the parison **233** to the final configuration involves a relatively moderate distension through angle C in the plane of the weld line **238**, so that full formation of that portion of the bottom extending from the weld line **238** occurs rapidly, substantially within the time required for blowing the main body portion of the container. Thus, the material formed along the end of the weld line **38** does not cool excessively before assuming its final configuration. The relatively moderate distension of the material also involves a correspondingly moderate thinning of the material near the ends of the weld line **238**, minimizing sharp changes in section at the ends of the weld line.

Because of the novel pinchoff arrangement in association with the semicircular contour of the bottom of the plane of weld line **238**, subjection of the container to internal pressure produces substantially only normal tensile stresses along the weld line, substantially free of shear, bending or other discontinuity stresses usually associated with seams. Also, the described manner of pinching provides substantially flawless knitting of the material at the ends of the weld line **238**. The resultant container bottom reacts to internal pressure substantially as a seamless member. Tests on blow molded containers having bottoms pinched-off as above described indicate substantially no predisposition to weld failure or substantial reduction in elasticity of the material in or along the weld line.

The invention is not limited to the preferred embodiment and modifications above described. Those skilled in the art will be enabled by the foregoing description to devise other embodiments and modifications within the spirit and scope of the invention, which is defined only by the appended claims.

We claim:

1. A blow molded plastic container having a tubular body terminating at a generally hemispherical outwardly convex bottom wall with a lowermost polar portion, said bottom wall being interrupted by a plurality of downwardly projecting wall portions defining hollow legs with adjacent legs being spaced from each other by meridian wall portions of said bottom wall, at least two of said meridian wall portions being disposed in generally diametrically opposed relationship, and said two meridian walls having a common parison weld along an arc of a radius equal to that of said hemispherical bottom wall.

2. The blow molded plastic container as defined in claim **1** wherein said hollow legs terminate in feet having radially inwardly directed apex wall portions, and said apex wall portions and said at least two meridian wall portions merge at said polar portion.

3. The blow molded plastic container as defined in claim **2** wherein said tubular body has a sidewall merging at a peripheral juncture with said bottom, and said parison weld is completely inboard of and substantially spaced from said peripheral juncture.

4. The blow molded plastic container as defined in claim **1** wherein said tubular body has a sidewall merging at a peripheral juncture with said bottom, and said parison weld is completely inboard of and substantially spaced from said peripheral juncture.

5. In a plastic container having a cylindrical lowermost side wall portion, an integral bottom end defined by a wall comprising first portions generally conformed to meridian elements of a common hemisphere having a radius which is substantially equal to that of said sidewall portion and having a downward pole, said first portions extending upward from said pole, other wall portions defining hollow legs terminating below said first portions in feet spaced around said end in the lowermost plane of said container, said first wall portions include at least one pair of petaloid portions oppositely extending from a polar wall portion, said legs alternating with said petaloid portions in series around said end, and a pair of opposed sidewalls of each said leg diverging upward and radially outward relative to said polar portion.

6. The invention as defined in claim **5** including wall portions defining gussets extending from said polar portion to said feet.

7. The invention as defined in claim **5** wherein adjacent ones of said sidewalls of adjacent ones of said legs join each other and the upper end of one of said petaloid portions at points along said cylindrical sidewall portion.

8. The invention as defined in claim **5** including a weld at said polar portion recessed above a plane through terminal lowermost walls of said hollow legs.