(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 346 858 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89110760.9**

(51) Int. Cl.[4]: **B65D 1/02**

(22) Date of filing: **14.06.89**

(30) Priority: **17.06.88 US 209084**

(43) Date of publication of application:
20.12.89 Bulletin 89/51

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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(54) Blow molded one-piece bottle and method for making same.

(57) A one piece self supporting blow molded plastic container having a generally cylindrical side wall and a plurality of hollow legs extending downwardly from the side wall. The legs terminate in substantially planar feet having radially outer edges forming a non-continuous support surface engaging area having a diameter slightly less than the diameter of the tubular side wall. A generally horizontal center section is disposed in the center of the container radially inwardly of the legs and merging with the inner edges of the feet. V-shaped ribs extend radially outwardly and upwardly from said center section so as to circumferentially separate said legs.

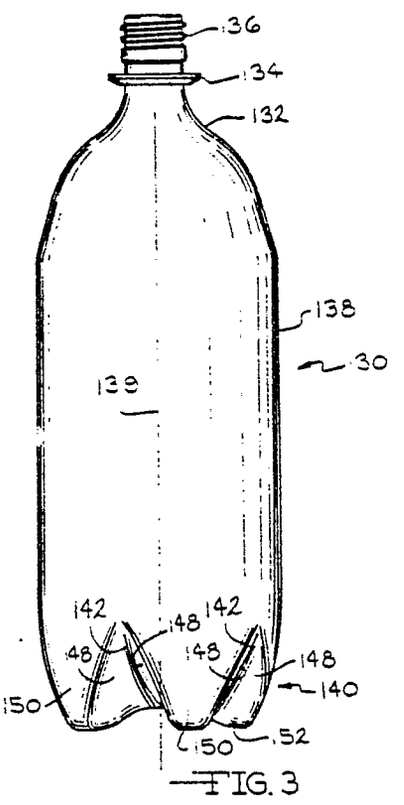


FIG. 3

EP 0 346 858 A2

BLOW MOLDED ONE-PIECE BOTTLE AND METHOD FOR MAKING SAME

BACKGROUND OF THE INVENTION

This invention relates generally to one piece plastic beverage bottles and more particularly to an improved bottle of this type which has flat horizontal surfaces of increased area that firmly support the bottle in an upright position when filled.

A major difficulty with the use of plastic bottles for carbonated beverages is the strength of the bottle base. Due to internal carbonation pressures which can exceed 75 psi, plastic bottles have a tendency to bulge outward at the base, resulting in what is referred to as a "rocker" which will rock back and forth when standing on a flat surface or possibly tip over. In addition, as the base bulges outward, the volume of the bottle increases, thereby lowering the fill line such that consumers may believe the bottle was not properly filled or sealed.

One solution to the problem of bulging is to provide a bottle having a hemispherical base portion and attach thereto a base cup having a flat lower surface for supporting the bottle in an upright position. This type of bottle is commonly referred to as a composite bottle. Composite bottles are widely used for carbonated beverage bottles of sixteen ounces or more. Increasing material cost for base cups has, however, encouraged the development of one piece bottles having a self-supporting base which is reinforced to prevent bulging due to carbonation pressures.

Several factors must be taken into consideration in the evaluation of a bottle base. Stability is one of the most important factors. A bottle must be stable when empty as well as full. An empty bottle must be stable enough to stand upright on bottle filling machinery. If bottles fall over while being conveyed, the efficiency of the filling operation will be adversely affected. To provide a stable bottle, the diameter of the bottle engaging area which contacts a supporting horizontal surface must be maximized. In addition, the area of the base that is in surface-to-surface contact with the supporting surface should be maximized.

Another evaluation factor is the strength of the base in resisting bursting upon impact when the bottle is filled. Stress cracking in the base will reduce the strength, resulting in a base which bursts easily. The amount of stress cracking is related to the base geometry. Relatively large radius curves in the base will reduce the stress cracking compared to a base with small radius curves.

Yet another evaluation factor to consider is the ability to properly vent the mold cavity when blow molding the bottle. Sufficient venting must be provided to ensure that the plastic material will be blown completely into each leg of the base to form feet at the lower ends of the legs which define the support surface engaging areas of the bottle.

Several one piece bottles have been developed. However, these bottles have one or more disadvantages associated with their base structures. The base structure of a plastic bottle will deflect downwardly when the bottle is filled with a carbonated liquid. When this occurs in several of the existing one piece bottles, the diameters and sizes of the support surface engaging areas are decreased, resulting in bottles of reduced stability when full.

Several prior bottles also have base geometries with small feet and relatively small radius curves. This results in support instability and stress cracks which reduce the strength of the base causing the base to burst upon impact.

With these short comings in the prior art in mind, it is an object of this invention to provide a bottle with flat support surface engaging areas of increased size and increased diameter relative to the bottle diameter to thereby improve stability of the filled bottle.

It is a further object of this invention to provide a bottle wherein deflection of the base due to filling does not decrease the support surface engaging area.

Accordingly it is a further object if the invention to provide a container with larger radius bends and curves to reduce the possibilities for stress cracking.

SUMMARY OF THE INVENTION

The present invention provides a base structure for a carbonated beverage container with a tubular side wall. The base structure includes a bottom wall extending downwardly and inwardly from the lower end of the tubular side wall. A plurality of legs extend downwardly from the bottom wall and terminate in planar feet having radially inner and outer edges. The outer edges of the feet form a non-continuous support surface engaging area having a diameter only slightly less than the diameter of the tubular side wall.

As a further improvement, the feet can be inclined radially inward and upward so that when the container is filled with a carbonated liquid, the pressure within the container forces the feet to rotate generally about their outer edges to substantially horizontal positions. In the horizontal positions, the feet provide large surface-to-surface con-

tact areas with the horizontal surface on which the container is supported. When the container is filled, the diameter of the support surface engaging areas of the container is not reduced as it is in many prior art containers when the containers are filled. When the container is filled, the outer edges of the feet remain in contact with the horizontal surface, providing support surface engaging areas having a diameter equal to that of an empty container.

The wall portions which extend downwardly from the base bottom wall taper slightly inwardly from the container tubular side wall. This taper is necessary to enable manufacture of the container. By minimizing this taper as much as possible, the radial distance from the container axis to the outer edges of the feet is maximized resulting in a relatively large diameter for the support surface engaging areas. This improves the stability of the container. In addition, a base with a larger diameter at its lower end enables the planar surface area of the feet to be increased over that shown in the prior art.

Furthermore, by increasing the diameter of the support surface engaging area, the radius of curves within the base can be increased to reduce stress cracking in the base.

Further objects, features and advantages of the invention will become apparent from a consideration of the following description and the appended claims when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of the base of a prior art container;

Figure 2 is a sectional view of the base of another prior art container;

Figure 3 is a side elevational view of a container of the present invention;

Figure 4 is a bottom view of the container of Figure 3;

Figure 5 is a sectional view as seen from substantially the line 5-5 of Figure 4;

Figure 5A is an enlarged view of a portion of Figure 5;

Figure 6 is a side elevational view of a modified form of the container of this invention;

Figure 7 is a side elevational view of the container of Figure 6 showing a different view of the base structure of the container from that shown in Figure 6;

Figure 8 is a top plan view of the container of Figures 6 and 7;

Figure 9 is a bottom view of the container of Figures 6 and 7; and

Figure 10 is a sectional view as seen from substantially the line 10-10 in Figure 9.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Prior art plastic container bases are shown in Figures 1 and 2. Base 102 of Figure 1 has a plurality of horizontal feet 104. The outer edges of the feet 104, indicated at 105, define the outer edges of the container support surface engaging areas having a diameter D. A center portion 106 closes the base between the inner edges 107 of the feet 104. The center portion 106 projects inwardly into the container forming a wall with a concave outer surface.

When the container having the base 102 is filled with a carbonated liquid, the pressure in the container forces the base to deflect downward such that the center portion 106 moves to the position shown in phantom line at 108. This in turn causes a rotation of the feet 104 generally about their outer edges 105 into the phantom line position at 110. In this position, the container is now supported on support surface engaging areas having a diameter d corresponding to the inner edge of the feet 110. The diameter d is significantly smaller that the diameter D, thus the stability of the container has been reduced upon filling of the container.

A base from another prior art container is shown in Figure 2. The base 112 has horizontal feet 114 and ribs 116 extending from the inner edges 118 of feet 114 transversely to the opposite side wall of the bottle and joining the side wall at 120. The support surface engaging areas of the base 112 have a diameter extending to the outer edges 122 of the feet 114 when the container is empty. However, when the container is filled with a carbonated beverage, the pressure in the container deflects the base 112 downward such that the previously straight ribs 116 are now bowed downward as shown by phantom line 124. This results in a rotation of the feet 114 generally about their outer edges 122 into the position shown in the phantom line at 126. In this position, the diameter of the support surface engaging areas of the base now extends only to the inner edges 128 of the feet 126 in the deflected position, thus reducing the stability of the filled container from that of the empty container.

The plastic container of this invention includes a base in which, when the container is filled, the diameter of the support surface engaging areas is not reduced. A plastic beverage container, indicated generally at 130, having a base structure of this invention is shown in Figure 3. The container is blow molded from a biaxially oriented saturated

polyester, preferably polyethylene terephtalate (PET) and includes an integral tapered top portion 132 which includes a flange 134 and threaded neck 136. Extending downward from the tapered top portion 132 is a hollow body having a tubular side wall 138. The side wall 138 is generally cylindrical having an upright longitudinal axis 139 through the center thereof. A base 140 extends downwardly from the lower end of the side wall 138 and closes the bottom of the container 130.

The base 140 has a downwardly extending bottom wall 142, best viewed in cross section in Figure 5. Bottom wall 142 is curved radially inwardly from the lower end of the tubular side wall 138. As shown in Figure 5, the bottom wall 142 is of a constant radius curve having a radius greater than the radius of the tubular side wall 138. A relatively small radius fillet section 144, is used to merge the upper end of the bottom wall 142 to the lower end of the side wall 138. The bottom wall 142 terminates at the lower end in a center section 146 that is substantially centrally of the base 140 and intersects the axis 139. The center section is generally horizontal at the center of said base although it may be slightly concave or convex.

The bottom wall is interrupted by a plurality of downwardly projecting wall portions defining hollow legs radially spaced from the center section 146 and extending below the bottom wall 142. These wall portions include leg side wall portions 148 and leg outer wall portions 150 as illustrated in Figure 3. Leg outer wall portions 150 form radially outer surfaces of the hollow legs. As shown, in Figures 3 and 5, the leg outer wall portions 150 are of a constant radius curve curving radially inwardly in a downward direction. Leg side wall portions 148 extend downwardly from the bottom wall and radially inwardly from the leg outer wall portions. The legs terminate in feet 152. Figure 5A is an enlarged view of the foot portion of Figure 10. Each foot 152 is planar and generally trapezoidal in shape (Figure 4) having an outer edge 154 which is generally parallel with inner edge 156. The side edges 155 of feet 152 taper toward one another, radially inwardly. The bottom wall circumferentially between the hollow legs forms inverted V-shaped ribs to separate the hollow legs.

Each foot 152 defines a planar surface which is inclined radially inwardly and upwardly such that the outer edge 154 of each foot is lower than the inner edge 156 of each foot. The outer edges 154 of the feet are adjacent the lower edges of the outer leg wall portions 150 and are merged thereto by a relatively small radius fillet section 158. The outer edges 154 of the feet 152 form support surface engaging areas for the container 130 having a diameter only slightly less than the diameter of the side wall 138. By locating the outer edges of the feet radially outward as much as possible, the stability of the bottle is improved.

When the container 130 is filled with a carbonated beverage, the pressure within the container forces the center section 146 to deflect downward to the position indicated in Figure 5 in broken lines 160. As a result of this downward motion of the center section 146, the feet 152 also move downward, rotating generally about the outer edges 154 to a horizontal position shown at 162. In this rotated position, the feet are now in surface-to-surface contact with the horizontal surface 163 upon which the container is supported. The outer edge of the engaging surfaces remains at 154 such that diameter of the support surface engaging areas is not reduced as a result of the deflection of the of the center section 146. Thus the stability of the bottle is not reduced when the bottle is filled.

The angle 157 which the feet 152 are inclined from the horizontal support surface 163 depends upon the size of the container and the material wall thickness of the base. These two factors will determine the amount of deflection of the base caused by internal pressure. It has been found that an angle of approximately 9° is sufficient for most two liter and sixteen ounce containers.

In addition to maintaining the stability of the base when the base is deflected, the surface area contact of the feet 162 with the surface 163 reduces wobbling of the container. An upright container, when bumped, will tend to wobble back and forth if it is not bumped hard enough to tip over. This wobble will eventually dampen out and the container will come to rest. When the feet 162 are in surface-to-surface contact with a support surface, the dampening of wobble is greater than when the bottle is empty and supported along the outer edges 154 of inclined feet 152.

Another embodiment of this invention is illustrated with the blow molded plastic container designated generally at 10 in Figures 6-10. The container 10 includes an integral tapered top portion 13 having a flange 12 and a threaded neck 18. The container 10 also has a hollow tubular side wall 14 and an integral base 16.

The base 16, as shown in Figure 10, includes a bottom wall extending downwardly from the side wall 14 having an upper portion 20 and a lower portion 30 which is arcuate radially inwardly in a downward direction. The bottom wall terminates in a center section 28 substantially centrally of the base 16.

The bottom wall is interrupted by a plurality of downwardly projecting wall portions defining hollow legs 26 extending below the bottom wall. These wall portions include leg side wall portions 32 and leg outer wall portions 33. Leg outer wall portions 33 form radially outer surfaces of the hollow legs

26. As shown in Figure 10, leg outer wall portions 33 uniformly taper radially inwardly in a downward direction. The legs terminate in planar feet 25 (Figure 10) which merge with the center section 28. Feet 25 are inclined radially inwardly and upwardly as shown in the broken lines indicating the position of the feet when the container is empty. The solid lines, showing the feet at 27, illustrate the position of the feet when the container is filled with a carbonated beverage. When the container is filled, the feet 25 rotate generally about their outer edges 24 to the position shown at 27 in which the feet are in surface-to-surface contact with a horizontal surface 29.

In both embodiments of the invention, having the feet spaced radially outwardly as much as possible enables the feet to have relatively large planar surfaces to form support surface engaging areas. The leg outer wall portions taper or curve inwardly in a downward direction to facilitate removal of the container from a mold. This taper or curve is minimized as much as possible so that the diameter of the non-continuous support surface engaging area, formed by the outer edges of the feet, is only slightly less than the diameter of the tubular side wall of the container. In addition, this spacing allows the radii of the curved portions in the base to be relatively large when compared with many prior art containers, thus reducing or eliminating the possibilities for stress cracking in the base. It has been found for both two liter and sixteen ounce containers that five feet is optimal to provide larger feet and larger radii curved portions in the base.

The containers 10 and 130 are blow molded from an injection molded plastic preform in a conventional manner. The preform is heated to the temperature at which it can be blow molded and then placed into a mold cavity having an interior surface of the desired configuration of the container. Pressurized air is introduced into the preform to expand the preform outwardly into contact with the mold cavity interior surface. The air within the cavity is exhausted through vent openings in the lower end of the mold cavity to enable the plastic to be completely blown into the feet portions of the mold cavity base portion. These vent openings are in the form of narrow slots in the mold cavity which forms small but noticeable lines in the bottle surface indicated by lines 172 in Figure 4, lines 34 in Figure 9 and lines 36 in Figures 6 and 7.

The hollow legs are formed by blowing the plastic material of the bottom wall downward from the bottom wall. The legs terminate in substantially flat support surface engaging areas which are ballooned out of the bottom wall. The inclined engaging areas rotate by internal pressure in the container to form coplanar areas for engagement with a horizontal surface for supporting the container thereon.

The invention provides a one piece blow molded plastic container which has a self supporting base. The base has a bottom wall extending from the lower end of the side wall of the container. A plurality of legs extend downward from the bottom wall forming hollow legs with planar feet that are inclined upwardly and inwardly from the outer edges of the legs. When filled with a carbonated beverage, the internal pressure in the container forces the bottom of the base downward, rotating the feet into a horizontal position defining co-planar support surface engaging areas for supporting the container. This deflection does not result in a decrease in the diameter of the container support surface engaging areas, thereby not decreasing the stability of the container when filled. In addition, the container base is formed with relatively large radius curved portions to reduce the amount of stress cracking in the base, thereby increasing the strength of the base and reducing the possibility of bursting.

It is to be understood that the invention is not limited to the exact construction or method illustrated and described above, but that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A base structure for a carbonated beverage container having a tubular side wall of a first diameter, said base structure comprising:
a bottom wall extending downwardly and radially inward from said side wall; and
a plurality of legs extending downwardly from said bottom wall and terminating in large planar feet having inner and outer radial edges, said feet forming a non-continuous support surface engaging area having an outer diameter only slightly less than said first diameter.

2. The base structure of claim 1 wherein said feet are inclined in a direction radially inwardly and upwardly such that during support of said container on a horizontal surface said outer edges of said feet are in contact with said horizontal surface and said inner edges are above said surface thereby enabling said feet to rotate downwardly about said outer edges to substantially horizontal positions in which said feet are in surface-to-surface engagement with said horizontal support surface in response to internal pressure of a carbonated beverage within said container.

3. The base structure of claims or 2 wherein said hollow legs include outer leg wall portions extending downwardly from said tubular side wall and merging with the outer edges of said feet, said outer leg wall portions uniformly tapering radially inwardly as said outer leg wall portions extend downwardly.

4. The base structure of claims 1 or 2 wherein said hollow legs include outer leg wall portions extending downwardly from said tubular side wall and merging with the outer edges of said feet, said outer leg wall portions including substantially constant radius arcuate wall portions curved radially inwardly in a direction downwardly from said side wall.

5. The base structure of claims 1 or 2 wherein said bottom wall includes a substantially horizontal center section at the center of said base structure, said center section extending radially outwardly and downwardly from the center of said base structure and merging with the inner edges of said feet.

6. The base structure of claims 1 or 2 wherein said bottom wall is arcuate.

7. The base structure of claim 6 wherein said bottom wall has a substantially constant radius arcuate portion.

8. The base structure of claims 1 or 2 wherein said legs are formed by outer leg wall portions extending downwardly from said tubular side wall and merging with the outer edges of said feet, and a pair of side leg wall portions extending downwardly from said bottom wall and inwardly from said outer leg wall portions, side leg wall portions of adjacent legs and said bottom wall forming inverted V-shaped ribs separating said legs.

9. The base structure of claims 1 or 2 wherein said feet are generally trapezoidal in shape.

10. The base structure of claims 1 or 2 having five legs.

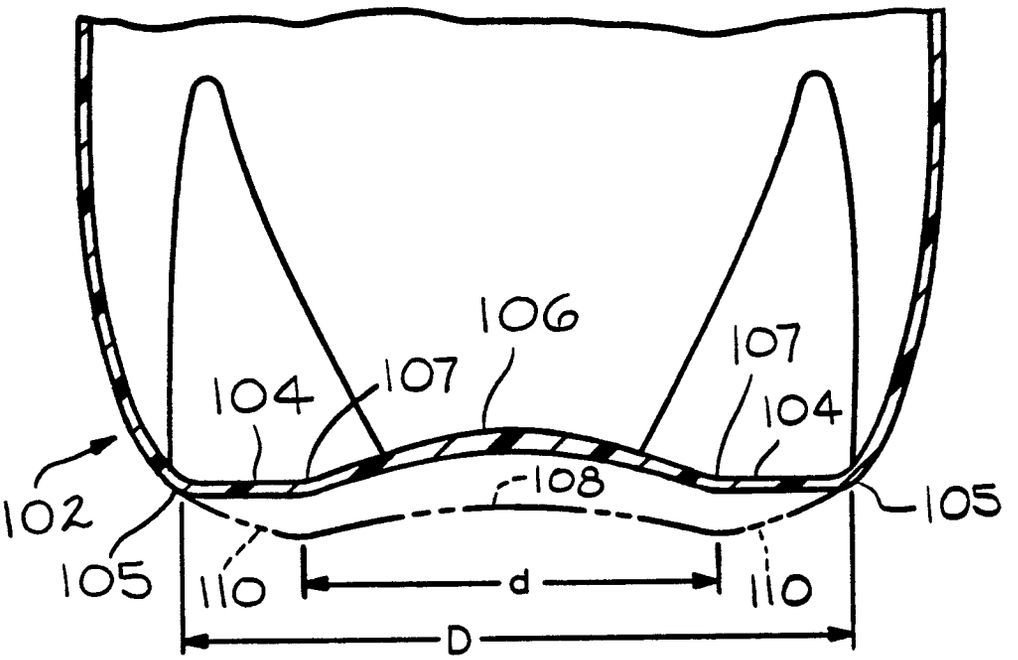


FIG. 1 PRIOR ART

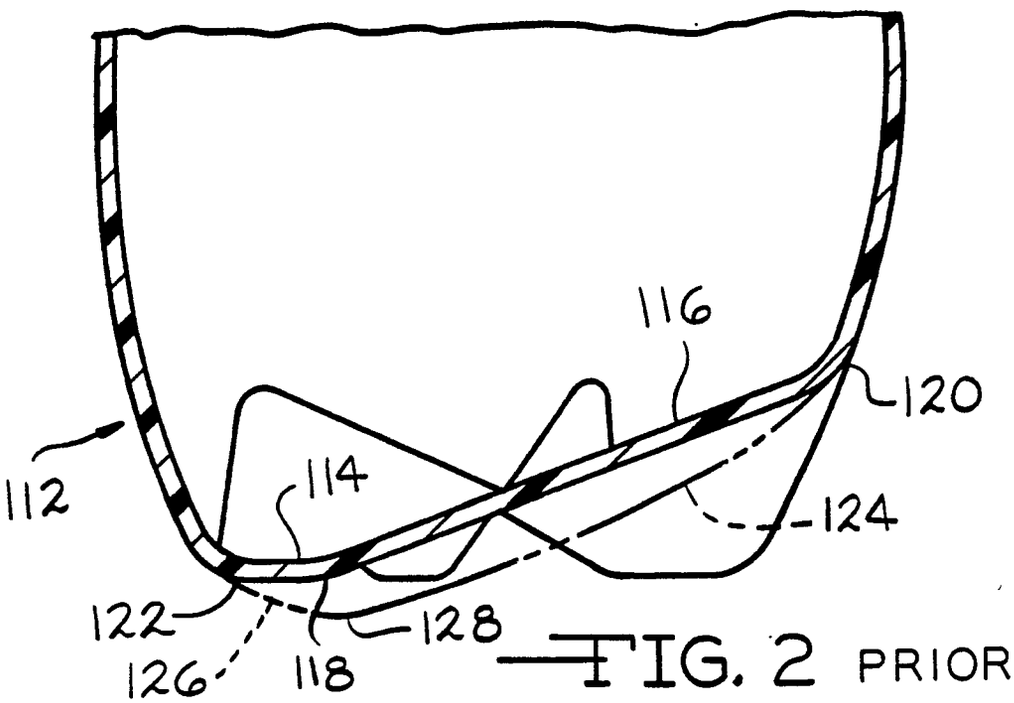


FIG. 2 PRIOR ART

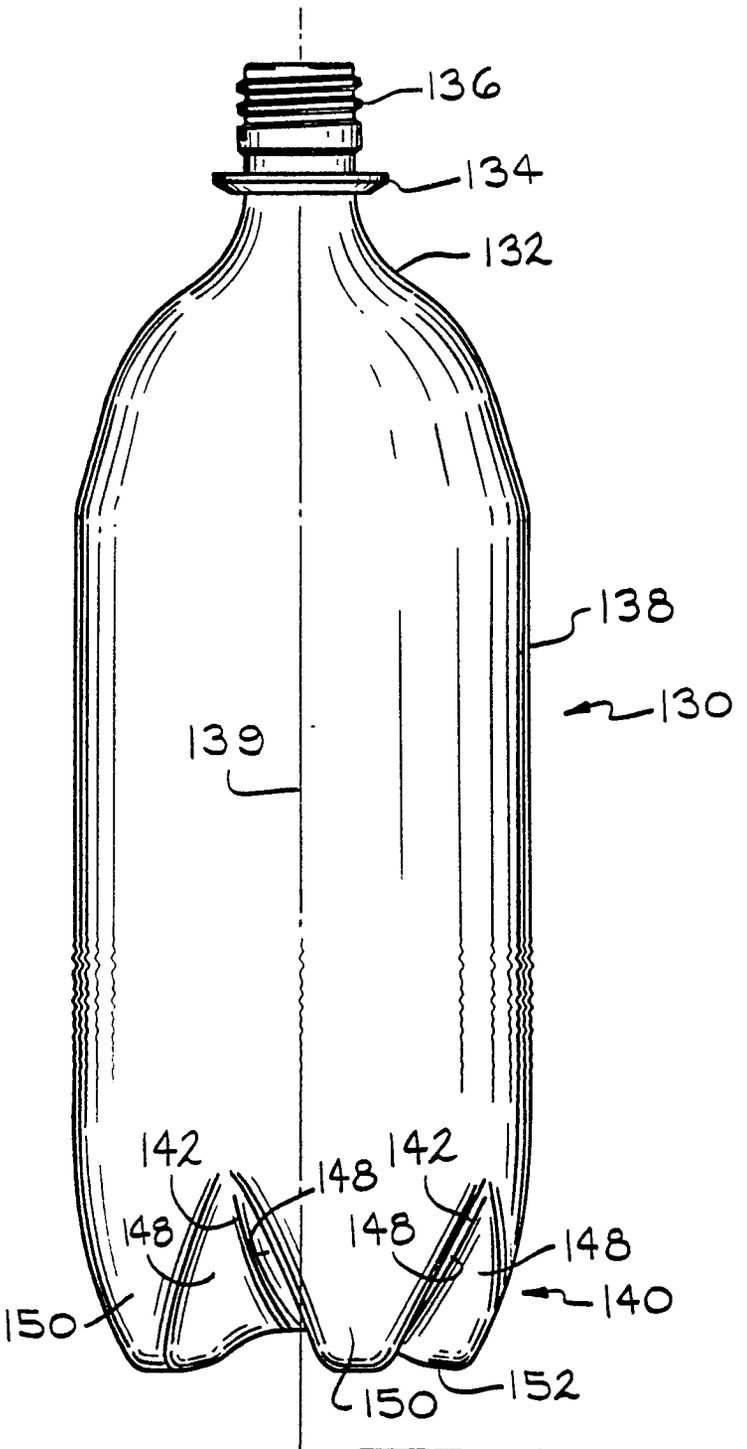


FIG. 3

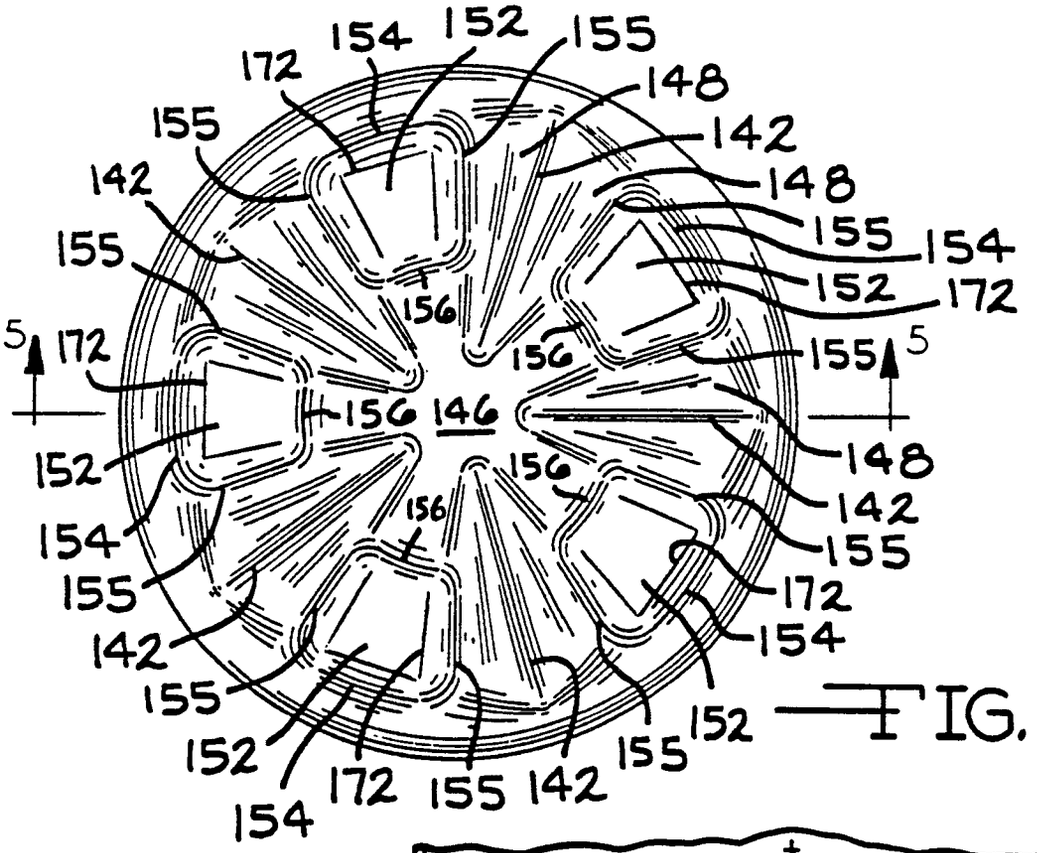


FIG. 4

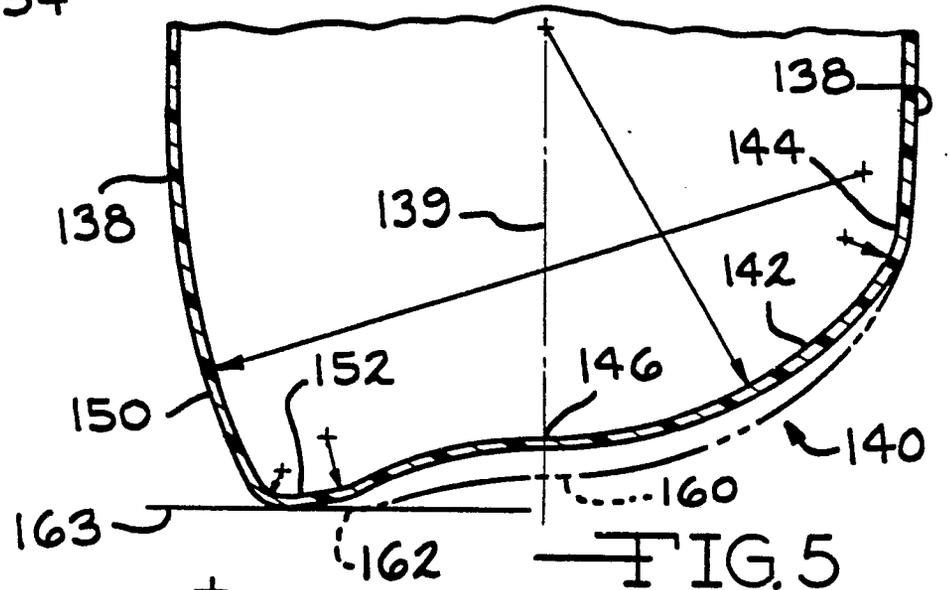


FIG. 5

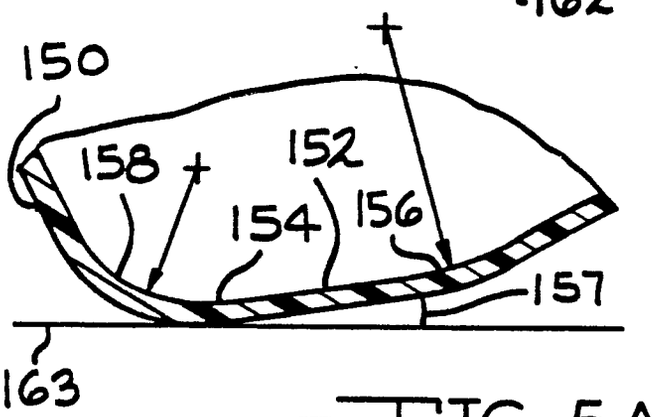


FIG. 5A

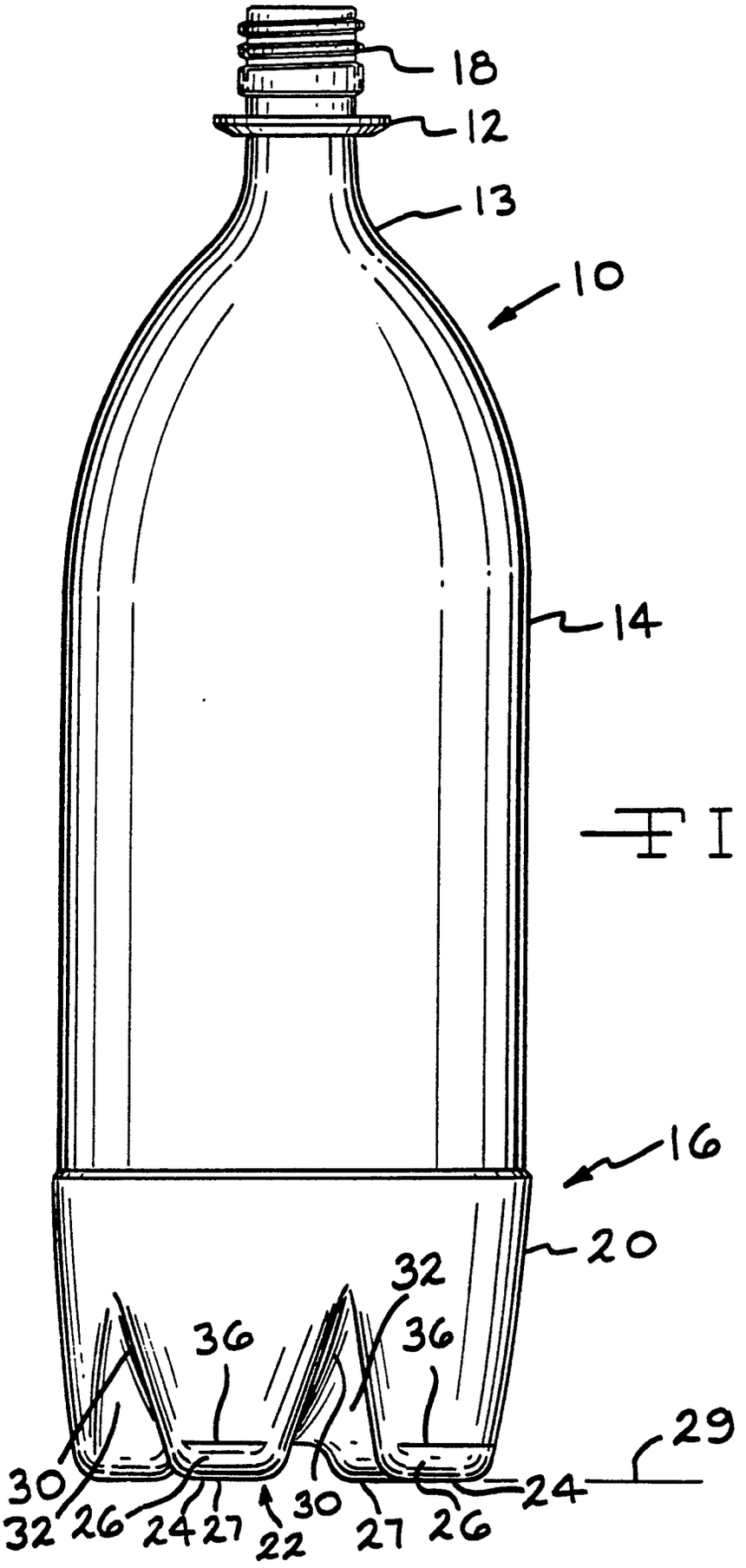


FIG. 6

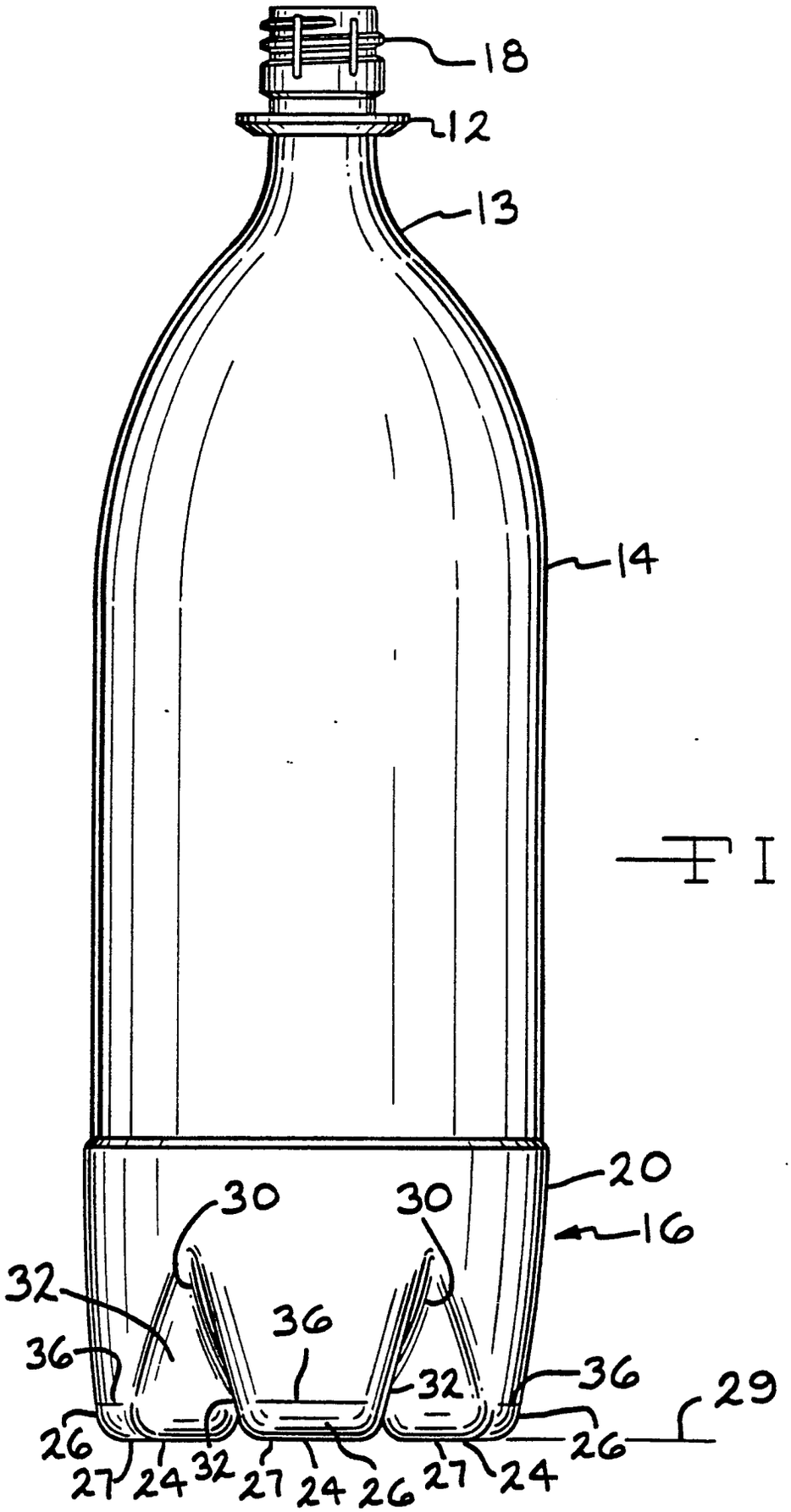
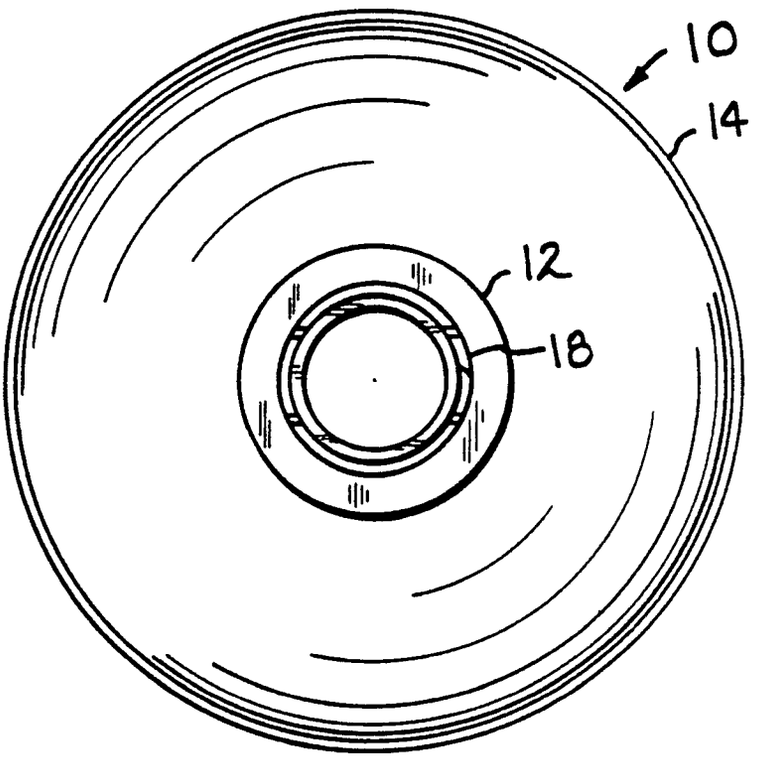


FIG. 7

FIG. 8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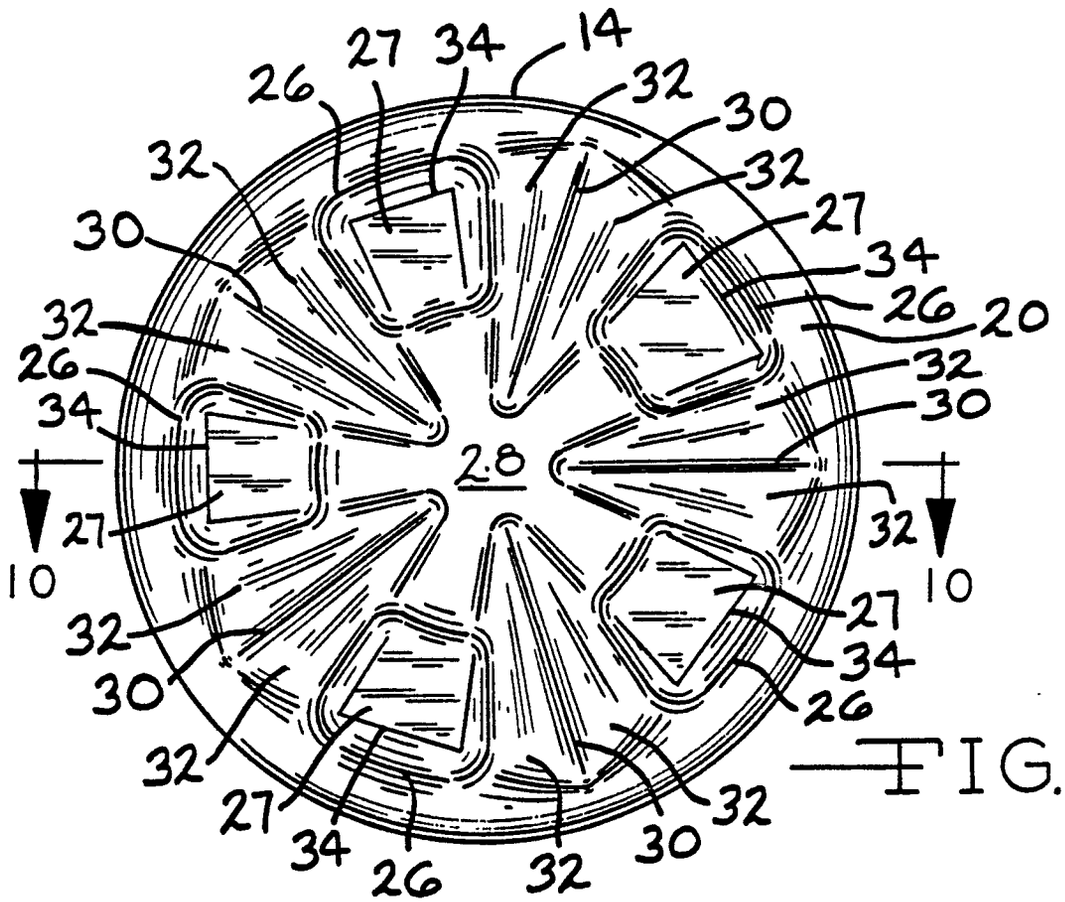
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FIG. 9

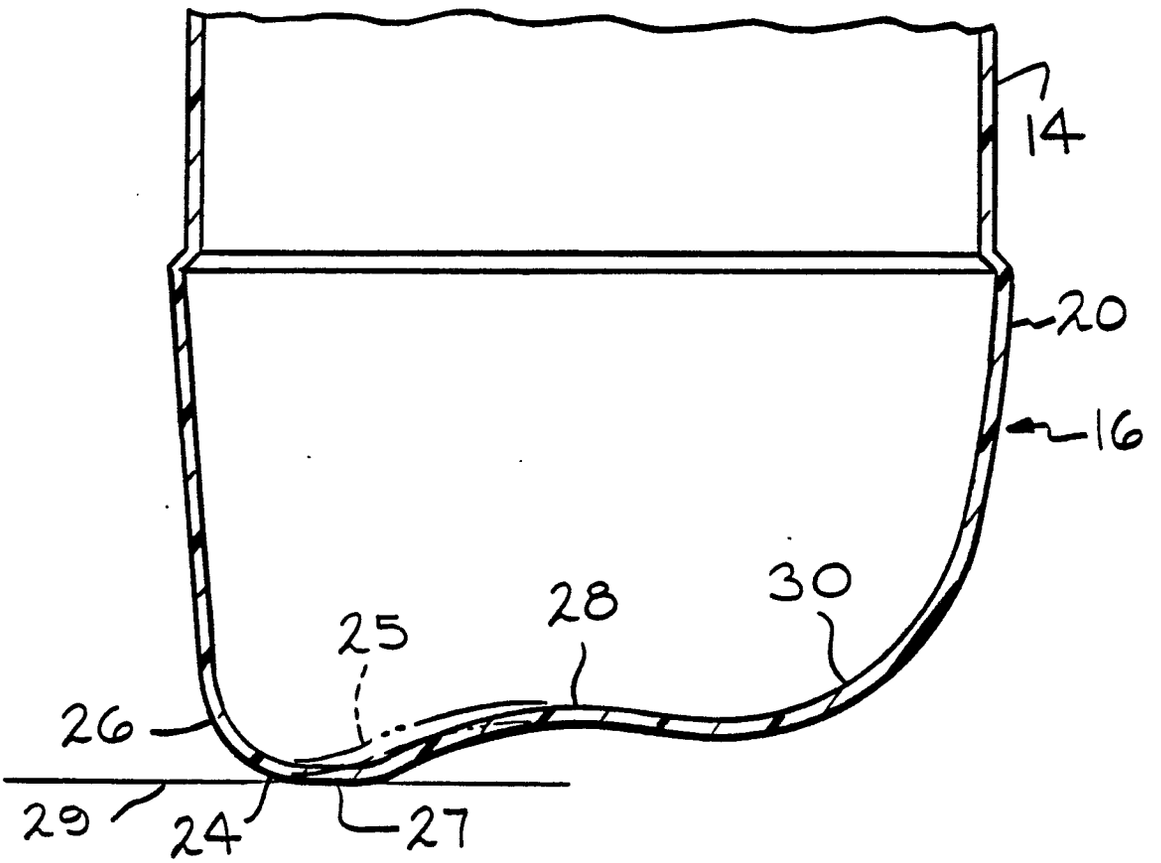

FIG. 10