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(54) HOT FILL CONTAINER WITH VERTICAL TWIST

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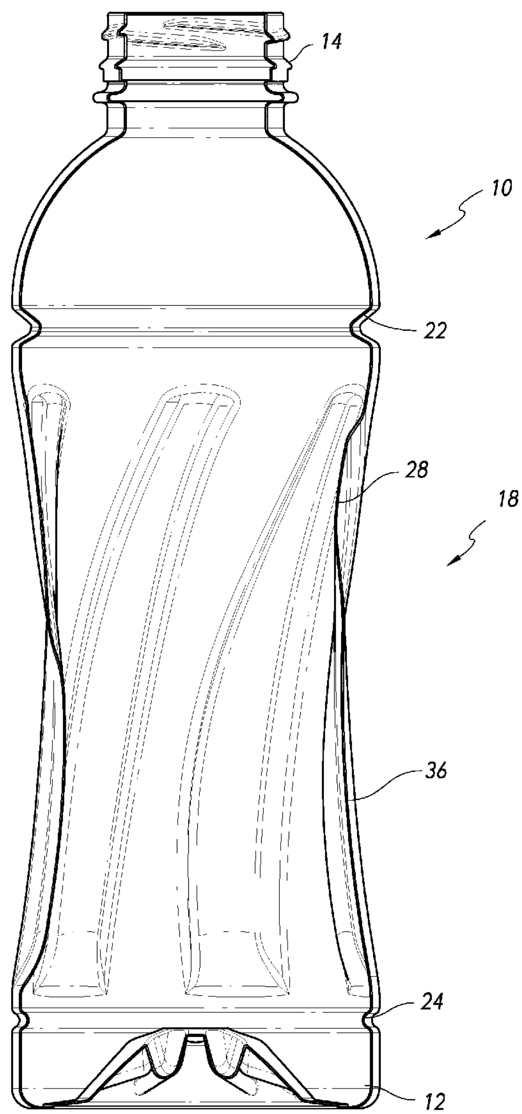
(57) ABSTRACT

A hot fill type plastic container includes a bottom, a finish portion and a main body portion. The main body portion has a maximum outer diameter and a sidewall having an outer surface. A sidewall has a plurality of helical vacuum panels defined therein. Each of the helical vacuum panels has a depth that is substantially within a range of about 1.7% to about 4.5% of the maximum outer diameter of the main body portion. In addition, each of the helical vacuum panels has an upper portion having a first maximum width and a lower portion having a second maximum width, with the second maximum width being greater than the first maximum width. The upper portion of each of the vacuum panels further has a first helical pitch that is greater than a second helical pitch of the lower portion.



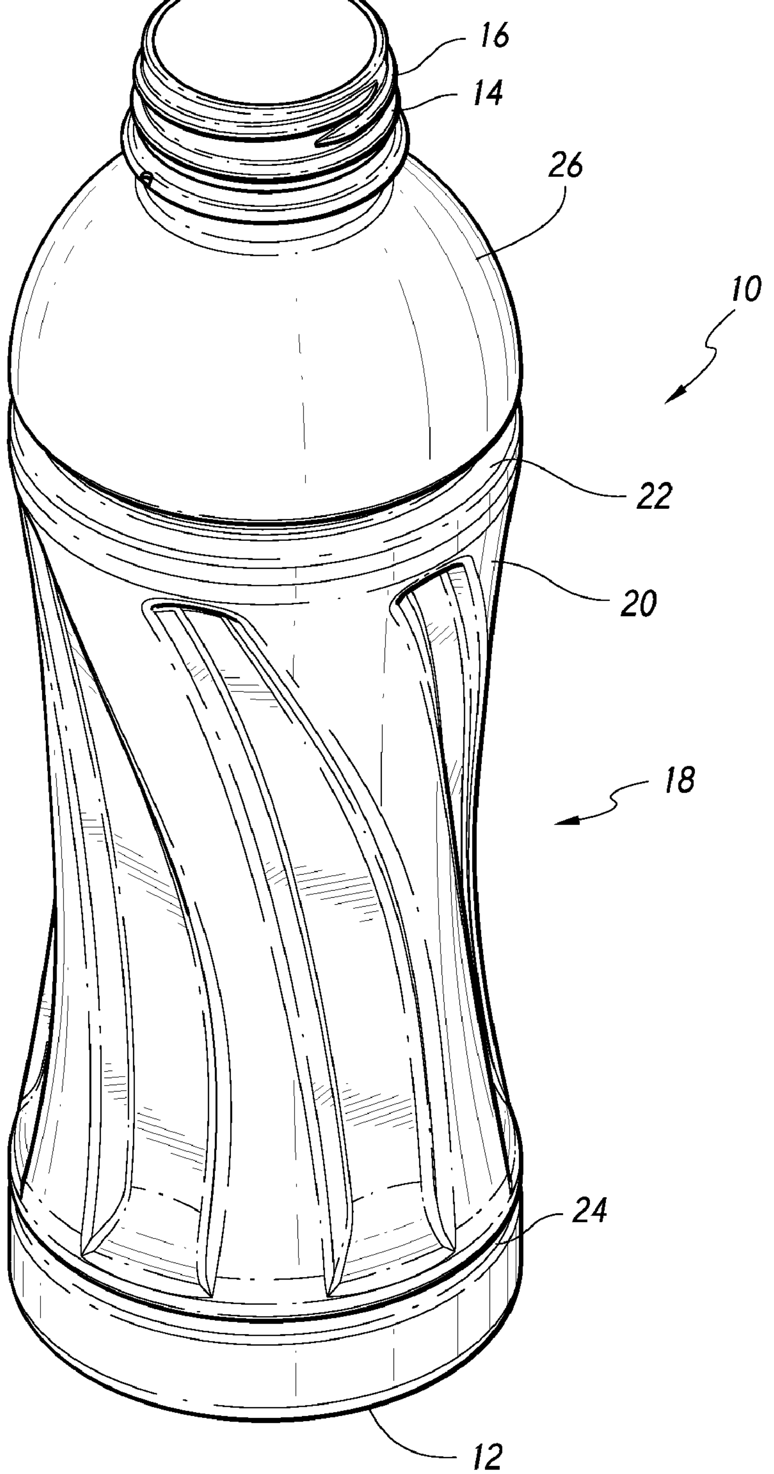


FIG. 1

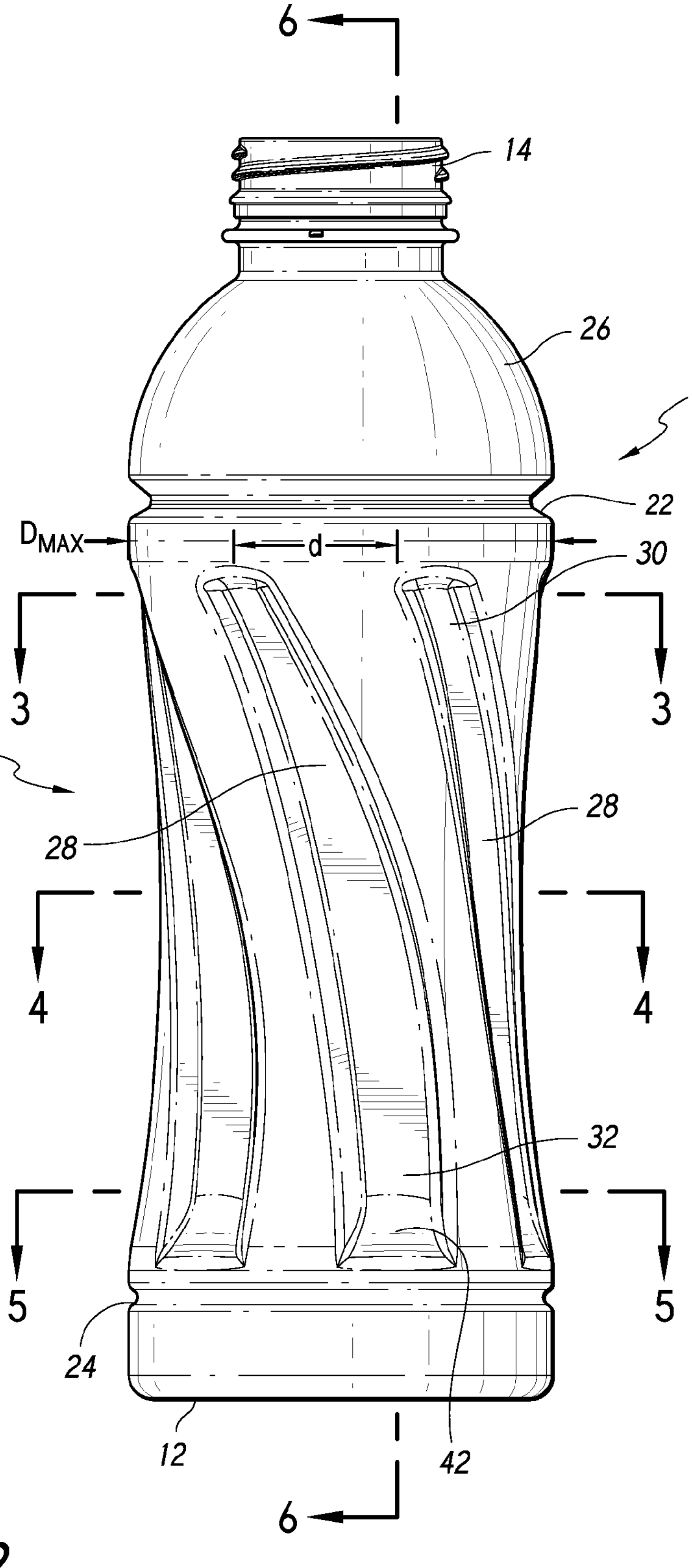


FIG. 2

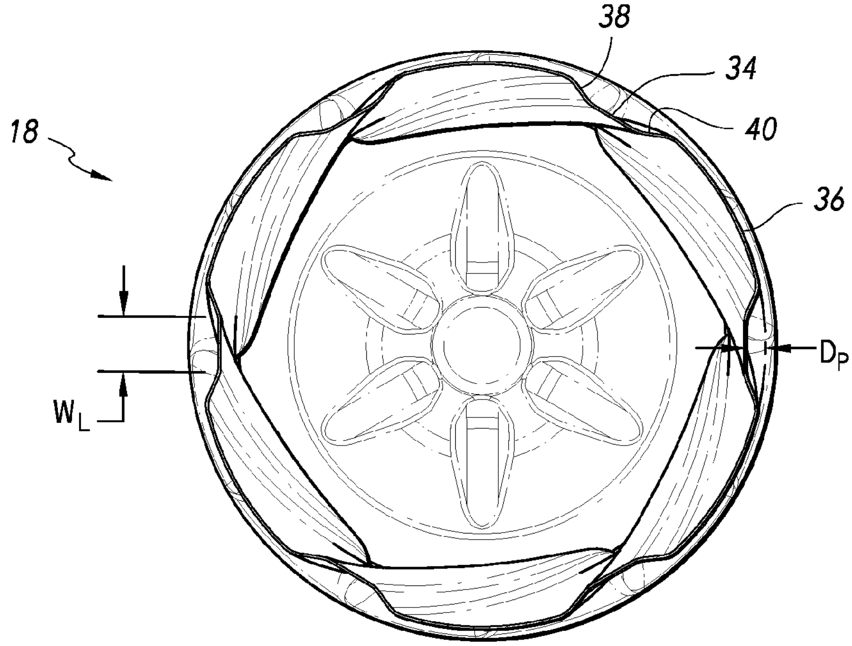


FIG. 3

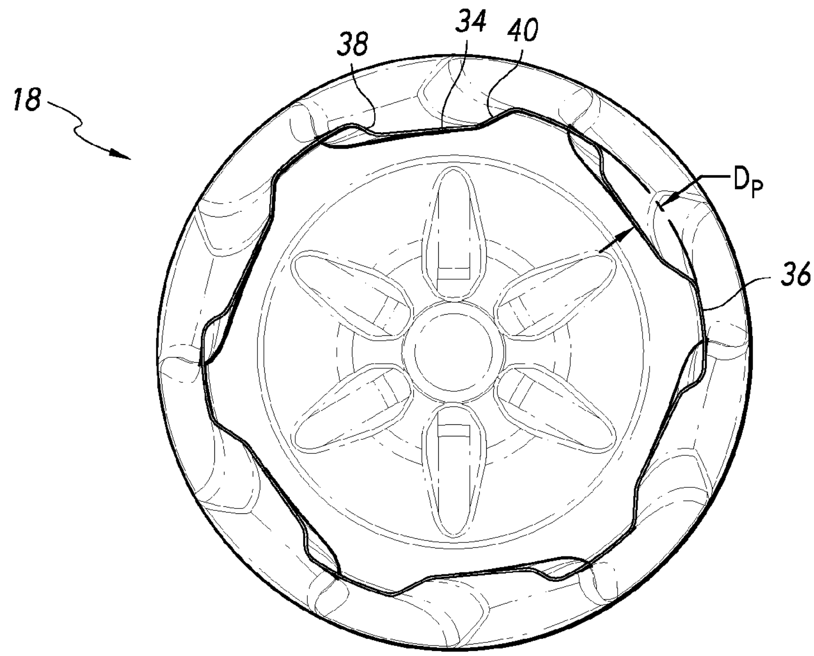


FIG. 4

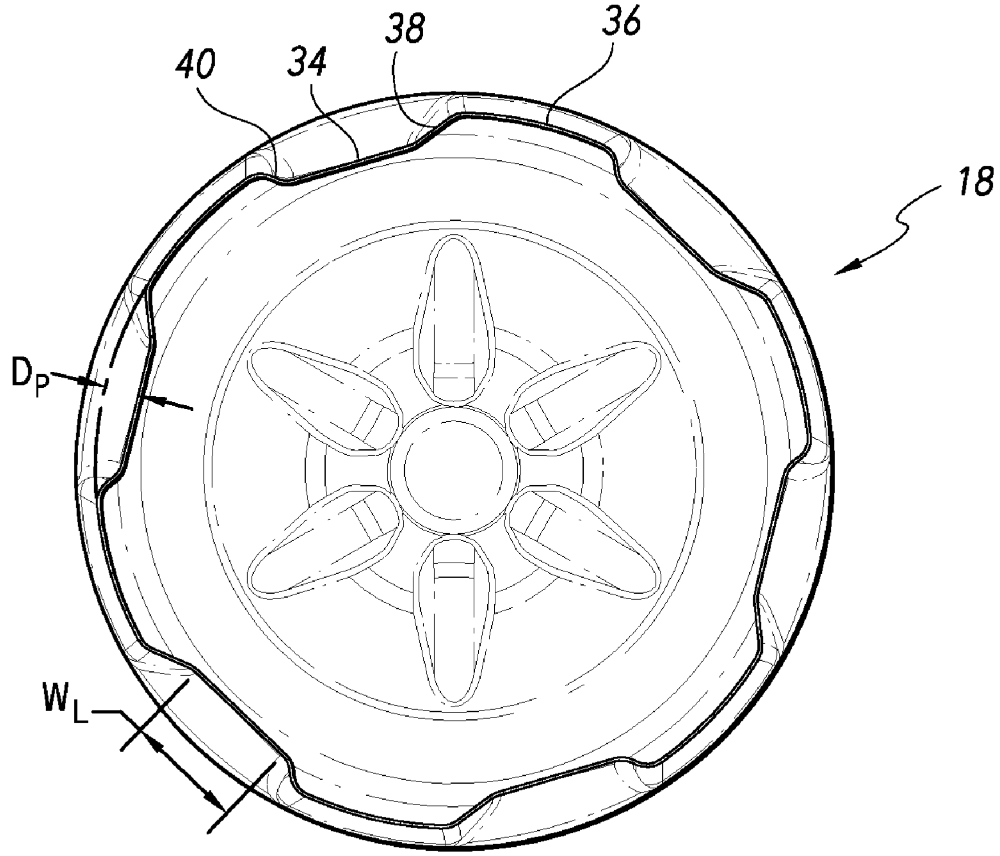


FIG. 5

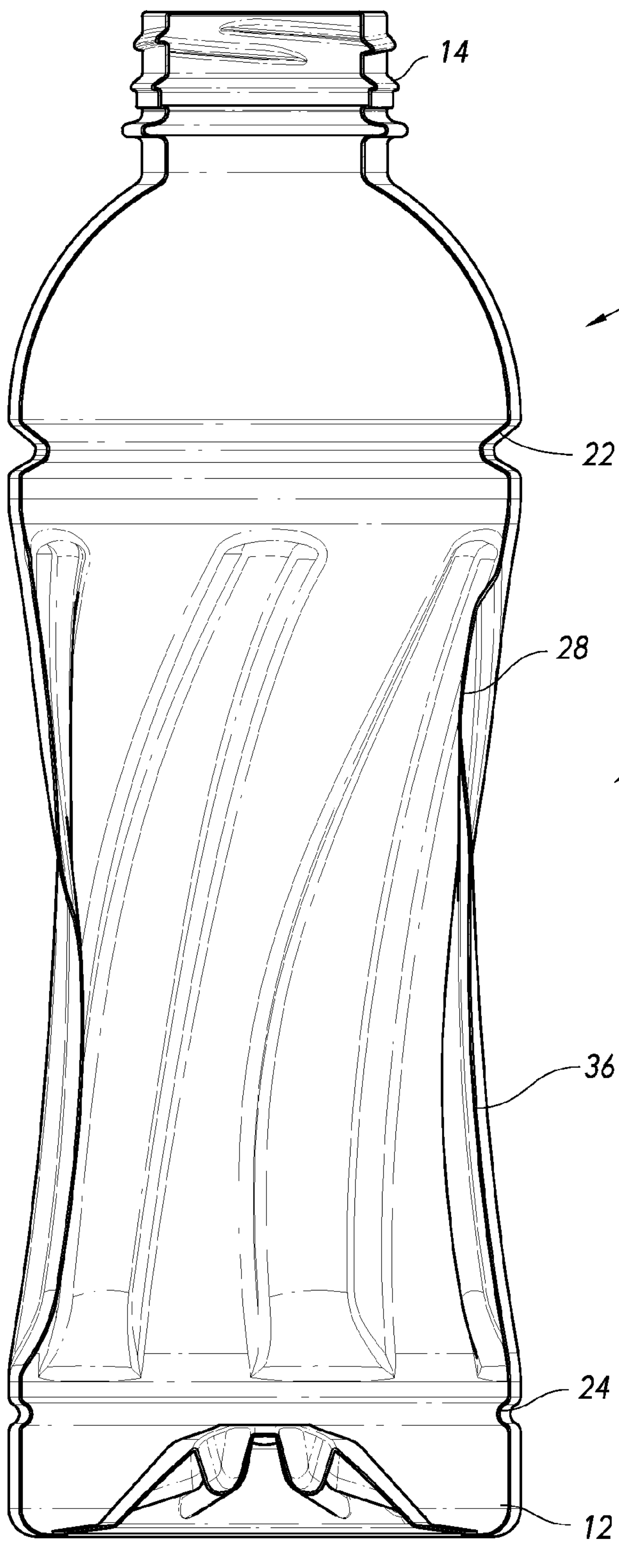


FIG. 6

HOT FILL CONTAINER WITH VERTICAL TWIST

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to the field of plastic containers, and more particularly to plastic containers that are designed to accommodate volumetric expansion and contraction such as that inherent to the hot-fill packaging process or to packaging applications where internal pressurization is anticipated.

[0003] 2. Description of the Related Technology

[0004] Many products that were previously packaged using glass containers are now being supplied in plastic containers, such as containers that are fabricated from polyesters such as polyethylene terephthalate (PET).

[0005] PET containers are typically manufactured using the stretch blow molding process. This involves the use of a preform that is injection molded into a shape that facilitates distribution of the plastic material within the preform into the desired final shape of the container. The preform is first heated and then is longitudinally stretched and subsequently inflated within a mold cavity so that it assumes the desired final shape of the container. As the preform is inflated, it takes on the shape of the mold cavity. The polymer solidifies upon contacting the cooler surface of the mold, and the finished hollow container is subsequently ejected from the mold.

[0006] Hot fill containers are designed to be used with the conventional hot fill process in which a liquid or semi-solid product such as fruit juice, sauce, salsa, jelly or fruit salad is introduced into the container while warm or hot, as appropriate, for sanitary packaging of the product. After filling, such containers undergo significant volumetric shrinkage as a result of the cooling of the product within the sealed container. Hot fill type containers accordingly must be designed to have the capability of accommodating such shrinkage. Typically this has been done by incorporating one or more vacuum panels into the side wall of the container that are designed to flex inwardly as the volume of the product within the container decreases as a result of cooling. Several vacuum panels are typically provided, with integral column structures interposed between the respective vacuum panels. The vacuum panel regions of conventional hot fill containers are usually recessed with respect to the adjacent columns. Hot fill containers are typically fabricated using PET, but alternatively can be fabricated using a material such as polypropylene using an extrusion blow molding process.

[0007] In many cases, the needs of a manufacturer require that a label be secured to the container over the vacuum panels. In order to avoid excessive crinkling or deformation of the label when the container is squeezed or when volumetric expansion or contraction occurs within the container, it is important that the vacuum panels and the container as a whole be designed to provide as much support for the label as possible. In some cases, one or more raised areas are provided within the vacuum panel for improved label support. These are typically referred to as pillows or islands. However, the use of large vacuum panels having pillows or islands can still create an undesirable asymmetrical appearance that may be visible to the consumer underneath the label. In addition, the vacuum uptake response of such containers can also be asymmetrical. In general, it is desirable for the vacuum uptake response for a particular container to be as predictable as possible, and to result in minimal stresses and deflection within the side wall of the container.

[0008] Grippability is an important design consideration in the engineering of such containers. In larger, multi-serve containers grippability has often been enhanced by providing a pair of deep vacuum panels that can also serve as gripping points for a consumer when picking the container up and handling the container during pouring. However, when a product manufacturer desires a container to which a shrink fit label will be applied, the use of such deep vacuum panels is impractical because the label will bridge the recesses that are defined by the vacuum panels and render them inaccessible for gripping the container. In addition, certain product manufacturers prefer round containers, i.e. containers that are substantially circular in transverse cross-section at their widest dimensions, and it is difficult to implement certain types of gripping recesses in a circular container. Accordingly, designing a container that is simultaneously suitable for use with a shrink fit label and that possesses adequate grippability for a consumer has been problematic, particularly in a round container.

[0009] A need exists for an improved hot fillable container that provides superior grippability, that has an appearance that is as symmetrical as possible and that is compatible with different container shapes, that permits optimal control of vacuum uptake performance and that is suitable for use with shrink fit labeling.

SUMMARY OF THE INVENTION

[0010] Accordingly, it is an object of the invention to provide an improved hot fillable container that provides superior grippability, that has an appearance that is as symmetrical as possible and that is compatible with different container shapes, that permits optimal control of vacuum uptake performance and that is suitable for use with shrink fit labeling.

[0011] In order to achieve the above and other objects of the invention, a hot fill type plastic container according to a first aspect of the invention includes a bottom, a finish portion and a main body portion. The main body portion has a maximum outer diameter and a side wall having an outer surface. The side wall has a plurality of helical vacuum panels defined therein, and each of the vacuum panels have a depth that is substantially within a range of about 1.7% to about 4.5% of the maximum outer diameter of the main body portion.

[0012] A hot fill type plastic container according to a second aspect of the invention includes a bottom, a finish portion and a main body portion. The main body portion has a maximum outer diameter and a side wall having an outer surface. The side wall has a plurality of helical vacuum panels defined therein, and each of the vacuum panels has an upper portion and a lower portion. The upper portion has a first helical pitch that is greater than a second helical pitch of the lower portion.

[0013] A hot fill type plastic container according to a third aspect of the invention includes a bottom, a finish portion and a main body portion. The main body portion has a maximum outer diameter and a side wall having an outer surface. The side wall has a plurality of helical vacuum panels defined therein. Each of the vacuum panels has an upper portion and a lower portion. The upper portion has a first maximum width and the lower portion has a second maximum width, and the second maximum width is greater than the first maximum width.

[0014] These and various other advantages and features of novelty that characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a perspective view depicting a hot fill type plastic container that is constructed according to a preferred embodiment of the invention;

[0016] FIG. **2** is a side elevational view depicting the container that is shown in FIG. **1**;

[0017] FIG. **3** is a cross-sectional view taken along lines **3-3** in FIG. **2**;

[0018] FIG. **4** is a cross-sectional view taken along lines **4-4** in FIG. **2**;

[0019] FIG. **5** is a cross-sectional view taken along lines **5-5** in FIG. **2**; and

[0020] FIG. **6** is a cross-sectional view taken along lines **6-6** in FIG. **2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0021] Referring now to the drawings, wherein like reference numerals designate corresponding structure throughout the views, and referring in particular to FIG. **1**, a hot fill type plastic container **10** that is constructed according to a preferred embodiment of the invention includes a bottom **12**, a finish portion **14** having a plurality of helical threads **16** defined thereon and a main body portion **18**.

[0022] Hot fill type plastic container **10** is preferably manufactured from a material such as polyethylene terephthalate (PET) from an injection molded preform, using the reheat stretch blow molding process that is well known in the industry.

[0023] Container **10** is preferably constructed as a round container, meaning that its maximum outer dimensions are substantially circular when viewed in transverse cross-section. As is best shown in FIG. **2**, container **10** has a maximum outer diameter D_{MAX}, which is preferably located on an uppermost portion of the main body portion **18**. Container **10** also preferably has a rounded dome portion **26** that is interposed between the finish portion **14** and the main body portion **18**. The bottom **12**, the finish portion **14**, the dome portion **26** and the main body portion **18** are preferably constructed so as to be unitary with each other, and together define an interior space of the container **10** in which a liquid product such as juice may be packaged.

[0024] As FIGS. **1** and **2** best show, the main body portion **18** preferably has a side wall **20** that is shaped to define a plurality of helical vacuum panels **28**. Each of the helical vacuum panels **28** has an upper portion **30** and a lower portion **32**. The main body portion **18** is preferably bounded by upper and lower circumferential grooves **22**, **24**, which in the preferred embodiment are concave. In the preferred embodiment, the upper portions **30** of each of the helical vacuum panels **28** terminate adjacent to the upper circumferential groove **22**, and the lower portions **32** of the helical vacuum panels **28** terminate substantially adjacent to the lower circumferential groove **24**.

[0025] In the preferred embodiment, each of the helical vacuum panels **28** is substantially identical to the others in size and in shape. However, in alternative embodiments, the shape and size of the helical vacuum panels may be varied. In the preferred embodiment, the main body portion **18** is substantially hourglass shaped. The nature of the helical vacuum panels **28** makes this aspect of the invention compatible with many different general shapes, including the hourglass shape of the preferred embodiment.

[0026] The upper portion **30** of each of the vacuum panels **28** preferably terminates at an upper wall **44** that extends radially outwardly from a substantially flat bottom surface **34** of the vacuum panel **28** to an outer most portion **36** of the side wall **22**. In other words, the upper portion **30** of each of the vacuum panels **28** is substantially closed. However, the lower portion **32** of each of the vacuum panels **28** is preferably constructed as a transitional blend out portion **42** that gradually blends outwardly from the bottom surface **34** to the outermost portion **36**.

[0027] The presence of the transitional blend out portions **42** facilitates the initiation of the vacuum uptake response of the vacuum panels **28** near the bottom of the lower portion **32** of the vacuum panels **28**. Initiation of the vacuum uptake response in this region is also facilitated by the fact that the helical shape of each of the vacuum panels **28** preferably has less of a pitch (i.e., it is sloped so as to be closer to vertical) in the lower portion **32** that it is in the upper portion **30**. This will be described in greater detail below.

[0028] Referring briefly to FIGS. **3-5**, it will be seen that a radial distance or depth D_P is defined between the bottom surface **34** of the vacuum panel **28** and the outermost portion **36** of the side wall **22** adjacent to the vacuum panel **28**. The depth D_P of each of the vacuum panels **28** remains substantially constant throughout the vacuum panel **28** in the preferred embodiment.

[0029] Preferably, a percentage ratio D_P/D_{MAX} of the depth of the vacuum panel **28** is substantially within a range of about 1.7% to about 4.5% of the maximum outer diameter of the main body portion. More preferably the percentage ratio D_P/D_{MAX} is substantially within a range of about 2% to about 4%, and most preferably it is substantially within a range of about 2.2% to about 3.8% of the maximum outer diameter of the main body portion.

[0030] As is best shown in FIG. **3**, the upper portion **30** of the vacuum panel **28** in the preferred embodiment has a first maximum width W_U as measured from the bottom surface **34**. As FIG. **5** best shows, the lower portion **32** of the vacuum panel **28** preferably has a second maximum width W_L, also as measured from the bottom surface **34**. Preferably, the second maximum width W_L is greater than the first maximum width W_U, meaning that the vacuum panels **28** in the preferred embodiment become wider from top to bottom. Preferably a ratio W_U/W_L of the first maximum width to the second maximum width is substantially within a range of about 0.4 to about 0.7, more preferably substantially within a range of about 0.45 to about 0.65, and most preferably substantially within a range of about 0.5 to about 0.6.

[0031] Each of the vacuum panels **28** preferably has a maximum longitudinal dimension L_P, as is that shown in FIG. **2**. In addition, each of the vacuum panels **28** subtends a first angle α from the top of the upper portion **30** to the bottom of the lower portion **32**. A ratio α/L_P of the first angle to the maximum longitudinal dimension for each of the vacuum panels **28** is preferably substantially within a range of about 0.29 to about 0.56°/mm, more preferably substantially within a range of about 0.34 to about 0.51°/mm and most preferably substantially within a range of about 0.39 to about 0.46°/mm. The ratio α/L_P is representative of the average pitch of the helical vacuum panels **28**.

[0032] Each of the vacuum panels **28** preferably has less of a pitch (i.e., it is sloped so as to be closer to vertical) in the lower portion **32** that it is in the upper portion **30**. It has been found that initiation of the vacuum uptake response for each of the vacuum panels **28** will tend to occur sooner and portions of the vacuum panels **28** that are oriented so as to be closer to vertical, i.e. that have a lesser pitch. As FIG. **2** clearly shows, the lower portion **32** of the vacuum panel **28** has less of a curvature and is oriented more vertically than the upper portion **30**. In addition, the lower portion **32** is wider than the upper portion **30**. As a combination of these factors, initiation of the vacuum uptake response will begin as flexure of the bottom surface **34** of the lower portion **32** of the vacuum panel **28**, and will gradually move upwardly into the upper portion **30** of the vacuum panel **28** as more vacuum uptake is required. This phenomenon results in greater control of the vacuum uptake response. In addition, the panel design for vacuum uptake and the helical panel profile together cause a twisting effect which increases as the vacuum uptake moves farther up the panel.

[0033] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A hot fill type plastic container, comprising:

a bottom;

a finish portion; and

a main body portion having a maximum outer diameter and a side wall having an outer surface, the side wall having a plurality of helical vacuum panels defined therein, and wherein each of the vacuum panels have a depth that is substantially within a range of about 1.7% to about 4.5% of the maximum outer diameter of the main body portion.

2. A hot fill type plastic container according to claim **1**, wherein each of the vacuum panels have a depth that is substantially within a range of about 2% to about 4% of the maximum outer diameter of the main body portion.

3. A hot fill type plastic container according to claim **2**, wherein each of the vacuum panels have a depth that is substantially within a range of about 2.2% to about 3.8% of the maximum outer diameter of the main body portion.

4. A hot fill type plastic container according to claim **1**, wherein each of the vacuum panels have an upper portion and a lower portion, and wherein the upper portion has a first helical pitch that is greater than a second helical pitch of the lower portion.

5. A hot fill type plastic container according to claim **1**, wherein each of the vacuum panels have an upper portion and a lower portion, the upper portion having a first maximum width and a lower portion having a second maximum width, and wherein the second maximum width is greater than the first maximum width.

6. A hot fill type plastic container according to claim **5**, wherein a ratio of the first maximum width to the second maximum width is substantially within a range of about 0.4 to about 0.7.

7. A hot fill type plastic container according to claim **6**, wherein the ratio of the first maximum width to the second maximum width is substantially within a range of about 0.45 to about 0.65.

8. A hot fill type plastic container according to claim **7**, wherein the ratio of the first maximum width to the second maximum width is substantially within a range of about 0.5 to about 0.6.

9. A hot fill type plastic container according to claim **1**, wherein the main body portion is bounded by a first upper circumferential groove and a second, lower circumferential groove.

10. A hot fill type plastic container according to claim **1**, wherein each of the vacuum panels have an upper portion and a lower portion, and wherein the lower portion is shaped so as to be blended into an outer most portion of the side wall of the main body portion.

11. A hot fill type plastic container according to claim **1**, wherein the main body portion is generally hourglass shaped.

12. A hot fill type plastic container according to claim **1**, wherein each of the vacuum panels has a maximum longitudinal dimension and subtends a first angle from an upper portion to a lower portion thereof, and wherein a ratio of the first angle to the maximum longitudinal dimension is substantially within a range of about 0.29 to about 0.56°/mm.

13. A hot fill type plastic container according to claim **12**, wherein the ratio of the first angle to the maximum longitudinal dimension is substantially within a range of about 0.34 to about 0.51°/mm.

14. A hot fill type plastic container according to claim **13**, wherein the ratio of the first angle to the maximum longitudinal dimension is substantially within a range of about 0.39 to about 0.46°/mm.

15. A hot fill type plastic container, comprising:

a bottom;

a finish portion; and

a main body portion having a maximum outer diameter and a side wall having an outer surface, the side wall having a plurality of helical vacuum panels defined therein, wherein each of the vacuum panels have an upper portion and a lower portion, and wherein the upper portion has a first helical pitch that is greater than a second helical pitch of the lower portion.

16. A hot fill type plastic container according to claim **15**, wherein each of the vacuum panels has a maximum longitudinal dimension and subtends a first angle from an upper portion to a lower portion thereof, and wherein a ratio of the first angle to the maximum longitudinal dimension is substantially within a range of about 0.29 to about 0.56°/mm.

17. A hot fill type plastic container according to claim **16**, wherein the ratio of the first angle to the maximum longitudinal dimension is substantially within a range of about 0.34 to about 0.51°/mm.

18. A hot fill type plastic container, comprising:

a bottom;

a finish portion; and

a main body portion having a maximum outer diameter and a side wall having an outer surface, the side wall having a plurality of helical vacuum panels defined therein, and wherein each of the vacuum panels have an upper portion and a lower portion, the upper portion having a first maximum width and a lower portion having a second maximum width, and wherein the second maximum width is greater than the first maximum width.

19. A hot fill type plastic container according to claim **18**, wherein a ratio of the first maximum width to the second maximum width is substantially within a range of about 0.4 to about 0.7.

20. A hot fill type plastic container according to claim **19**, wherein the ratio of the first maximum width to the second maximum width is substantially within a range of about 0.45 to about 0.65.

21. A hot fill type plastic container according to claim **20**, wherein the ratio of the first maximum width to the second maximum width is substantially within a range of about 0.5 to about 0.6.

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