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(54) PLASTIC CONTAINER WITH VARYING DEPTH RIBS

KUNSTSTOFFBEHÄLTER MIT RIPPEN MIT VARIIERENDER TIEFE

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EP 2 788 261 B1

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Description

BACKGROUND

Field

[0001] The present application generally relates to plastic containers, particularly to plastic containers designed to hold liquids while resisting deformation.

Description of the Related Art

[0002] Plastic containers have been used as a replacement for glass or metal containers in the packaging of beverages for several decades. The most common plastic used in making beverage containers today is polyethylene terephthalate (PET). Containers made of PET are transparent, thin-walled, and have the ability to maintain their shape by withstanding the force exerted on the walls of the container by their contents. PET resins are also reasonably priced and easy to process. PET bottles are generally made by a process that includes the blow-molding of plastic preforms which have been made by injection molding of the PET resin.

[0003] Advantages of plastic packaging include lighter weight and decreased breakage as compared to glass, and lower costs overall when taking both production and transportation into account. Although plastic packaging is lighter in weight than glass, there is still great interest in creating the lightest possible plastic packaging so as to maximize the cost savings in both transportation and manufacturing by making and using containers that contain less plastic, while still exhibiting good mechanical properties.

[0004] FR 2 899 204 discloses a plastic bottle having a gripping portion with spaced apart grip panels arranged in parallel manner with respect to a central axis for gripping by hands. This document discloses a container according to the preamble of claim 1 and 5. The panels have a specific height in a median zone. In particular, the bottle has a lower portion with a cross section of constant profile and terminated by an upper portion. The gripping portion has flat grip panels arranged in a parallel manner with respect to a central axis at a distance from each other for gripping by hands. The panels have a height of 2 centimeter in a median zone. The panels have a serration extending in a transversal plane of a body which his connected between the panels by a web panel.

SUMMARY

[0005] The bottling industry is moving in the direction of removing auxiliary packaging from cases or pallets. A case of bottles with film only and no paperboard is called a "film only conversion" or "lightweighting" of auxiliary packaging. The removal of supporting elements such as paperboard places additional stress on a bottle, which increases the structural demands on the bottle. In certain

embodiments, a bottle design can provide one or more of the benefits of reducing bending and point loading failures. The disclosed design embodiments can alleviate the stresses during shipping and handling (including film only packaging) while maintaining ease of blow molding. In certain embodiments, a bottle design uses less resin for the same or similar mechanical performance, resulting in a lightweight product.

[0006] The bottle disclosed herein may be made of polyethylene terephthalate (PET), which has viscoelastic properties of creep and relaxation. As a plastic, PET and other resins tend to relax at temperatures normally seen during use. This relaxation is a time dependent stress relieving response to strain. Bending can provide exaggerated strains over what would be seen in tensile loading. Due to exaggerated strains, the relaxation in bending can be much more severe. Bending happens at multiple length scales. Bending can happen at the length scale of the bottle or on a small length scale. An example of the bottle length scale bending is a person bending the bottle in his/her hands, or bending experienced during packing in a case on a pallet. An example of the small scale is the flexing or folding of ribs or other small features on the wall of the bottle. In response to loads at the first, larger length scale, ribs flex at the local, smaller length scale. When they are held in this position with time, the ribs will permanently deform through relaxation.

[0007] Further, the bottles disclosed herein may undergo pressurization. Pressure inside a bottle can be due to the bottle containing a carbonated beverage. Pressure inside a bottle can be due to pressurization procedures or processes performed during bottling and packaging. For example, a bottle can be pressurized to help the bottle retain its shape. As another example, the bottle can be pressurized with certain gases to help preserve a beverage contained in the bottle.

[0008] Embodiments of the bottles disclosed herein have varying depth ribs that achieve a balance of strength and rigidity to resist the bending described above while maintaining hoop strength. Varying depth ribs can smoothly transition around the circumference of the bottle from a flattened and/or shallow depth rib portion to a deep rib portion. A collection of flattened and/or shallow depth ribs act as recessed columns in the body of the bottle that distribute bending and top load forces along the wall to resist leaning and crumbling. The collection of flattened and/or shallow depth ribs can help the bottle retain its shape during pressurization, such as, for example, help inhibit stretching of the bottle when pressurized. Inhibiting stretching of the bottle helps retain desired bottle shape to aid in packaging of the bottles as discussed herein by, for example, maintaining a substantially constant height of the bottle. Inhibiting stretching of the bottle can help with applying a label to a label portion of the bottle. For example, with a label applied to a bottle, inhibiting stretching of the bottle helps retain a constant length or height of the bottle at the label panel portion, which can help prevent tearing of the label and/or prevent

the label from at least partially separating from the bottle (i.e., failure of the adhesive between the bottle and the label).

[0009] The deep rib portions provide hoop strength and make the bottle body more rigid and/or stiffer when gripped by a user. A balance may be achieved between flattened and/or shallow ribs and deep ribs to attain a desired resistance to bending, leaning, and/or stretching while maintaining stiffness in a lightweight bottle. In some embodiments, at least some of the aforementioned desired qualities may be further achieved through a steeper bell portion of a bottle. A steeper bell portion can increase top load performance in a lightweight bell. A lightweight bottle body and bell leaves more resin for a thicker base of the bottle, which can increase stability. A thicker base may better resist bending and top load forces and benefits designs with a larger base diameter with respect to the bottle diameter for tolerance even when the base is damaged during packaging, shipping, and/or handling.

[0010] The present invention provides a container as detailed in claim 1.

[0011] The present invention further provides a container as detailed in claim 5.

[0012] Further aspects and embodiments are detailed in the accompanying dependent claims.

[0013] The foregoing is a summary and thus contains, by necessity, simplifications, generalization, and omissions of detail; consequently, those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting. Other aspects, features, and advantages of the devices and/or processes and/or other subject matter described herein will become apparent in the teachings set forth herein. The summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of any subject matter described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The foregoing and other features of the present disclosure will become more fully apparent from the following description, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only some embodiments in accordance with the disclosure and are, therefore, not to be considered limiting of its scope, the disclosure will be described with additional specificity and detail through use of the accompanying drawings.

FIGURE 1A illustrates a 3D-rendering of an embodiment of a bottle;

FIGURE 1B illustrates a 3D-rendering of an embodiment of a bottle;

FIGURE 2A illustrates a 3D-rendering showing the varying depth features of the ribs;

FIGURE 2B illustrates a 3D-rendering showing the

varying depth features of the ribs;

FIGURE 3 illustrates a cross-section of a deep rib;

FIGURE 4 illustrates a cross-section of a middle rib;

FIGURE 5 illustrates a cross-section of a flattened and/or shallow rib;

FIGURE 6A illustrates a cross-section of the bottle;

FIGURE 6B illustrates a cross-section of the bottle;

FIGURE 7A illustrates a cross-section of a label panel rib;

FIGURE 7B illustrates a cross-section of a label panel rib;

FIGURE 8 illustrates a base rib;

FIGURE 9A illustrates an embodiment showing a wire frame embodiment of the bottle;

FIGURE 9B illustrates an embodiment showing a wire frame embodiment of the bottle of FIGURE 9A rotated 120 degrees;

FIGURE 9C illustrates an embodiment showing a wire frame embodiment of the bottle;

FIGURE 9D illustrates an embodiment showing a wire frame embodiment of the bottle of FIGURE 9C rotated 120 degrees;

FIGURE 10A illustrates an embodiment showing a cross-section of the bottle along a central axis of the bottle;

FIGURE 10B illustrates an embodiment showing a cross-section of the bottle along a central axis of the bottle;

FIGURE 11 illustrates an embodiment showing angles of a bell; and

FIGURE 12 illustrates a preform of the bottle.

DETAILED DESCRIPTION

[0015] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description and drawings are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the FIGURES, may be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are explicitly contemplated and make part of this disclosure.

[0016] In particular, disclosed herein are articles, including preforms and containers, which utilize less plastic in their construction while maintaining the ease of processing and excellent structural properties associated with current commercial designs.

[0017] Referring to FIGURE 1A, an embodiment of the container is a bottle 1 with a base 24 that extends up into a base rib 22. Connected to the base 24, the grip portion 8 comprises a plurality of grip portion ribs 3. As illustrated

in FIGURE 1A, grip portion ribs 3 (positioned in the grip portion 8) may vary in depth by separating or transitioning the rib into at least three portions of a deep rib 2, a middle rib 4, and a flattened and/or shallow rib 6 to be discussed in further detail below. In the illustrated embodiment, the grip portion ribs 3 swirl or angulate around the grip portion 8. In some embodiments, the grip portion ribs 3 include straight and/or constant depth ribs such as the label panel ribs 20 (positioned in a label portion 10), including a combination of straight and swirl or angulating ribs.

[0018] Referring to FIGURE 1A, a label portion 10 is connected to the grip portion 8 and comprises one or more label panel ribs 20. In some embodiments, the label panel ribs 20 are a combination of straight and swirl or angulating ribs as discussed herein. The label panel portion 10 transitions into a shoulder 18, which connects to a bell 16. The bell 16 may include scallops (including as illustrated) or other design features or it may be smooth and generally unornamented. The bell 16 connects to a neck 14, which connects to a finish 12. From the label portion 10, the bell 16 leads upwards and radially inward, relative to a central axis 25, to the neck 14 and finish 12. The finish 12 can be adapted to receive a closure to seal contents in the bottle 1. The finish 12 defines an opening 11 that leads to an interior of the bottle 1 for containing a beverage and/or other contents. The interior can be defined at least one of the finish 12, the neck 14, the bell 16, the shoulder 18, the label portion 10, the grip portion 8, or the base 24.

[0019] A substantially vertical wall comprising the grip portion 8 and label portion 10 between the base 24 and bell 16, extending substantially along the central axis 25 to define at least part of the interior of the bottle 1, can be considered a sidewall of the bottle 1. The perimeter of the sidewall is substantially perpendicular to the central axis 25 of the interior. The sidewall defines at least part of the interior of the bottle 1. The finish 12, the neck 14, the bell 16, the shoulder 18, the label portion 10, the grip portion 8, and the base 24 can each define a respective perimeter (substantially perpendicular to the central axis 25) corresponding to that portion. For example, the label portion 10 has a label portion perimeter. As another example, the grip portion 8 has a grip portion perimeter.

[0020] As illustrated in FIGURE 1B, the label portion 10b may have label panel ribs 20b that vary in depth. The label panel rib 20b may vary in depth by separating or transitioning the rib into at least three portions of a deep rib 2b, a middle rib 4b, and a flattened and/or shallow rib 6b to be discussed in further detail below. As shown in FIGURE 1B, the label panel ribs 20b are straight around the label portion perimeter. The label panel ribs 20b may be a combination of straight and swirl or angulating ribs. As shown in FIGURE 1B, the label portion 10b may have three label panel ribs 20b. The label portion 10b can have 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, or 12 panel ribs 20b, including ranges bordered and including the foregoing values.

[0021] The number of ribs, including base ribs 22, grip

portion ribs 3, and/or label panel ribs 20, 20b, may vary from 1 to 30 ribs every 10 centimeters of any rib containing portion of the bottle, such as, but not limited to the grip portion 8 and/or label panel portion 10, including 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, or 29 ribs every 10 centimeters, including ranges bordered and including the foregoing values. The aforementioned 10 centimeter section that is used to measure the number of ribs need not be actually 10 centimeters in length. Rather, 10 centimeters is used illustratively to provide a ratio for the number of ribs. Further, while in certain embodiments, the illustrated cross-section of the ribs, including base ribs 22, grip portion ribs 3, and/or label panel ribs 20, 20b, are trapezoidal or triangular-shaped, as will be discussed in further detail below, the ribs may have any shape known in the art, including but not limited to, rounded, squared, oval, hemispherical, and the like. The bottom portion of the bottle includes the base 24, which may be of any suitable design, including those known in the art and that illustrated.

[0022] In the embodiment illustrated in FIGURE 2A, each of the grip portion ribs 3 comprise a deep rib 2, a middle rib 4, and a flattened and/or shallow rib 6 sections. The deep, middle, and shallow rib sections may also be called deep, middle, and shallow ribs as shorthand, but it is to be understood that these terms are meant to define sections of a rib in the grip portion 8, label portion 10, and base rib 22. A varying depth grip portion rib 3 transitions from a deep rib 2 to a middle rib 4, then to a flattened and/or shallow rib 6. The varying depth grip portion rib 3 comprises one or more of each of a deep rib, a middle rib, and a shallow rib in any combination. For example, a grip portion rib may include (in order around the circumference of the bottle) a deep rib, middle rib, shallow rib, middle rib, deep rib, middle rib, shallow rib, middle rib, deep rib, middle rib, shallow rib, and middle rib. As shown in FIGURE 1A, the transition between the ribs may be gradual. The transition can be more abrupt. The term "middle" of a middle rib 4 refers to a rib of certain depth and does not mean a location.

[0023] In the embodiment illustrated in FIGURE 2B, each of the label panel ribs 20b comprise a deep rib 2b, a middle rib 4b, and a flattened and/or shallow rib 6b sections. A varying depth label panel rib 20b transitions from a deep rib 2b to a middle rib 4b, then to a flattened and/or shallow rib 6b. The varying depth label panel rib 20b comprises one or more of each of a deep rib, a middle rib, and a shallow rib in any combination. For example, a label panel rib 20b may include (in order around the circumference of the bottle) a deep rib, middle rib, shallow rib, middle rib, deep rib, middle rib, shallow rib, middle rib, deep rib, middle rib, shallow rib, and middle rib. As shown in FIGURE 1B, the transition between the ribs is gradual. The transition can be more abrupt. The term "middle" of a middle rib 4b refers to a rib of certain depth and does not mean a location.

[0024] FIGURES 3-5 illustrate examples where the

deep rib 2 is a depth D_d that is larger than a depth D_m of the middle rib 4, which is larger than a depth D_f of the flattened and/or shallow rib 6. The transition between the varying depths D_d , D_m , and D_f is smooth as depicted in FIGURE 2A. The transition can have some other form such as a step change connecting the varying depth portions or sections of the grip portion rib 3. In the illustrated embodiments, a varying depth grip portion rib 3 has three deep rib 2 portions, six middle rib 4 portions, and three flattened and/or shallow rib 6 portions. As disclosed herein, the term "portions" can be equivalent to the term "sections" in reference to varying depth ribs.

[0025] FIGURES 4, 7A, and 7B illustrate embodiments where the deep rib 2b is a depth D_L that is larger than a depth D_m of the middle rib 4b, which is larger than a depth D_s of the flattened and/or shallow rib 6b. The transition between the varying depths D_L , D_m , and D_s is smooth as depicted in FIGURE 2B. The transition can have some other form such as a step change connecting the varying depth portions or sections of the label portion rib 20b. In the illustrated embodiments, a varying depth label portion rib 20b has three deep rib 2b portions, six middle rib 4b portions, and three flattened and/or shallow rib 6b portions.

[0026] Referring to FIGURE 6A, an embodiment showing a cross-section of the bottle 1, looking down the vertical or central axis 25, illustrates a cross-section of a varying depth grip portion rib 3. As disclosed herein, the term "vertical axis" can be equivalent of the term "central axis". The depth of the varying depth grip portion rib 3 varies from deep ribs 2 to flattened and/or shallow ribs 6. The one or more flattened and/or shallow ribs 6 form an equivalent of recessed columns 7 at portions where a plurality flattened and/or shallow ribs 6 substantially vertically line up along the vertical or central axis 25 of the bottle 1 as illustrated in FIGURES 1A and 2A. A plurality of deep ribs 2 substantially vertically line up along the vertical or central axis 25 of the bottle 1 as illustrated in FIGURES 1A and 2A. A plurality of middle ribs 4 substantially vertically line up along the vertical or central axis 25 of the bottle 1 as illustrated in FIGURES 1A and 2A.

[0027] In the illustrated embodiments with three lined-up flattened and/or shallow rib 6 portions of FIGURE 5, the bottle respectively has three recessed columns 7. As illustrated in FIGURE 6, The three recessed columns 7 may be equally spaced apart around the circumference of the bottle and located on the opposite side of the bottle circumference from the deep rib 2 portions. The flattened and/or shallow ribs 6 can be unequally spaced apart around the circumference of the bottle 1. Any number of recessed columns 7 may be incorporated into a design of the bottle 1 by increasing or decreasing the number of flattened and/or shallow ribs 6 that substantially vertically line up along the vertical or central axis 25. For instance, the bottle may have as few as 1 or up to 10 recessed columns 7, including 2, 3, 4, 5, 6, 7, 8, or 9 recessed columns 7, including ranges bordered and includ-

ing the foregoing values. The collections of flattened and/or shallow ribs 6 that form recessed columns 7 provide resistance to leaning, load crushing, and/or stretching. Leaning can occur when during and/or after bottle packaging, a bottle experiences top load forces (tangential forces or otherwise) from other bottles and/or other objects stacked on top of the bottle. Similarly, top load crushing can occur due to vertical compression (or otherwise) forces from bottles and/or other objects stacked on top. Stretching can occur when a bottle is pressurized. The recessed columns 7 transfer the resulting tangential or compression forces along the wall to the base 24 and increase bottle 1 rigidity. Deep ribs 2 of the grip label rib 3 provide the hoop strength that can be equivalent to the hoop strength of normal depth ribs. As with the flattened and/or shallow rib 6 portions, the deep rib 2 portions may vary from 1 to 10 in number on the grip panel ribs 3, including 2, 3, 4, 5, 6, 7, 8, or 9 deep rib 2 portions, including ranges bordered and including the foregoing values.

[0028] Referring to FIGURE 6B, an embodiment showing a cross-section of the bottle 1b, looking down the vertical or central axis 25, illustrates a cross-section of a varying depth label panel rib 20b. The depth of the varying depth label panel rib 20b varies from deep ribs 2b to flattened and/or shallow ribs 6b. The one or more flattened and/or shallow ribs 6b form an equivalent of recessed columns 7b at portions where a plurality flattened and/or shallow ribs 6b substantially vertically line up along the vertical or central axis 25 of the bottle 1b as illustrated in FIGURES 1B and 2B. The recessed columns 7b can include one or more flattened and/or shallow ribs 6 of the grip portion 8 as discussed herein. A plurality of deep ribs 2b substantially vertically line up along the vertical or central axis 25 of the bottle 1b as illustrated in FIGURES 1B and 2B. A plurality of middle ribs 4b substantially vertically line up along the vertical or central axis 25 of the bottle 1b as illustrated in FIGURES 1B and 2B.

[0029] In the illustrated embodiments with three lined-up flattened and/or shallow rib 6b portions of FIGURE 7B, the bottle respectively has three recessed columns. The flattened and/or shallow ribs 6b of the label panel ribs 20B can vertically line up along the vertical or central axis 25 with the flattened and/or shallow ribs 6 of the grip portion ribs 3 to form the three recessed columns 7b. As illustrated in FIGURE 1B, the recessed columns 7b may extend along a majority or substantial entirety of the sidewall (e.g., height and/or length) of the bottle 1b.

[0030] The flattened and/or shallow ribs 6b of the label panel ribs 20B can be vertically misaligned with the flattened and/or shallow ribs 6 of the grip portion ribs 3 such that the label portion 10 has a set of recessed columns and the grip portion 8 has another set of recessed columns. Thus, the recessed column of the label portion 10 can be vertically misaligned from the recessed columns of the grip portion 8.

[0031] As illustrated in FIGURES 1B and 2B, the plu-

rality of deep ribs 2b of the label portion 10 may substantially vertically line up along the vertical or central axis 25 with the plurality of deep ribs 2 of the grip portion 8. The plurality of deep ribs 2b of the label portion 10 can be vertically misaligned with the plurality of deep ribs 2 of the grip portion 8. The plurality of middle ribs 4b label portion 10 substantially vertically line up along the vertical or central axis 25 with the middle ribs 4 of the grip portion 8 as illustrated in FIGURES 1B and 2B. The plurality of middle ribs 4b label portion 10 can be vertically misaligned with the middle ribs 4 of the grip portion 8.

[0032] As illustrated in FIGURE 6B, the three recessed columns 7b may be equally spaced apart around the circumference of the bottle and located on the opposite side of the bottle circumference from the deep rib 2b portions. The flattened and/or shallow ribs 6, 6b can be unequally spaced apart around the circumference of the bottle 1b. Any number of recessed columns 7b may be incorporated into a design of the bottle 1b by increasing or decreasing the number of flattened and/or shallow ribs 6, 6b that substantially vertically line up along the vertical or central axis 25. For instance, the bottle may have as few as 1 or up to 10 recessed columns 7b, including 2, 3, 4, 5, 6, 7, 8, or 9 recessed columns 7b, including ranges bordered and including the foregoing values. The collections of flattened and/or shallow ribs 6b that form recessed columns 7b provide resistance to leaning, load crushing, and/or stretching as discussed herein. The recessed columns 7b transfer the resulting tangential or compression forces along the wall to the base 24 and increase bottle 1b rigidity. Deep ribs 2b of the label panel rib 20b provide the hoop strength that can be equivalent to the hoop strength of normal depth ribs. As with the flattened and/or shallow rib 6b portions, the deep rib 2b portions may vary from 1 to 10 in number on the label panel rib 20b, including 2, 3, 4, 5, 6, 7, 8, or 9 deep rib 2b portions, including ranges bordered and including the foregoing values.

[0033] The grip panel ribs 3 can be any combination of constant depth ribs and varying depth ribs described above. For instance, the constant versus varying depth rib may vary to be every other grip portion rib 3, or every 2, 3, 4, 5 or 6, including ranges bordered and including the foregoing values. A constant depth rib is illustrated by a label panel rib 20 or base rib 22 of the bottle 1 in FIGURE 1A. The illustrated embodiment in FIGURE 1A shows that the label panel portion 10 has constant depth label panel ribs 20. However, any combination and order of varying depth and/or swirl ribs described above may be incorporated into the label panel portion 10 of bottle 1. For example, the label panel ribs 20b can be any combination of constant depth ribs and varying depth ribs described above. For instance, the constant versus varying depth rib may vary to be every other label panel rib 20b, or every 2, 3, 4, 5 or 6, including ranges bordered and including the foregoing values. Further, while the illustrated embodiment shows a single, constant depth base rib 22, any combination and order of varying depth and/or swirl ribs described above may also be incorpo-

rated into the base 24 of bottle 1. The shape of the constant depth base rib 22 may be any shape illustrated in FIGURES 3-5 or other shapes known in the art.

[0034] Referring to a cross-section of a deep rib 2 embodiment illustrated in FIGURE 3, the deep rib 2 has a land 28, which is part of the grip portion 8, that is connected to an outer radius 30. The outer radius 30 is joined to an inner radius 34 by a connecting wall 32. The inner radius 34 is joined to an opposing inner radius 34 on the other side of the deep rib 2 by a root wall 36, which in turn is connected to a connecting wall 32, connected to an outer radius 30 connecting to the land 28. The depth D_d as measured from the land 28 to the root wall 36 may vary from 1 to 10 millimeters, including 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, or 2.9 millimeters, or 1 to 9, 1 to 7, 1 to 5, or 1 to 3 millimeters, including ranges bordered and including the foregoing values. The length of the root wall 36 may vary from 0.5 to 3 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, or 2.9 millimeters, including ranges bordered and including the foregoing values. The ratio of D_d to the length of the root wall 36 may vary from 1:3 to 20:1, including 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, or 19:1, including ranges bordered and including the foregoing values. The radius of the inner radius 34 may vary from 0.1 to 0.3 millimeters, including 0.15, 0.2, or 0.25 millimeters, including ranges bordered and including the foregoing values. The acute angle between the two connecting walls 32 may vary from 60 to 80 degrees, including 62.5, 65, 67.5, 70, 72.5, 75, or 77.5 degrees, including ranges bordered and including the foregoing values.

[0035] The embodiment of FIGURE 3 illustrates that the cross-section of deep ribs 2 forms a substantially trapezoidal shape. The cross-sectional shape of deep ribs 2 can have any shape illustrated in FIGURES 3-5 or other shapes known in the art. As discussed above, the deep ribs 2 provide hoop strength for the bottle 1. Deep ribs 2 make the bottle 1 feel stiffer and thus, it can be desirable to have deep ribs 2 in the grip portion 8. However, deep ribs 2 with a large depth D_d can cause the bottle 1 to crumble more easily under top load forces. The ratio of depth D_d to either base diameter L_d or shoulder diameter L_s (see FIGURE 10A and 10B) may vary from 1:5 to 1:150, including to 1:10, 1:20, 1:30, 1:40, 1:50, 1:60, 1:70, 1:80, 1:90, 1:100, 1:110, 1:120, 1:130, or 1:140, including ranges bordered and including the foregoing values. Thus, embodiments of the bottles disclosed herein work toward achieving a balance between desired stiffness and desired top load strength and/or bending resistance by balancing deep rib 2 depth D_d and the ratio of the trapezoidal-shaped to triangular-shaped ribs of FIGURE 5 (or other shapes known in the art) as will be discussed in further detail below.

[0036] Referring to a cross-section of a middle rib 4 embodiment illustrated in FIGURE 4, the middle rib 4 has a land 28, which is part of the grip portion 8, that is con-

nected to an outer radius 130. The outer radius 130 is joined to an inner radius 134 by a connecting wall 132. The inner radius 134 is joined to an opposing inner radius 134 on the other side of the middle rib 4 by a root wall 136, which in turn is connected to a connecting wall 132, connected to an outer radius 130 connecting to the land 28. The depth D_m as measured from the land 128 to the root wall 136 may vary from 0.5 to 5 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, or 4.9 millimeters, including ranges bordered and including the foregoing values. The length of the root wall 136 may vary from 0.3 to 2.5 millimeters, including 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, or 2.4 millimeters, including ranges bordered and including the foregoing values. The ratio of D_m to the length of the root wall 136 may vary from 1:5 to 20:1, including 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, or 19:1, including ranges bordered and including the foregoing values. The ratio of D_d of the deep ribs 2 to the D_m of middle ribs 4 may vary from 1:1 to 20:1, including 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, or 19:1, including ranges bordered and including the foregoing values. The radius of the inner radius 134 may vary from 0.1 to 0.3 millimeters, including 0.15, 0.2, or 0.25 millimeters, including ranges bordered and including the foregoing values. The acute angle between the two connecting walls 132 may vary from 60 to 80 degrees, including 62.5, 65, 67.5, 70, 72.5, 75, or 77.5 degrees, including ranges bordered and including the foregoing values.

[0037] The embodiment of FIGURE 4 illustrates that the cross-section of middle ribs 4 forms a substantially trapezoidal shape. The cross-sectional shape of middle ribs 4 can have any shape illustrated in FIGURES 3-5 or other shapes known in the art. As discussed above, the middle ribs 4 acts as a transitional rib from deep ribs 2 to flattened and/or shallow ribs 6. Further, the middle ribs 4 may provide some benefits of both a deep rib 2 and a flattened and/or shallow rib 6 such as hoop strength and bending resistance, respectively.

[0038] Referring to a cross-section of a flattened and/or shallow rib 6 embodiment illustrated in FIGURE 5, the flattened and/or shallow rib 6 has a land 28, which is part of the grip portion 8, that is connected to an outer radius 230. The outer radius 230 is joined to an inner radius 234 by a connecting wall 232. The inner radius 234 is joined to a connecting wall 232, connected to an outer radius 230 connecting to the land 28. The depth D_f as measured from the land 228 to the inner radius 234 may vary from 0 to 2.5 millimeters, including 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, or 2.4 millimeters, including ranges bordered and including the foregoing values. The ratio of D_d of the deep ribs 2 to the D_f of the flattened and/or shallow

ribs 6 may vary from 1:1 to 100:1, including 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, 25:1, 26:1, 27:1, 28:1, or 29:1, or 1:1 to 90:1, 1:1 to 80:1, 1:1 to 70:1, 1:1 to 60:1, 1:1 to 50:1, 1:1 to 40:1, 1:1 to 30:1 or 1:1 to 20:1, including ranges bordered and including the foregoing values, including where D_f is zero, resulting in an infinite ratio. The ratio of D_m of the middle ribs 4 to the D_f of the flattened and/or shallow ribs 6 may vary from 1:1 to 50:1, including 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, or 24:1 or 1:1 to 40:1, 1:1 to 30:1, or 1:1 to 20:1, including ranges bordered and including the foregoing values, including where D_f is zero, resulting in an infinite ratio. The radius of the inner radius 234 may vary from 0.1 to 0.3 millimeters, including 0.15, 0.2, or 0.25 millimeters, including ranges bordered and including the foregoing values. The acute angle between the two connecting walls 232 may vary from 50 to 70 degrees, including 52.5, 55, 57.5, 60, 62.5, 63.56, 65, or 67.5 degrees, including ranges bordered and including the foregoing values.

[0039] The embodiment of FIGURE 5 illustrates that the cross-section of flattened and/or shallow ribs 6 forms substantially a triangular shape. As illustrated in FIGURE 5, a triangular shape can be described as a triangle standing on one of its corners with a rounded corner forming the inner radius 234. While FIGURE 5 illustrates a flattened and/or shallow rib 6 with a triangular shape, the cross-sectional shape of flattened and/or shallow ribs 6 may be any shape illustrated in FIGURES 3-5 or other shapes known in the art. A triangle-shaped rib may have better recovery and/or resiliency, but may have less hoop strength. As discussed above, collections of flattened and/or shallow ribs 6 that form recessed columns 7 make the bottle 1 more rigid. Recessed columns 7 transfer the resulting tangential or compression forces to the base 24 that can minimize or prevent leaning and/or bending. Further, recessed columns 7 can inhibit stretching substantially along the length or height of the bottle 1. As FIGURE 6A illustrates, the bottles disclosed herein may minimize the triangle-shaped or flattened and/or shallow ribs 6 to 20-30%, including 21, 22, 23, 24, 25, 26, 27, 28, or 29%, of the bottle circumference, resulting in a respective 70-80%, including 71, 72, 73, 74, 75, 76, 77, 78, or 79%, of the bottle circumference being trapezoid-shaped or deep ribs 2 and middle ribs 4, including ranges bordered and including the foregoing values. However, any ratio of triangle-shaped to trapezoidal ribs, or other shapes known in the art, may be utilized.

[0040] Referring to of the bottle comprising a label panel rib 20 cross-section illustrated in FIGURE 7A, the label panel rib 20 has a land 128, which is part of the label panel portion 10, that is connected to an outer radius 330. The outer radius 330 is joined to an inner radius 334 by a connecting wall 332. The inner radius 334 is joined to an opposing inner radius 334 on the other side of the label panel rib 20 by a root wall 336, which in turn is

connected to a connecting wall 332, connected to an outer radius 330 connecting to the land 128. The depth D_L as measured from the land 128 to the root wall 336 may vary from 0.5 to 10 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.9, 4, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, or 4.9 millimeters, 0.5 to 9, 0.5 to 7, 0.5 to 5, or 0.5 to 3 millimeters, including ranges bordered and including the foregoing values. The length of the root wall 336 may vary from 0.3 to 2.5 millimeters, including 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, or 2.4 millimeters, including ranges bordered and including the foregoing values. The ratio of D_L to the length of the root wall 336 may vary from 1:5 to 35:1, including 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, 25:1, 26:1, 27:1, 28:1, 29:1, 30:1, 31:1, 32:1, 33:1, or 34:1, including ranges bordered and including the foregoing values. The radius of the inner radius 334 may vary from 0.1 to 0.3 millimeters, including 0.15, 0.2, or 0.25 millimeters, including ranges bordered and including the foregoing values. The radius of the outer radius 330 may vary from 0.5 to 3 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, or 2.9 millimeters, including ranges bordered and including the foregoing values. The acute angle between the two connecting walls 332 may vary from 50 to 70 degrees, including 52.5, 55, 57.5, 60, 62.5, 65, or 67.5 degrees, including ranges bordered and including the foregoing values.

[0041] The embodiment of FIGURE 7A illustrates that the cross-section of label panel rib 20 forms a substantially trapezoidal shape. The cross-section of a label panel rib 20 can have any shape illustrated in FIGURES 3-5 or other shapes known in the art. The label panel ribs 20 may act in a substantially similar manner as the deep ribs 2 and/or middle ribs 4 as discussed above. As also discussed above, label panel ribs 20 may have varying depth from deep ribs 2 to middle ribs 4 to flattened and/or shallow ribs 6, incorporating the recessed columns 7 feature, which can provide the benefits of hoop strength and/or bending resistance. The label panel ribs 20 may also swirl or angulate.

[0042] As illustrated in FIGURE 1B, the label panel rib 20 illustrated in FIGURE 7A may be the deep rib 2b of the varying depth label panel rib 20b. The deep rib 2b of the varying depth label panel rib 20b can be the deep rib 2 of the grip portion ribs 3. The deep rib 2b can transition to the middle rib 4, 4b (FIGURE 4), then to the flattened and/or shallow rib 6b illustrated in FIGURE 7B.

[0043] Referring to a cross-section of a flattened and/or shallow rib 6b embodiment illustrated in FIGURE 7B, the flattened and/or shallow rib 6b has a land 328, which is part of the label portion 10, that is connected to an outer radius 530. The outer radius 530 can connect directly to an inner radius 534 such that an inner connecting wall

532 is the continuation of the outer radius 530 along substantially the same radius of curvature. The outer radius 530 can connect to the inner radius 534 without the connecting wall 532. The radius of the outer radius 530 may vary from 0.5 to 2.5 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, and 2.4, including ranges bordered and including the foregoing values. The outer radius 530 can be joined to an inner radius 534 by a connecting wall 532. The inner radius 534 is joined to an opposing inner radius 534 on the other side of the flattened and/or shallow rib 6b by a root wall 536, which in turn is connected to a connecting wall 532, connected to an outer radius 530 connecting to the land 328. The inner radius 534 can be smaller than the outer radius 530 to give the flattened and/or shallow rib 6b a knob-shape and/or generally a trapezoidal-shape in a cross-sectional profile as illustrated in FIGURE 7B. The radius of the outer radius 530 and/or the inner radius 534 may vary from 0.1 to 0.3 millimeters, including 0.15, 0.2, or 0.25 millimeters, including ranges bordered and including the foregoing values.

[0044] The depth D_s as measured from the land 328 to the inner radius 534 may vary from 0 to 2.5 millimeters, including 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, or 2.4 millimeters, including ranges bordered and including the foregoing values. The ratio of D_s of the deep ribs 2 (FIGURE 3) to the D_s of the flattened and/or shallow ribs 6b may vary from 1:1 to 100:1, including 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, 25:1, 26:1, 27:1, 28:1, or 29:1, or 1:1 to 90:1, 1:1 to 80:1, 1:1 to 70:1, 1:1 to 60:1, 1:1 to 50:1, 1:1 to 40:1, 1:1 to 30:1 or 1:1 to 20:1, including ranges bordered and including the foregoing values, including where D_s is zero, resulting in an infinite ratio. The ratio of D_L of the deep ribs 2b (FIGURE 7A) to the D_s of the flattened and/or shallow ribs 6b may vary from 1:1 to 100:1, including 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, 25:1, 26:1, 27:1, 28:1, or 29:1, or 1:1 to 90:1, 1:1 to 80:1, 1:1 to 70:1, 1:1 to 60:1, 1:1 to 50:1, 1:1 to 40:1, 1:1 to 30:1 or 1:1 to 20:1, including ranges bordered and including the foregoing values, including where D_s is zero, resulting in an infinite ratio.

[0045] The length of the root wall 536 may vary from 0.3 to 4 millimeters, including 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, or 3.9 millimeters, including ranges bordered and including the foregoing values. The ratio of D_s to the length of the root wall 536 may vary from 1:40 to 10:1, including 1:39, 1:38, 1:37, 1:36, 1:35, 1:34, 1:33, 1:32, 1:31, 1:30, 1:29, 1:28, 1:27, 1:26, 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, or 9:1, including ranges bordered and including the foregoing values, including

where D_s is zero, resulting in an infinite ratio. The ratio of D_m of the middle ribs 4, 4b to the D_s of the flattened and/or shallow ribs 6b may vary from 1:1 to 50:1, including 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, or 24:1 or 1:1 to 40:1, 1:1 to 30:1, or 1:1 to 20:1, including ranges bordered and including the foregoing values, including where D_s is zero, resulting in an infinite ratio. The acute angle between the two connecting walls 532 may vary from 50 to 80 degrees, including 52.5, 55, 57.5, 60, 62.5, 63.56, 65, 67.5, 70, 72.5, 75, or 77.5 degrees, including ranges bordered and including the foregoing values.

[0046] The embodiment of FIGURE 7B illustrates that the cross-section of flattened and/or shallow ribs 6b forms substantially a trapezoidal shape. A trapezoid-shaped flattened and/or shallow rib 6b can have the features and benefits of the triangle-shaped flattened and/or shallow ribs 6 as discussed herein while providing some of the features and benefits of the trapezoid-shaped ribs as discussed herein, such as, for example, a deep rib 2. While FIGURE 7B illustrates a flattened and/or shallow rib 6b with a trapezoidal shape, the cross-sectional shape of flattened and/or shallow ribs 6b may be any shape illustrated in FIGURES 3-5, 7A, or other shapes known in the art. As discussed above, collections of flattened and/or shallow ribs 6, 6b that form recessed columns 7b make the bottle 1b more rigid. Recessed columns 7b transfer the resulting tangential or compression forces to the base 24 that can minimize or prevent leaning and/or bending. Further, recessed columns 7b can inhibit stretching substantially along the length or height of the bottle 1b.

[0047] Referring to a base rib 22 detail illustrated in FIGURE 8, the base rib 22 has a land 228, which is part of the base 24, that is connected to an outer radius 430. The outer radius 430 is joined to an inner radius 434 by a connecting wall 432. The inner radius 434 is joined to an opposing inner radius 434 on the other side of the base rib 22 by a root wall 436, which in turn is connected to a connecting wall 432, connected to an outer radius 430 connecting to the land 228. The depth D_b as measured from the land 428 to the root wall 436 may vary from 0.3 to 10 millimeters, including 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, or 2.4 millimeters, or 0.3 to 9, 0.3 to 7, 0.3 to 5, or 0.3 to 3 millimeters, including ranges bordered and including the foregoing values. The length of the root wall 436 may vary from 0.5 to 3 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, or 2.9 millimeters, including ranges bordered and including the foregoing values. The ratio of D_b to the length of the root wall 436 may vary from 1:10 to 20:1, including 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, or 19:1, including ranges bordered and including the foregoing values. The radius of the inner radius 434 may vary from 0.1 to 0.3

millimeters, including 0.15, 0.2, or 0.25 millimeters, including ranges bordered and including the foregoing values. The radius of the outer radius 430 may vary from 0.5 to 3 millimeters, including 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, or 2.9 millimeters, including ranges bordered and including the foregoing values. The angle between the two connecting walls 432 may vary from 80 to 120 degrees, including 82.5, 85, 87.5, 90, 92.5, 95, 97.5, 100, 102.5, 105, 107.5, 110, 112.5, 115, or 117.5 degrees, including ranges bordered and including the foregoing values.

[0048] FIGURE 8 illustrates that the cross-section of a base rib 22 forms a substantially trapezoidal shape. The cross-section of a base rib 22 can have any shape illustrated in FIGURES 3-5 or other shapes known in the art. A trapezoid-shaped base rib 22 can reduce nesting at a processing line. The base rib 22 may act in a substantially similar manner as the deep ribs 2 and/or middle ribs 4 as discussed above. As also discussed above, base ribs 22 may have varying depth from deep ribs 2 to middle ribs 4 to flattened and/or shallow ribs 6, incorporating the recessed columns 7 feature, which provide the benefits of hoop strength and/or bending resistance. The base ribs 22 may also swirl or angulate.

[0049] Any of the ribs discussed herein can be used interchangeably in any portion of the bottle. For example, grip portion ribs 3 can be used in the label portion 10. As another example, the grip portion ribs 3 can be used as base ribs 22. As another example, label panel ribs 20 can be used in the grip portion 8. As another example, label panel ribs 20 can be used as base ribs 22. As another example, label panel ribs 20b can be used in the grip portion 8. As another example, label panel ribs 20b can be used as base ribs 22. As another example, the base rib 22 can be used in the label portion 10. As another example, the base rib 22 can be used in the grip portion 8.

[0050] The embodiment of FIGURES 9A and 9B illustrates a wire frame model of the bottle 1. FIGURE 9B is a view of FIGURE 9A rotated 120 degrees, representing a bottle 1 embodiment with three recessed columns 7 comprising substantially vertically lined up flattened and/or shallow ribs 6. FIGURE 9A illustrates the front view of flat ribs or recessed column 7. FIGURE 9B illustrates the front view of deep ribs 2. FIGURES 9A and 9B illustrate the smooth transition from flattened and/or shallow ribs 6 to deep ribs 2 of an embodiment. FIGURES 9A and 9B also illustrate a smooth swirl or angulation of the grip portion ribs 3. FIGURES 9A and 9B further illustrate the constant depth of the label panel ribs 20 and base rib 22. However, as discussed above, any combination or lack thereof of the aforementioned features may comprise a bottle 1 such as the label panel ribs 20 and base rib 22 incorporating recessed columns 7 and/or the grip portion ribs 3, but not swirling or angulating.

[0051] The embodiment of FIGURES 9C and 9D illustrates a wire frame model of the bottle 1b. FIGURE 9B is a view of FIGURE 9A rotated 120 degrees, represent-

ing a bottle 1b embodiment with three recessed columns 7b comprising substantially vertically lined up flattened and/or shallow ribs 6, 6b. FIGURE 9C illustrates the front view of flat ribs or recessed column 7b. FIGURE 9D illustrates the front view of deep ribs 2, 2b. FIGURES 9C and 9D illustrate the smooth transition from flattened and/or shallow ribs 6, 6b to deep ribs 2, 2b of an embodiment. FIGURES 9C and 9D also illustrate a smooth swirl or angulation of the grip portion ribs 3. The grip portion ribs 3 can be substantially straight around the perimeter or circumference of the bottle. The label panel ribs 20b may swirl or angulate around the perimeter or circumference of the bottle. FIGURES 9C and 9D further illustrate the constant depth of the base rib 22. However, as discussed above, any combination or lack thereof of the aforementioned features may comprise a bottle 1b.

[0052] FIGURE 10A illustrates a cross-section along the central axis 25 of an embodiment of the bottle 1. As shown in FIGURE 10A, the flat rib or recessed column 7 is located on the opposite side of the bottle circumference of the deep rib 2 portions (with, for example, a bottle having three recessed columns 7). In the illustrated embodiment, both the label panel ribs 20 and the base ribs 22 have constant cross-sections throughout the circumference of the bottle 1. The diameter L_d of the base 24 can be larger by 0.5 to 2 millimeters, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, or 1.9 millimeters, including ranges bordered and including the foregoing values, than any other diameter of the bottle 1. With the largest diameter of the bottle 1 being L_d , the bottle may have a single point of contact at just the base 24 with other substantially similar bottles in a production line and/or packaging. Further, a larger base 24 diameter L_d may improve stability when there is any damage to the base 24. As shown in FIGURE 10A, the diameter L_s at the shoulder 18 may be equal to the diameter L_d , which provides for two points of contact, at the shoulder 18 and base 24, with other substantially similar bottles in a production line and/or packaging. The diameter(s) in any portion of the bottle 1 may vary, where the largest diameters create points of contact in a production line and/or packaging. The bottles may have either a single point of contact or multiple points of contact.

[0053] FIGURE 10B illustrates a cross-section along the central axis 25 of an embodiment of the bottle 1b. As shown in FIGURE 10B, the flat rib or recessed column 7b may be located on the opposite side of the bottle circumference of the deep rib 2b portions (with, for example, a bottle having three recessed columns 7b). In the illustrated embodiment, the base ribs 22 have constant cross-sections throughout the circumference of the bottle 1b. The diameter L_d of the base 24 may be larger by 0.5 to 2 millimeters, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, or 1.9 millimeters, including ranges bordered and including the foregoing values, than any other diameter of the bottle 1b to help achieve features and benefits as discussed herein. As shown in FIGURE 10B, the diameter L_s at the shoulder 18 may be equal to the

diameter L_d , which provides for two points of contact, at the shoulder 18 and base 24, with other substantially similar bottles in a production line and/or packaging. The diameter(s) in any portion of the bottle 1b may vary, where the largest diameters create points of contact in a production line and/or packaging. The bottles may have either a single point of contact or multiple points of contact.

[0054] Referring to FIGURE 9B and 9C, the bell 16 may have various bell angles 26 as measured from the vertical wall of the finish 12 to the downward sloping wall of the bell 16. The bell angle 26 may be obtuse, varying from 120 to 175 degrees, including 122, 125, 127, 130, 132, 135, 137, 140, 142, 145, 147, 150, 152, 155, 157, 160, 162, 165, 167, 170, or 172 degrees, including ranges bordered and including the foregoing values. Referring to FIGURE 11, the bell angle 26 represented by θ_2 is larger than the bell angle 26 represented by θ_1 . The wall of bell 16 with θ_2 bell angle 26 is steeper than the wall of bell 16 with θ_1 bell angle 26. A steeper wall of bell 16 can increase the top load capacity of the bottle 1, 1b while maintaining the same or even decreasing bell 16 wall thickness.

[0055] Referring to FIGURE 12, an embodiment of the bottle 1, 1b may use a preform 38 with a thin wall finish 12 and a thin wall neck 14 to form a lightweight bottle. A thin wall neck 14 improves the ability to blow efficient, lightweight bottles. A thin wall neck 14 is a feature that aids in protecting critical dimensions of the bottle and stabilizing the production blowing process. A thin wall neck 14 can also utilize less resin while achieving the desired mechanical performance resulting in a reduction in the use of petroleum products by the industry. A thin wall neck 14 of preform 38 can aid in forming bottles 1, 1b with larger bell angles 26 and/or steeper bell 16 walls as discussed above. As also discussed above, steeper, but relatively thinner, bell 16 walls can support greater top load forces, which can be transferred to the base 24 via the recessed columns 7, 7b. Thus, bottles disclosed herein may incorporate thicker base 24 designs to withstand greater top load forces even when damaged. Achieving a thicker base 24 is aided by a thin wall neck 14 and thin bell 16 walls.

[0056] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0057] It will be understood by those within the art that, in general, terms used herein, are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced embod-

iment recitation is intended, such an intent will be explicitly recited in the embodiment, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the disclosure may contain usage of the introductory phrases "at least one" and "one or more" to introduce embodiment recitations. However, the use of such phrases should not be construed to imply that the introduction of an embodiment recitation by the indefinite articles "a" or "an" limits any particular embodiment containing such introduced embodiment recitation to embodiments containing only one such recitation, even when the same embodiment includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce embodiment recitations. In addition, even if a specific number of an introduced embodiment recitation is explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, embodiments, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

Claims

1. A container (1) comprising:

a base (24);
 a grip portion (8) connected to the base (24) through a constant depth base rib (22) and defining a grip portion perimeter that is substantially perpendicular to a central axis (25);

a label panel portion (10) connected to the grip portion (8) and defining a label portion perimeter that is substantially perpendicular to the central axis (25); and

a bell (16) with an obtuse angle as measured from the central axis (25) to a wall of the bell (16) of at least 120 degrees, the bell (16) connected to the label panel portion (10) through a shoulder (18) and leading upward and radially inward to a finish (12) connected to the bell (16), the finish (12) adapted to receive a closure;

characterized in that the container (1) further comprises:

a plurality of angulating and varying depth ribs (3) positioned substantially along the perimeter of the grip portion (8) wherein each angulating and varying depth rib (3) comprises a plurality of shallow sections (6), a plurality of middle sections (4), and a plurality of deep sections (2); and a plurality of constant depth ribs (20) positioned substantially along the perimeter of the label portion (8), or a plurality of varying depth ribs (20b) positioned substantially along the perimeter of the label portion (10b) wherein each varying depth rib (20b) comprises a plurality of shallow sections (6b), a plurality of middle sections (4b), and a plurality of deep sections (2b)

wherein the shallow sections (6) of the angulating and varying depth ribs (3) have a rib depth less than a rib depth of the middle sections (4) of the angulating and varying depth ribs (3), and the deep sections (2) of the angulating and varying depth ribs (3) have a rib depth greater than the rib depth of the middle sections (4) of the angulating and varying depth ribs (3);

wherein the shallow sections (6) of the angulating and varying depth ribs (3) substantially vertically line up along the central axis (25) and form recessed columns (7); and

whereby the recessed columns (7) are configured to resist at least one of bending, leaning, crumbling, or stretching, and the plurality of deep sections (2) are configured to provide hoop strength.

2. The container (1b) according to claim 1, wherein the shallow sections (6b) of the varying depth ribs (20b) have a rib depth less than a rib depth of the middle sections (4b) of the varying depth ribs (20b), and the deep sections (2b) of the varying depth ribs (20b) have a rib depth greater than the rib depth of the middle sections (4b) of the varying depth ribs (20b); and wherein the shallow sections (6b) of the varying depth ribs (20b) substantially vertically line up along the central axis (25) and form a second plurality of

- recessed columns (7b).
3. The container of claim 2, wherein the first plurality of recessed columns (7) substantially vertically lines up along the central axis (25) with the second plurality of recessed columns (7b).
 4. The container of any of claims 2 or 3, wherein the varying depth ribs (20b) of the label portion (10b) angulate.
 5. A container (1) comprising:
 - a base (24);
 - a sidewall connected to the base (24), the sidewall defining a sidewall perimeter that is substantially perpendicular to a central axis (25) and extending substantially along the central axis (25) to define at least part of an interior of the container (1);
 - a bell (16) connected to the sidewall and leading upward and radially inward to a finish (12) connected to the bell (16), the finish (12) adapted to receive a closure; and
 - characterized in that** the container (1) further comprises a varying depth rib (3) positioned substantially along the sidewall perimeter wherein the varying depth rib (3) comprises a shallow section (6), a middle section (4), and a deep section (2); wherein the shallow section (6) has a rib depth less than a rib depth the middle section (4), and the deep section (2) has a rib depth greater than the rib depth of the middle section (4); and
 - whereby the shallow section (6) of the rib (3) is configured to resist at least one of bending, leaning, crumbling, or stretching, and the deep section is configured to provide hoop strength; wherein at least two shallow sections (6) substantially vertically line up along the central axis (25) and form a recessed column whereby the recessed column is configured to resist at least one of bending, leaning, crumbling, or stretching.
 6. The container of claim 5, wherein the varying depth rib (3) transitions from the shallow section (6) to the middle section (4) to the deep section (2) as at least one of a gradual transition or an abrupt transition.
 7. The container of any of claims 5 or 6, wherein the varying depth rib (3) has a shape of at least one of trapezoidal, triangular, rounded, squared, oval, or hemispherical.
 8. The container of any of claims 5-7, wherein the varying depth rib (3) angulates around the sidewall perimeter.

9. The container of any of claims 5-8, wherein the varying depth rib (3) has a plurality of shallow sections (6), a plurality of middle sections (4), and a plurality of deep sections (2).
10. The container of any of claims 5-9, further comprising a rib of a constant depth (20).
11. The container of any of claims 5-10, wherein the bell (16) has an obtuse angle as measured from the central axis (25) to a wall of the bell (16) of at least 120 degrees.

15 Patentansprüche

1. Behälter (1) welcher umfasst:

eine Basis (24);
 ein Griffbereich (8), der mit der Basis (24) über eine Basisrippe (22) mit konstanter Tiefe verbunden ist und einen Griffbereich-Umfang definiert, der im Wesentlichen senkrecht zu einer zentralen Achse (25) steht;
 ein Etikettfeld-Bereich (10), das mit dem Griffbereich (8) verbunden ist und einen Etikett-Bereich-Umfang definiert der im Wesentlichen senkrecht zu der zentralen Achse (25) steht; and
 eine Glocke (16) mit einem von der zentralen Achse (25) zu einer Wand der Glocke (16) gemessenen abgestumpften Winkel von mindestens 120 Grad, worin die Glocke (16) mit dem Etikettfeld-Bereich (10) über eine Schulter (18) verbunden ist, die nach oben und radial nach innen auf ein Ende (12) zu führt, das mit der Glocke (16) verbunden ist, worin das Ende (12) angepasst ist, einen Verschluss aufzunehmen;
dadurch gekennzeichnet, dass der Behälter (1) weiter umfasst:

mehrere angewinkelte Rippen (3) unterschiedlicher Tiefe, die im Wesentlichen entlang des Umfangs des Griffbereichs (8) angeordnet sind, worin jede angewinkelte Rippe (3) unterschiedlicher Tiefe mehrere flache Bereiche (6) umfasst, mehrere mittlere Bereiche (4) und mehrere tiefe Bereiche (2); und
 mehrere Rippen (20) mit konstanter Tiefe, die im Wesentlichen entlang des Umfangs des Etikett-Bereichs (8) angeordnet sind, oder mehrere Rippen (20) mit variierender Tiefe die im Wesentlichen entlang des Umfangs des Etikett-Bereichs (10b) angeordnet sind, worin jede Rippe (20) mit variierender Tiefe mehrere flache Bereiche (6b), mehrere mittlere Bereiche (4b), und mehrere tiefe Bereiche (2b) umfasst;

worin die flachen Bereiche (6) der angewinkelten Rippen (3) unterschiedlicher Tiefe eine Rippentiefe aufweisen, die geringer ist als eine Rippentiefe der mittleren Bereiche (4) der angewinkelten Rippen (3) unterschiedlicher Tiefe, und worin die tiefen Bereiche (2) der angewinkelten Rippen (3) unterschiedlicher Tiefe eine Rippentiefe aufweisen, die größer ist als die Rippentiefe der mittleren Bereiche (4) der angewinkelten Rippen (3) unterschiedlicher Tiefe; worin sich die flachen Bereiche (6) der angewinkelten Rippen (3) unterschiedlicher Tiefe im Wesentlichen vertikal entlang der zentralen Achse (25) aufreihen und zurückversetzte Säulen (7) ausbilden; und worin die zurückversetzten Säulen (7) ausgestaltet sind, mindestens einem zu widerstehen von Biegen, Beugen, Zerbröckeln oder Dehnen, und worin die mehreren tiefen Bereiche (2) ausgestaltet sind Gebindestärke zu liefern.

2. Behälter (1b) nach Anspruch 1, worin die flachen Bereiche (6b) der Rippen (20) mit variierender Tiefe eine Rippentiefe aufweisen von Kleiner ist als der Rippentiefe der mittleren Bereiche (4b) der Rippen (20) mit variierender Tiefe, und worin die tiefen Bereiche (2b) der Rippen (20) mit variierender Tiefe eine Rippentiefe aufweisen von größer ist als die Rippentiefe der mittleren Bereiche (4b) der Rippen (20) mit variierender Tiefe; und worin sich die flachen Bereiche (6b) der Rippen (20) mit variierender Tiefe im Wesentlichen vertikal entlang der zentralen Achse (25) aufreihen und eine zweite Mehrzahl zurückversetzter Säulen (7b) ausbilden.
3. Behälter nach Anspruch 2, worin sich die ersten mehreren zurückversetzten Säulen (7) im Wesentlichen vertikal entlang der zentralen Achse (25) mit den zweiten mehreren zurückversetzten Säulen (7b) aufreihen.
4. Behälter nach einem der Ansprüche 2 oder 3, worin die Rippen (20) mit variierender Tiefe den Etikett-Bereich (10b) anwinkeln.
5. Behälter (1), welcher umfasst:
 - eine Basis (24);
 - eine Seitenwand, die mit der Basis (24) verbunden ist, worin die Seitenwand einen Seitenwand-Umfang definieren, der im Wesentlichen senkrecht zu einer zentrale Achse (25) steht und sich im Wesentlichen entlang der zentralen Achse (25) erstreckt, um mindestens einen Teil des Behälters (1) zu definieren;
- eine Glocke (16), die mit der Seitenwand verbunden ist und nach oben und sich radial nach innen zu einem Ende (12) führt, der mit der Glocke (16) verbunden ist, worin das Ende (12) angepasst ist, einen Verschluss aufzunehmen; und
- dadurch gekennzeichnet, dass** der Behälter (1) weiter eine Rippe (3) mit variierender Tiefe umfasst, die im Wesentlichen entlang des Seitenwand-Umfangs angeordnet ist, worin die Rippe (3) mit variierender Tiefe einen flachen Bereich (6) umfasst, einen mittleren Bereich (4), und einen tiefen Bereich (2); worin der flache Bereich (6) eine Rippentiefe aufweist, die kleiner ist als eine Rippentiefe des mittleren Bereich (4), und der tiefe Bereich (2) eine Rippentiefe aufweist, die größer ist als die Rippentiefe des mittleren Bereichs (4); und
- wobei der flache Bereich (6) der Rippe (3) ausgestaltet ist, einem zu widerstehen von Biegen, Beugen, Zerbröckeln oder Dehnen, und worin der tiefe Bereich ausgestaltet ist, Gebindestärke zu liefern;
- worin sich mindestens zwei flache Bereiche (6) im Wesentlichen vertikal entlang der zentralen Achse (25) aufreihen und eine zurückversetzte Säule ausbilden, wobei die zurückversetzte Säule ausgestaltet ist, mindestens einem zu widerstehen von Biegen, Beugen, Zerbröckeln oder Dehnen.
6. Behälter nach Anspruch 5, worin die Rippe (3) mit variierender Tiefe von dem flachen Bereich (6) zu dem mittleren Bereich (4) zu dem tiefen Bereich (2) übergeht, wie mindestens einem von einem allmählichen Übergang oder einem abrupten Übergang.
7. Behälter nach einem der Ansprüche 5 oder 6, worin die Rippe (3) mit variierender Tiefe eine Form aufweist von mindestens einem von trapezförmig, dreieckig, abgerundet, rechteckig, oval oder halbkugelig.
8. Behälter nach einem der Ansprüche 5 - 7, worin die Rippe (3) mit variierender Tiefe sich um den Seitenwand-Umfang anwinkelt.
9. Behälter nach einem der Ansprüche 5 - 8, worin die Rippe (3) mit variierender Tiefe mehrere flache Bereiche (6) aufweist, mehrere mittlere Bereiche (4), und mehrere tiefe Bereiche (2).
10. Behälter nach einem der Ansprüche 5 - 9, welcher weiter eine Rippe mit konstanter Tiefe (20) umfasst.
11. Behälter nach einem der Ansprüche 5 - 10, worin die Glocke (16) einen stumpfen Winkel von mindestens 120 Grad aufweist, gemessen von der zentralen

Achse (25) zu einer Wand der Glocke (16).

Revendications

1. Contenant (1) comprenant :

une base (24) ;
 une partie de préhension (8) reliée à la base (24)
 par une nervure de base de profondeur constante (22) et définissant un périmètre d'une partie de préhension qui est sensiblement perpendiculaire à un axe central (25) ;
 une partie du panneau d'étiquette (10) connectée à la partie de préhension (8) et définissant un périmètre d'une partie d'étiquette qui est sensiblement perpendiculaire à l'axe central ; et
 une cloche (16) ayant un angle obtus mesuré entre l'axe central (25) et une paroi de la cloche (16) d'au moins 120 degrés, la cloche (16) étant reliée à la partie du panneau d'étiquette (10) à travers un épaulement (18) et dirigée vers le haut et radialement vers l'intérieur jusqu'à une finition (12) reliée à la cloche (16), la finition étant adaptée pour recevoir une fermeture ;
caractérisé en ce que le contenant (1) comprend en outre :

une pluralité de nervures anguleuses et à profondeur variable (3) positionnées sensiblement le long du périmètre de la partie de préhension (8) dans laquelle chaque nervure anguleuse et à profondeur variable (3) comprend une pluralité de sections peu profondes (6), une pluralité de sections médianes (4), et une pluralité de sections profondes (2) ; et
 une pluralité de nervures de profondeur constante (20) positionnées sensiblement le long du périmètre de la partie d'étiquette (8), ou une pluralité de nervure à profondeur variable (20b) positionnées sensiblement le long du la partie du panneau d'étiquette (10b) dans laquelle chaque nervure à profondeur variable (20b) comprend une pluralité de sections peu profondes (6b), une pluralité de sections médianes (4b), et une pluralité de sections profondes (2b) ; et
 dans lequel les sections peu profondes (6) des nervures anguleuses et à profondeur variable (3) ont une profondeur de nervure inférieure à une profondeur de nervure des sections médianes (4) des nervures anguleuses et à profondeur variable (3), et les sections profondes (2) des nervures anguleuses et à profondeur variable (3) ont une profondeur de nervure supérieure à la profondeur de nervure des sections médianes

(4) des nervures anguleuses et à profondeur variable (3) ;
 dans lequel les sections peu profondes (6) des nervures anguleuses et à profondeur variable (3) s'alignent sensiblement verticalement le long de l'axe central (25) et forment des colonnes encastrées (7) ; et
 dans lequel les colonnes encastrées (7) sont configurées pour résister à au moins un pliage, une inclinaison, un affaissement ou un étirement, et la pluralité des sections profondes (2) sont configurées pour fournir une force radiale.

2. Contenant (1b) selon la revendication 1, dans lequel les sections peu profondes (6b) des nervures à profondeur variable (20b) ont une profondeur de nervure inférieure à une profondeur de nervure des sections médianes (4b) des nervures à profondeur variable (20b), et les sections profondes (2b) des nervures à profondeur variable (20b) ont une profondeur de nervure supérieure à la profondeur de nervure des sections médianes (4b) des nervures à profondeur variable (20b) ; et
 dans lequel les sections peu profondes (6b) des nervures à profondeur variable (20b) s'alignent sensiblement verticalement le long de l'axe central (25) et forment une deuxième pluralité de colonnes encastrées (7b).

3. Contenant selon la revendication 2, dans lequel la première pluralité de colonnes encastrées (7) s'aligne sensiblement verticalement le long de l'axe central (25) avec la deuxième pluralité de colonnes encastrées (7b).

4. Contenant selon l'une quelconque des revendications 2 ou 3, dans lequel les nervures à profondeurs variables (20b) de la partie de panneau d'étiquette (10b) présentent des angles.

5. Contenant (1) comprenant :

une base (24) ;
 une paroi latérale connectée à la base (24), la paroi latérale définissant un périmètre de paroi latérale qui est sensiblement perpendiculaire à un axe central (25) et s'étendant sensiblement le long de l'axe central (25) pour définir au moins une partie d'un intérieur du contenant (1) ;
 une cloche (16) reliée à la paroi latérale et dirigée vers le haut et radialement vers l'intérieur jusqu'à une finition (12) reliée à la cloche (16), la finition (12) étant adaptée pour recevoir une fermeture ; et
caractérisé en ce que le contenant (1) comprend en outre une nervure à profondeur variable (3) positionnée sensiblement le long du pé-

rimètre de la paroi latérale dans lequel la nervure à profondeur variable (3) comprend une section peu profonde (6), une section médiane (4), et une section profonde (2) ; dans laquelle la section peu profonde (6) a une profondeur de nervure supérieure à la profondeur de nervure de la section médiane (4) ; et

dans lequel la section peu profonde (6) de la nervure (3) est configurée pour résister à au moins un pliage, une inclinaison, un affaissement ou un étirement, et la section profonde est configurée pour fournir la résistance du cercle ; dans lequel au moins deux sections peu profondes (6) s'alignent sensiblement verticalement le long de l'axe central (25) et forment une colonne encastrée configurée pour résister à au moins un pliage, une inclinaison, un affaissement ou un étirement.

6. Contenant selon la revendication 5, dans lequel la nervure à profondeur variable (3) passe de la section peu profonde (6) à la section centrale (4) à la section profonde (2) par au moins une transition progressive ou une transition abrupte.
7. Contenant selon l'une quelconque des revendications 5 à 6, dans lequel la nervure à profondeur variable (3) a au moins une forme trapézoïdale, triangulaire, arrondie, carrée, ovale ou hémisphérique.
8. Contenant selon l'une quelconque des revendications 5 à 7, dans lequel la nervure à profondeur variable (3) se courbe autour du périmètre de la paroi latérale.
9. Contenant selon l'une quelconque des revendications 5 à 8, dans lequel la nervure à profondeur variable (3) possède une pluralité de sections peu profondes (6), une pluralité de sections médianes (4), et une pluralité de sections profondes (2).
10. Contenant selon l'une quelconque des revendications 5 à 9, comprenant en outre une nervure d'une profondeur constante (20).
11. Contenant selon l'une quelconque des revendications 5 à 10, dans lequel la cloche (16) a un angle obtus mesuré à partir de l'axe central (25) jusqu'à une paroi de la cloche (16) d'au moins 120 degrés.

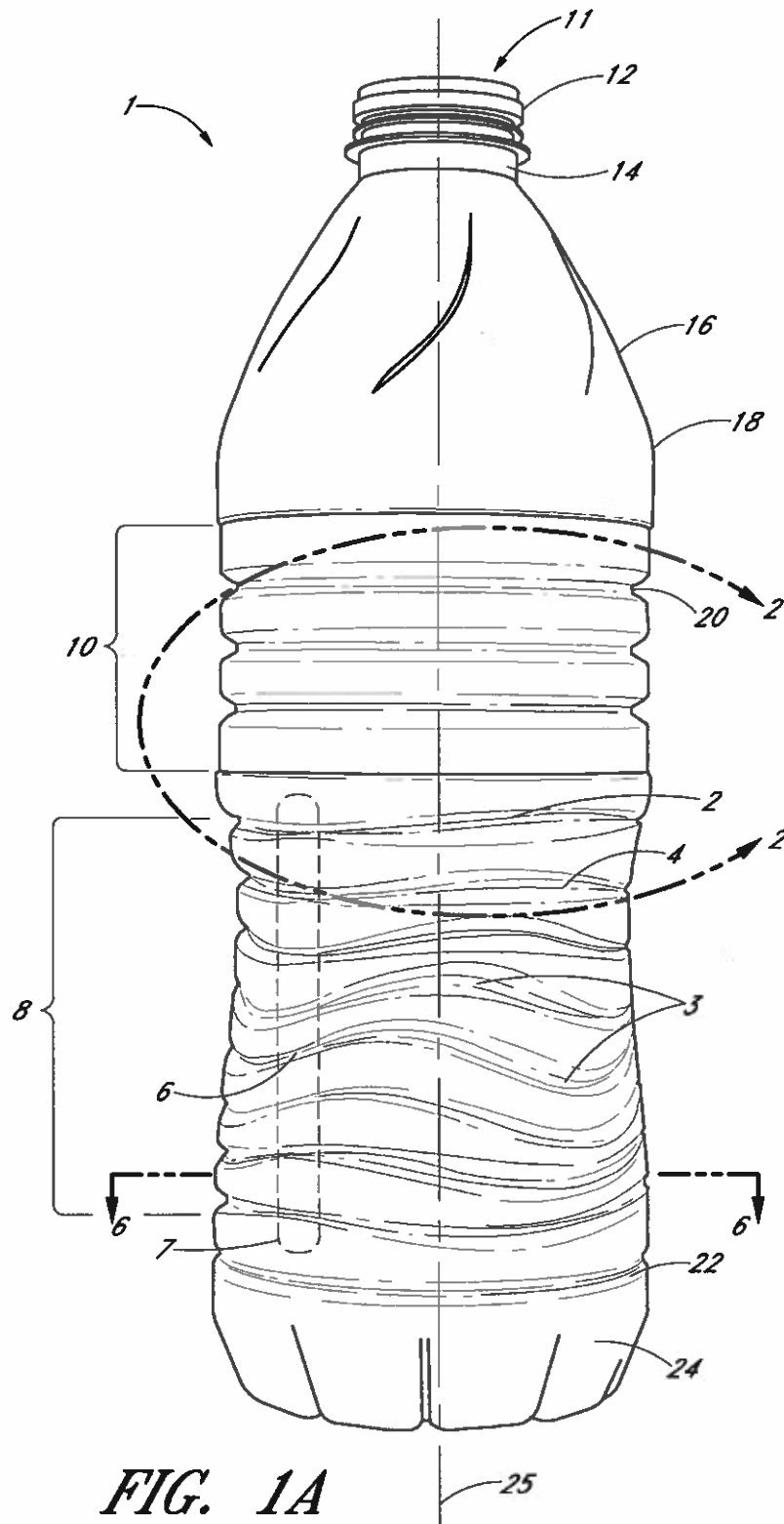


FIG. 1A

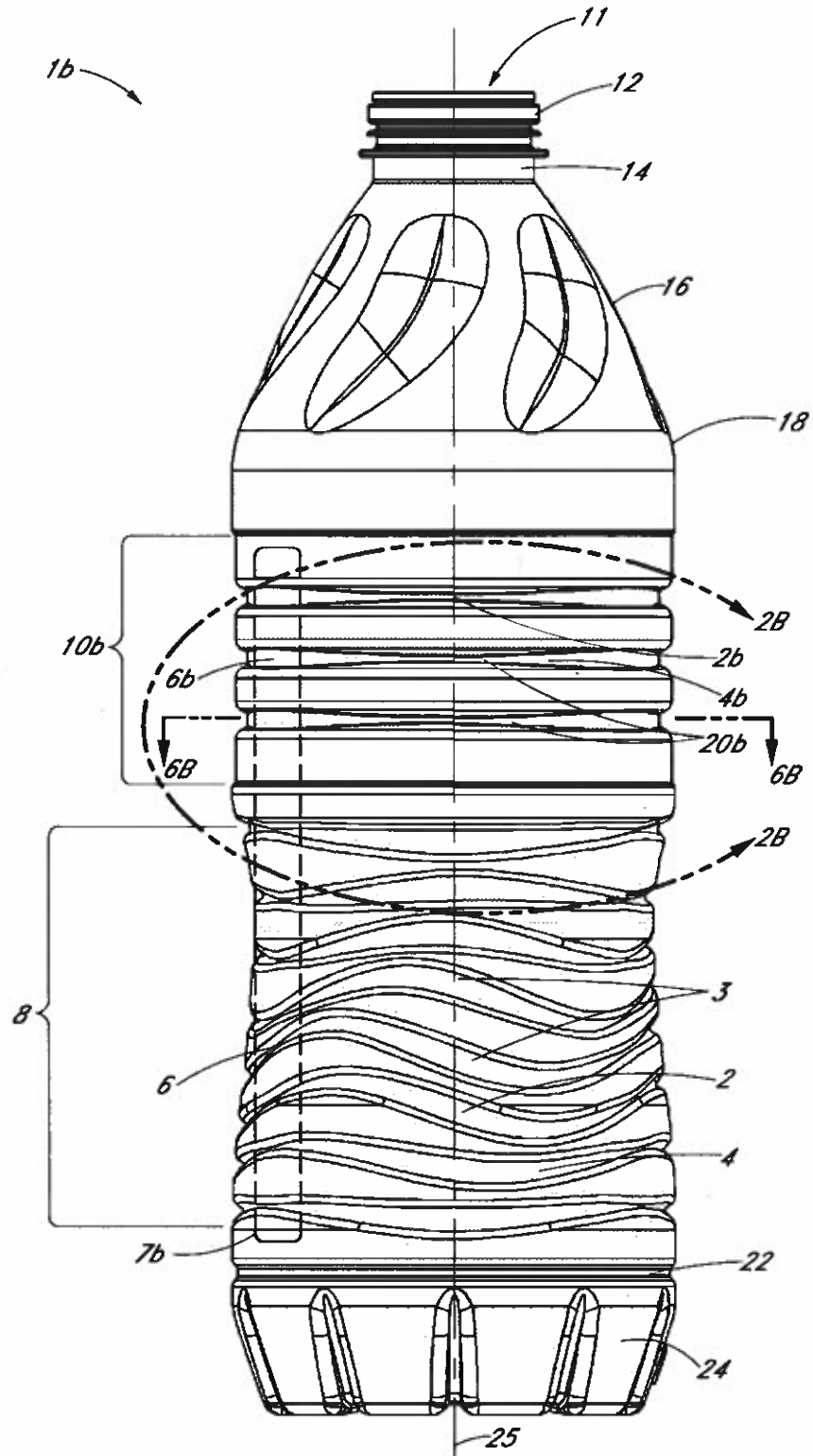


FIG. 1B

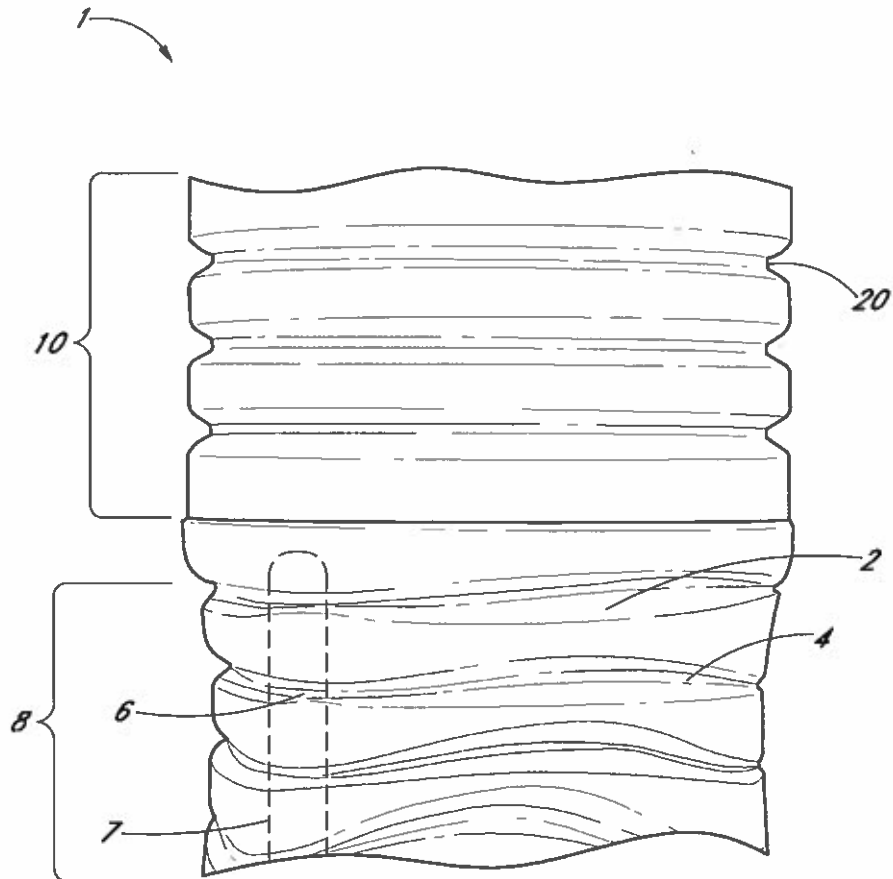


FIG. 2A

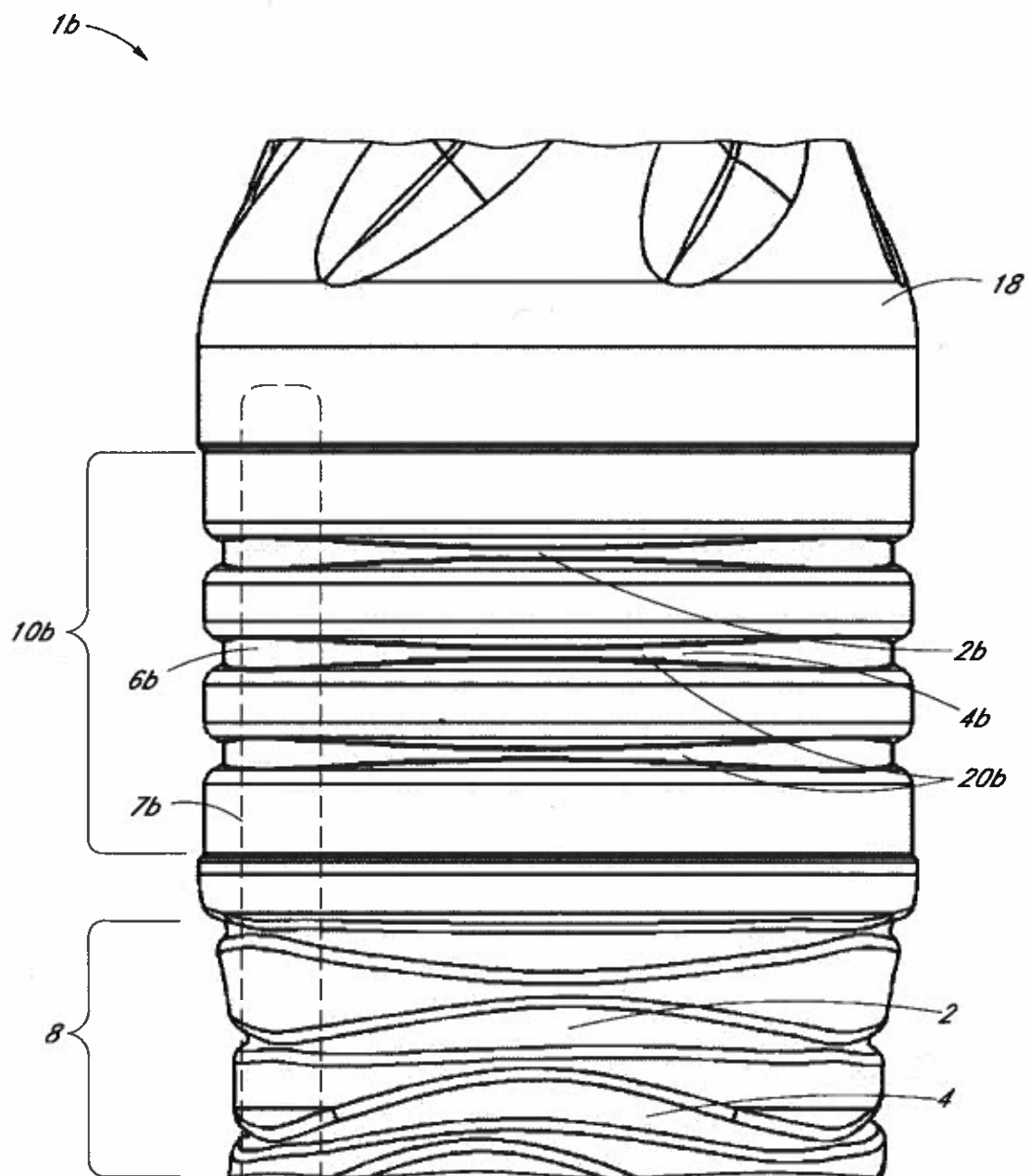


FIG. 2B

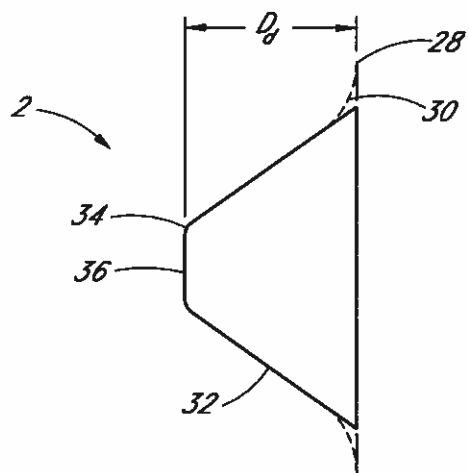


FIG. 3

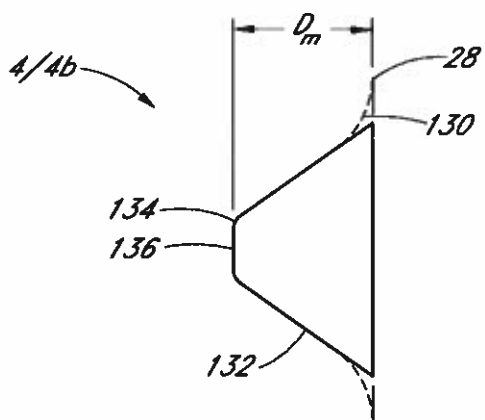


FIG. 4

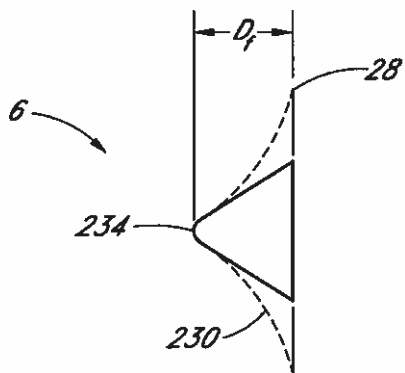


FIG. 5

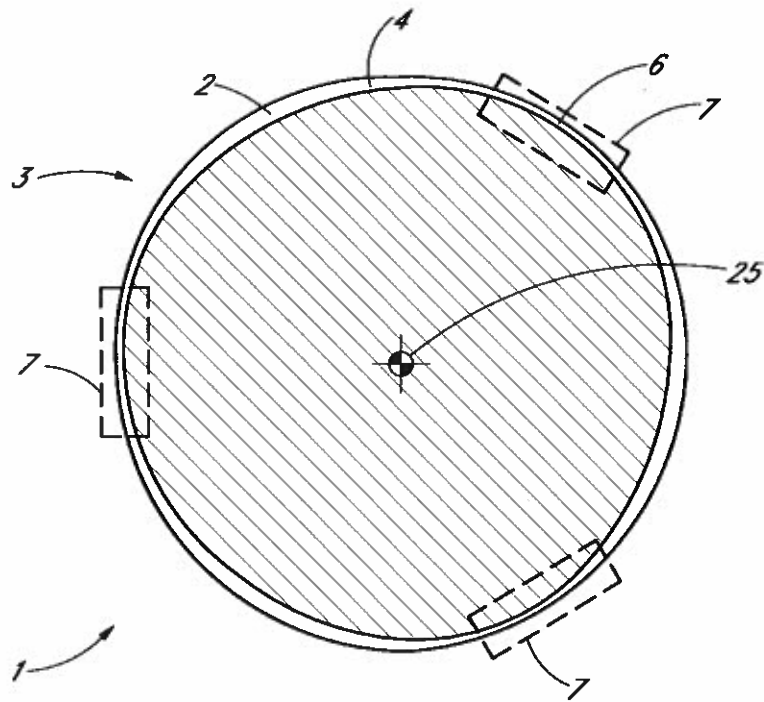


FIG. 6A

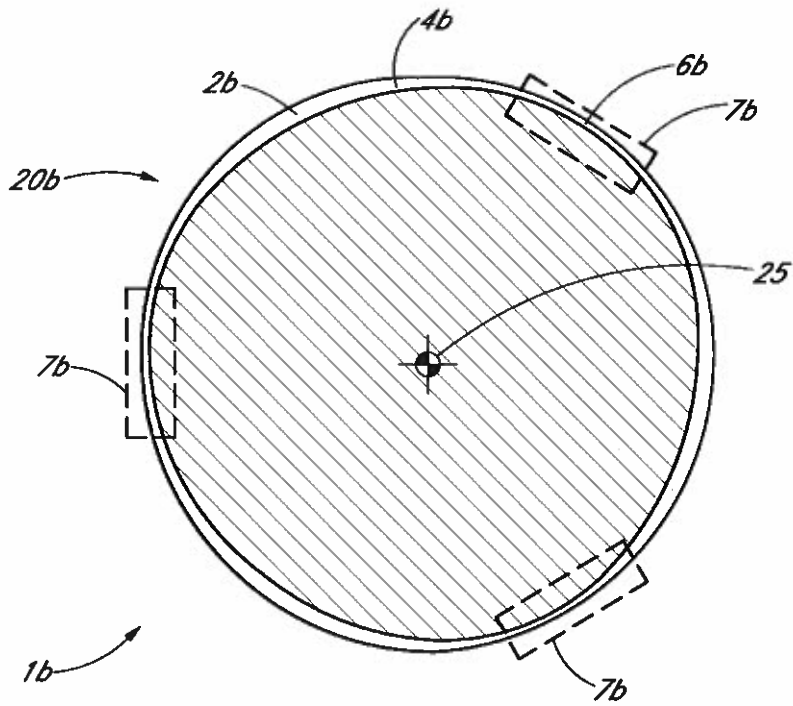


FIG. 6B

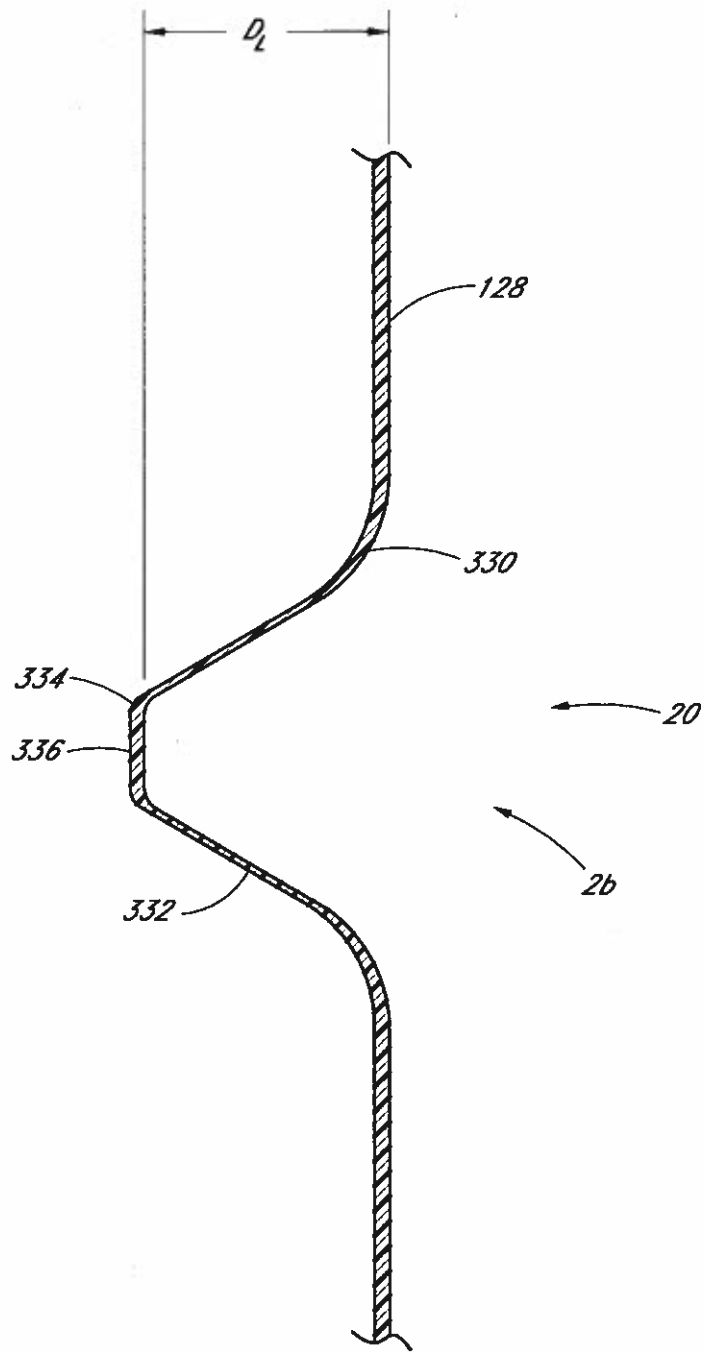


FIG. 7A

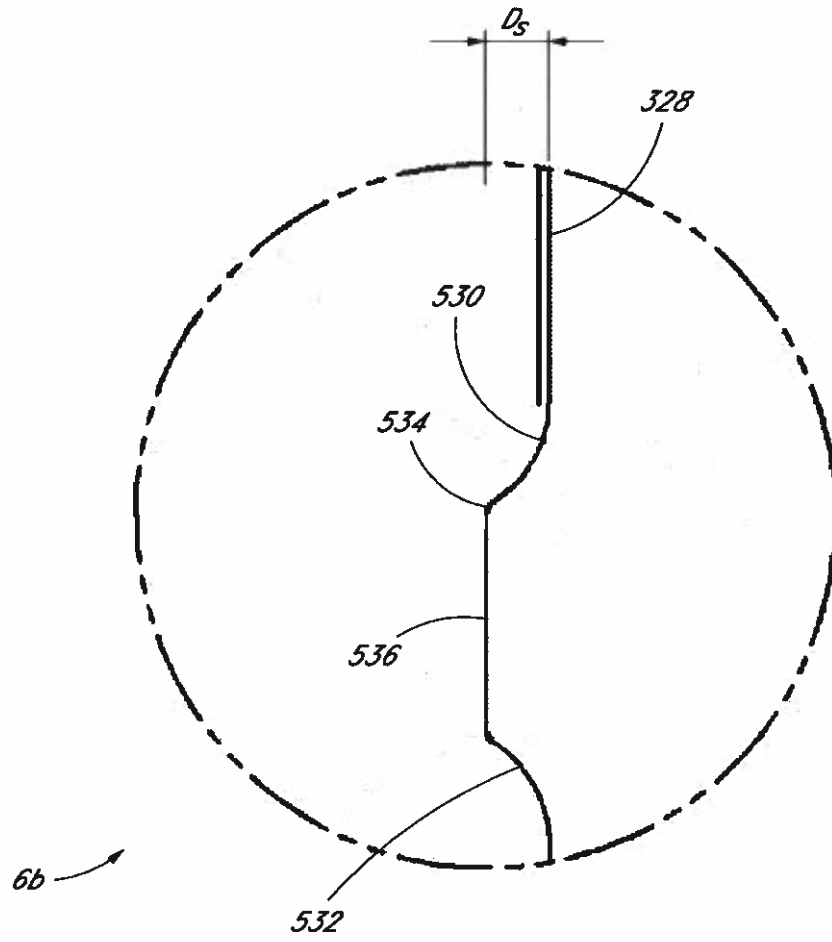


FIG. 7B

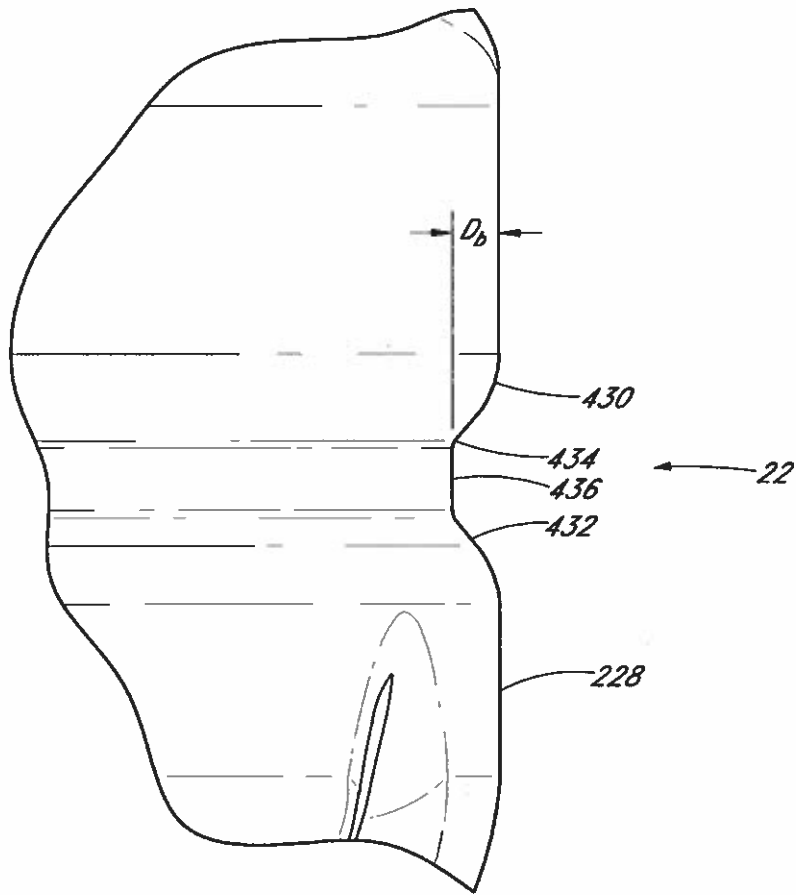


FIG. 8

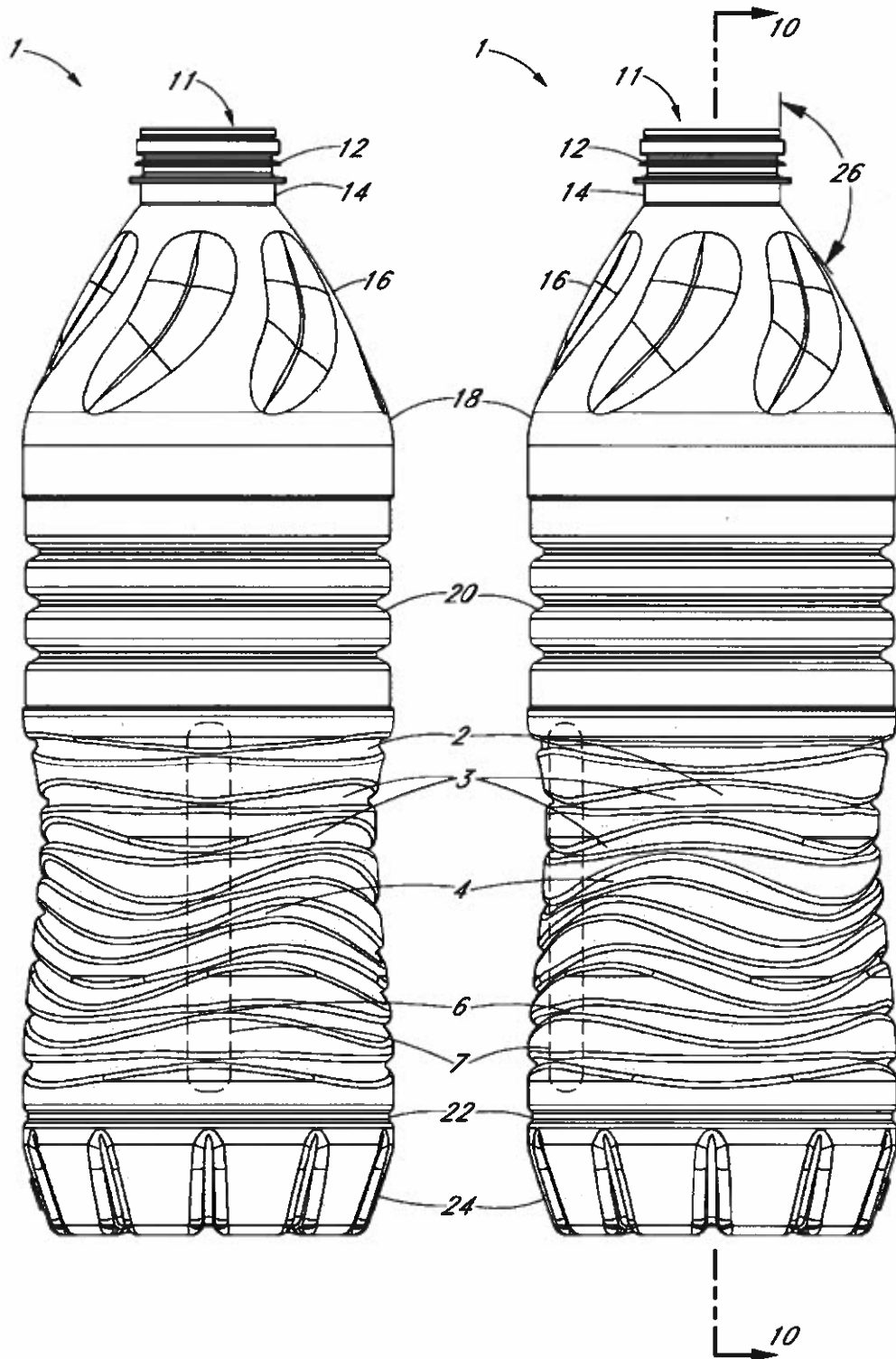


FIG. 9A

FIG. 9B

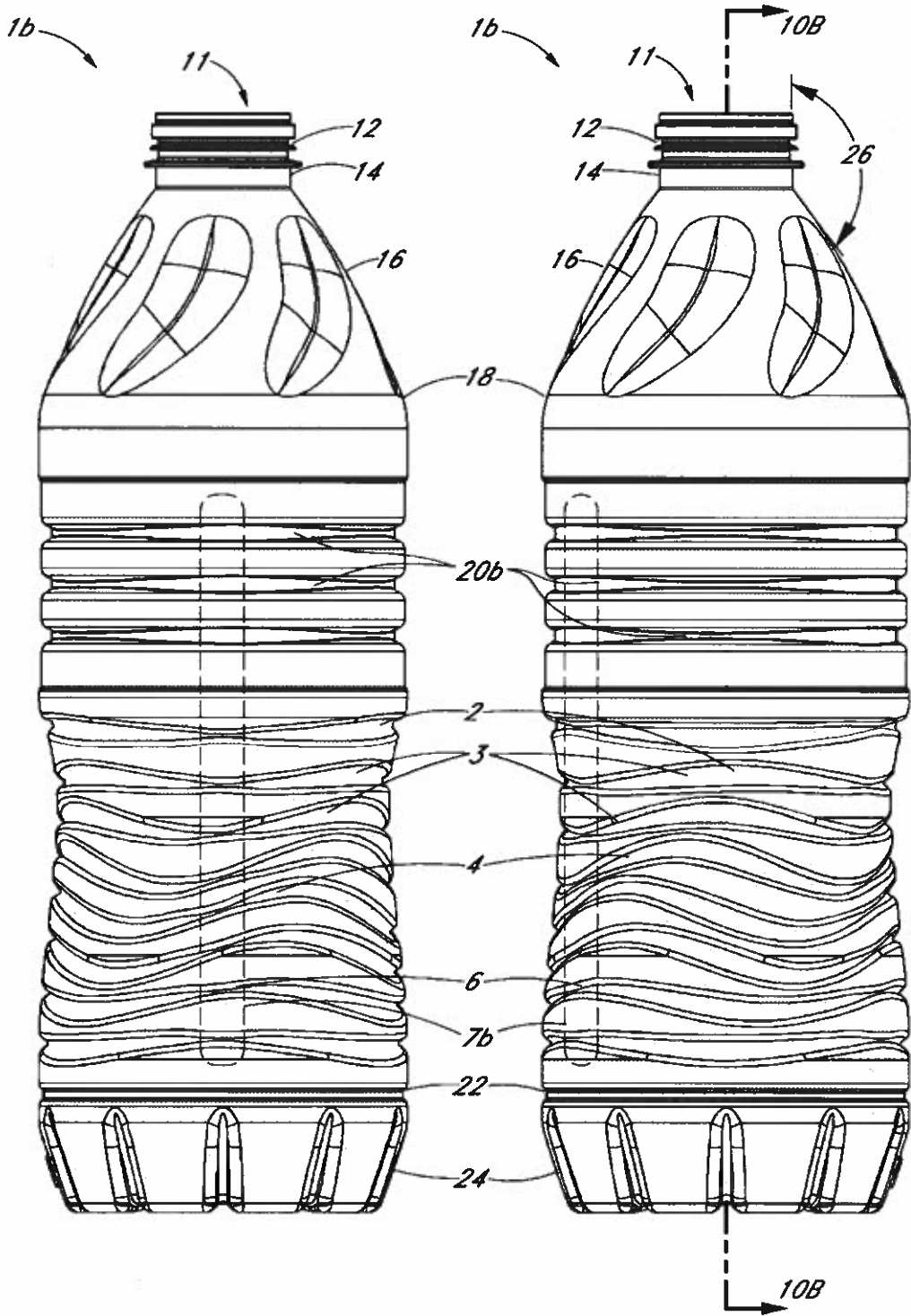


FIG. 9C

FIG. 9D

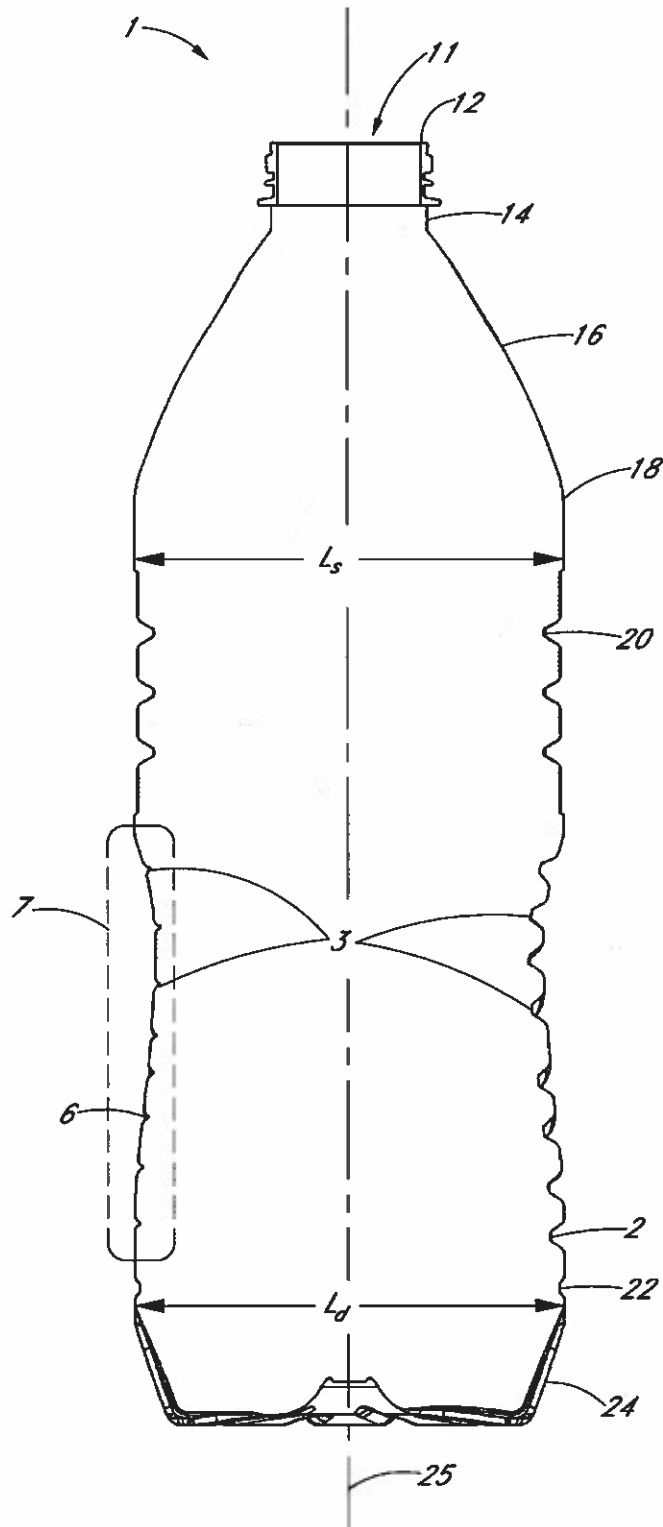


FIG. 10A

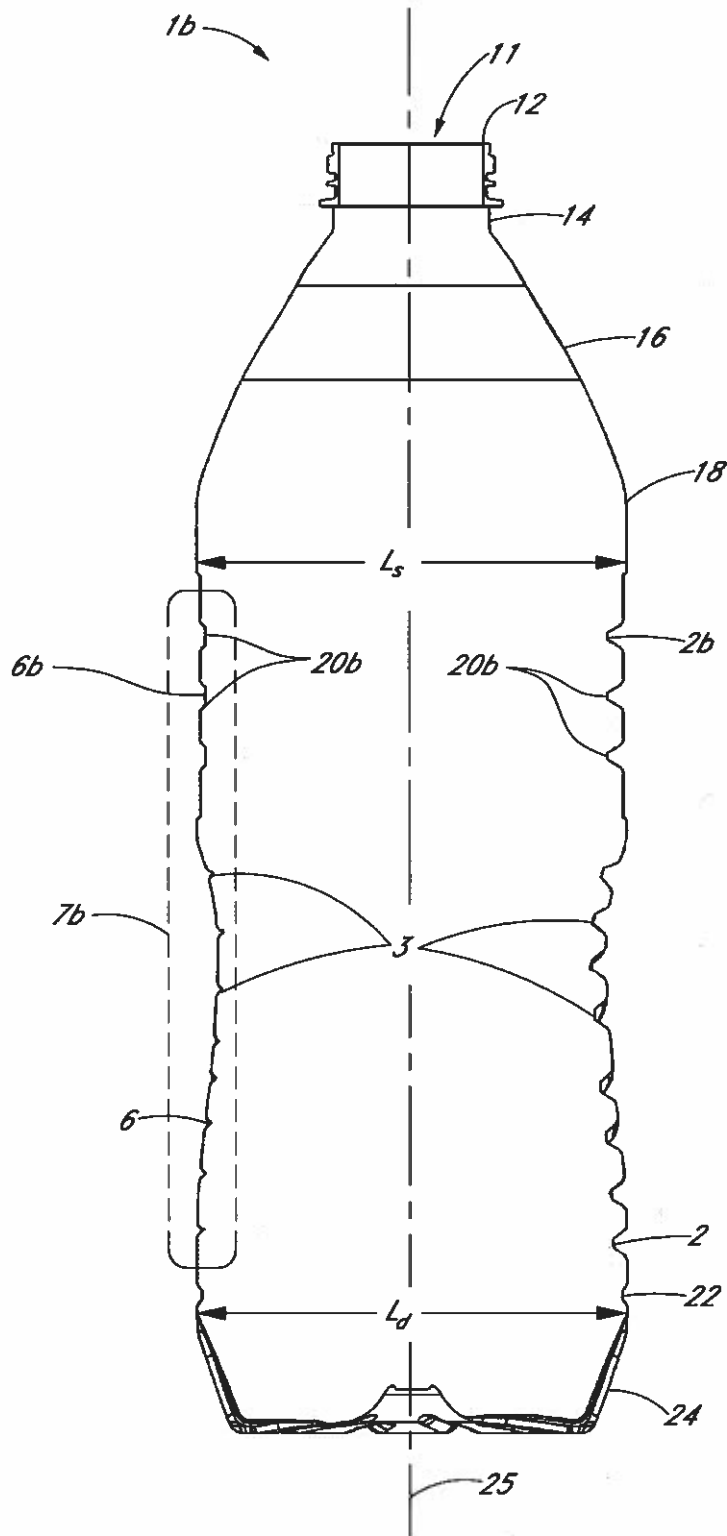


FIG. 10B

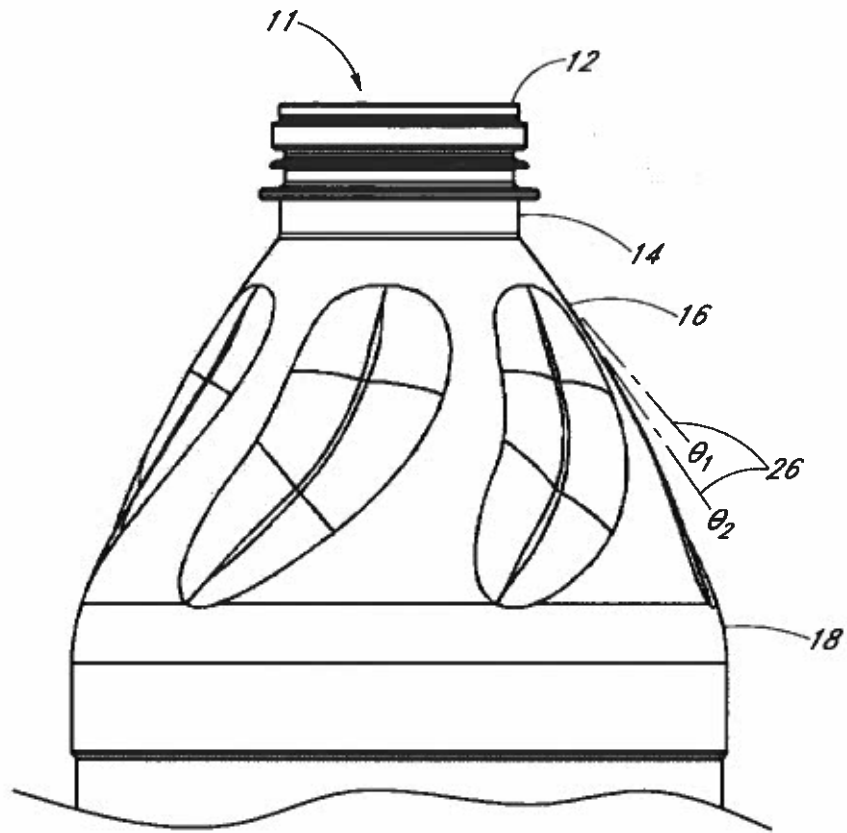


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- FR 2899204 [0004]