US 20150033671A1

(19) United States

(12) Patent Application Publication

Stanley et al.

(10) Pub. No.: US 2015/0033671 A1

(43) Pub. Date: Feb. 5, 2015

(54) METHOD OF FORMING A FLEXIBLE CONTAINER

(71) Applicant: **The Procter & Gamble Company**, Cincinnati, OH (US)

(72) Inventors: **Scott Kendyl Stanley**, Mason, OH (US); **Marc Richard Bourgeois**, Liberty Township, OH (US); **Benjamin Jacob Clare**, Cincinnati, OH (US); **Tadayoshi Ishihara**, West Chester, OH (US); **Joseph Craig Lester**, Liberty Township, OH (US); **Andrew Paul Rapach**, Fairfield, OH (US)

(21) Appl. No.: **14/448,491**

(22) Filed: **Jul. 31, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/861,118, filed on Aug. 1, 2013.

Publication Classification

(51) **Int. Cl.**

B65B 43/08	(2006.01)
B65B 43/30	(2006.01)
B65B 61/18	(2006.01)
B65B 3/04	(2006.01)

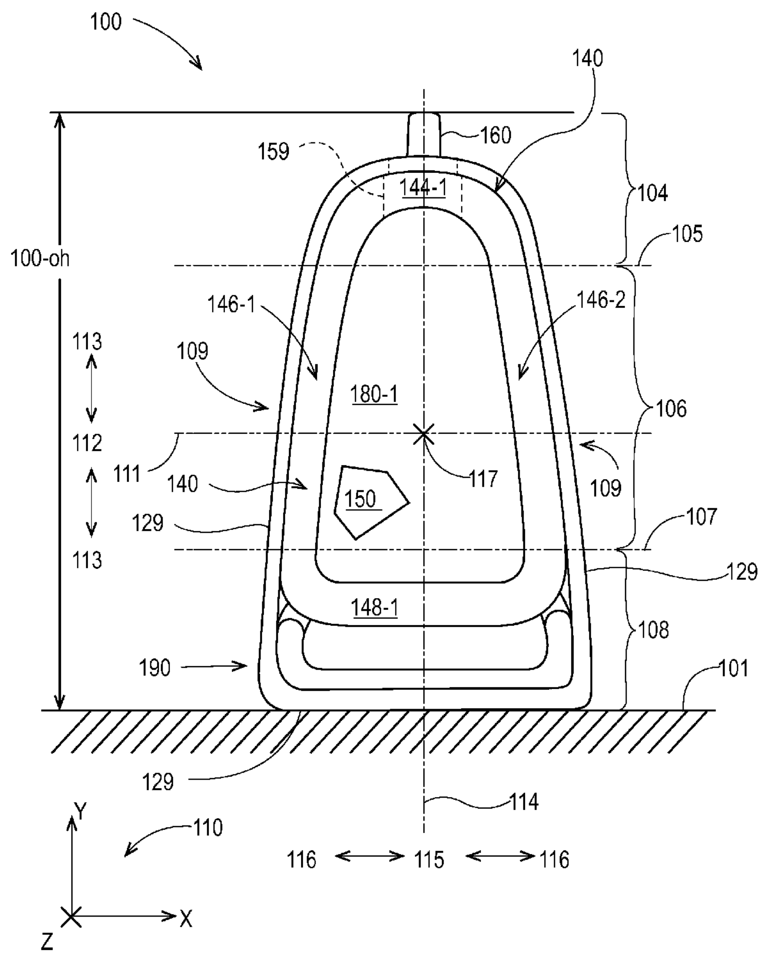
(52) **U.S. Cl.**

CPC ***B65B 43/08*** (2013.01); ***B65B 3/045*** (2013.01); ***B65B 43/30*** (2013.01); ***B65B 61/186*** (2013.01)

USPC **53/410**; 493/210

(57) **ABSTRACT**

Methods of forming flexible containers, the methods comprising joining together a first flexible material and a second flexible material, to form a joined material, using the joined material, at least partially forming a structural support volume and an expansion port in communication with the structural support volume, and by joining a third flexible material to the joined material, at least partially forming a product volume and a fill port in communication with the product volume.



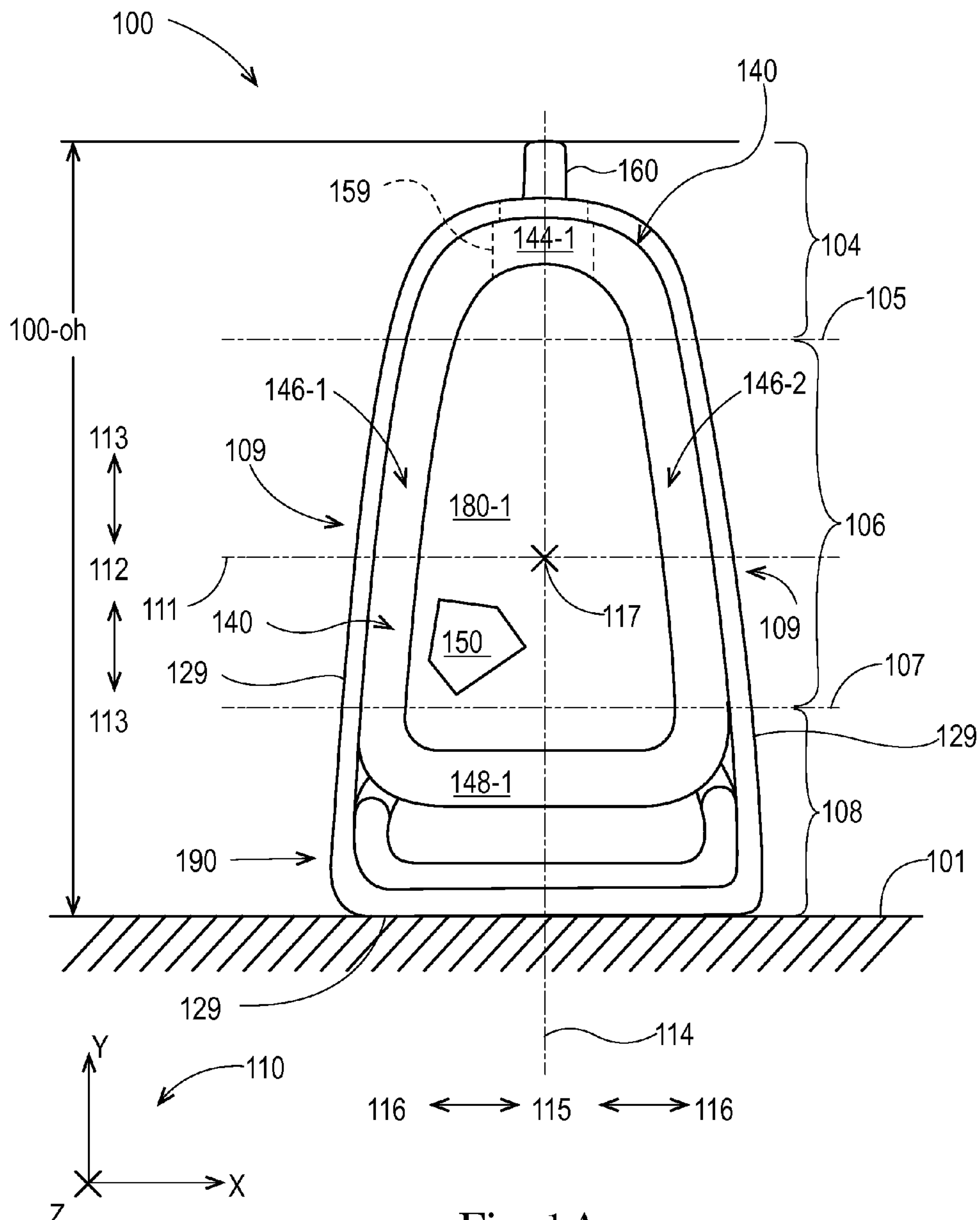

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Fig. 1A

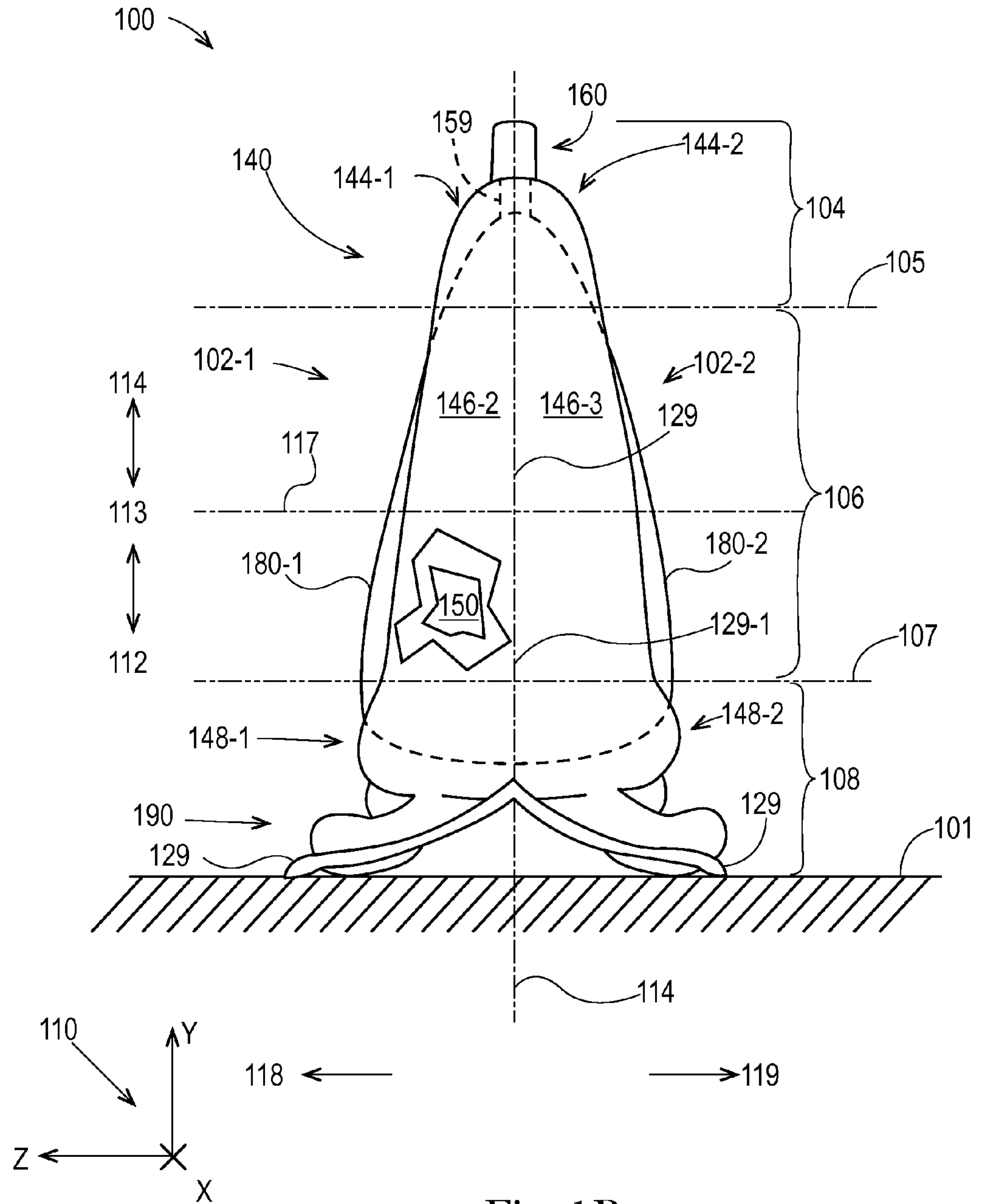
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Fig. 1B

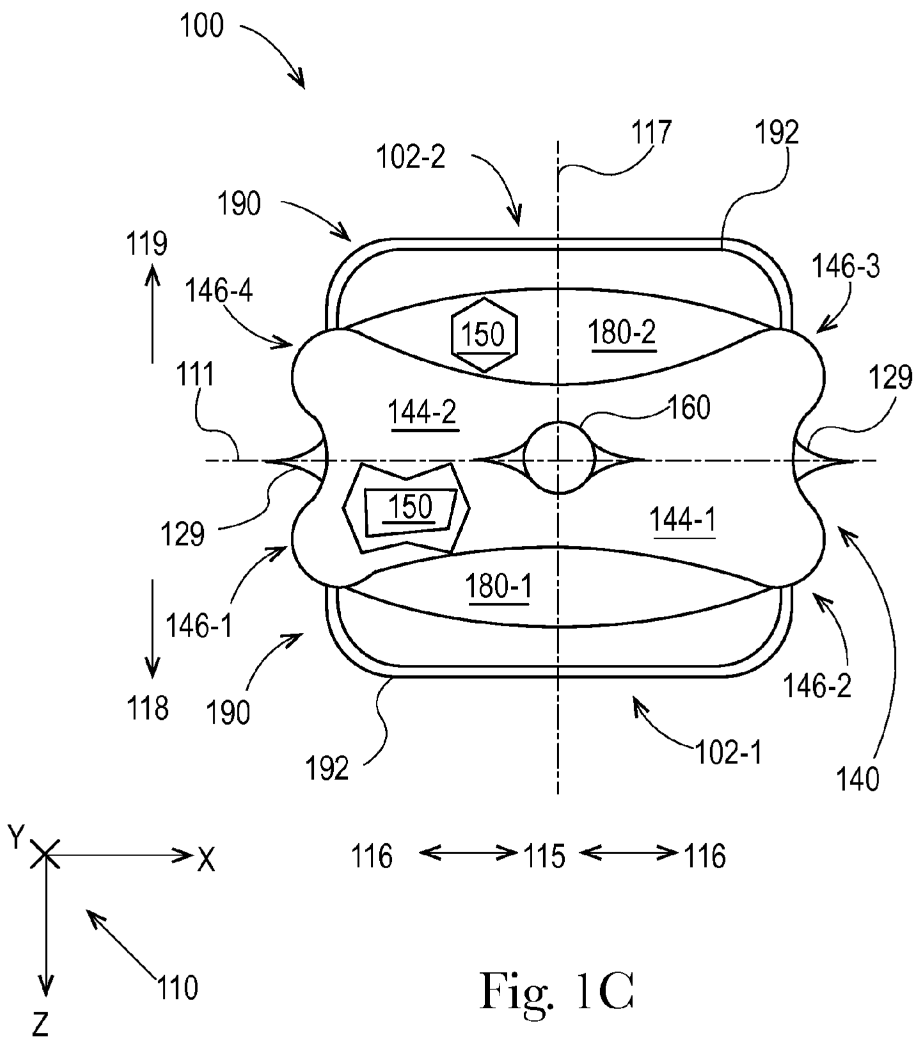
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Fig. 1C

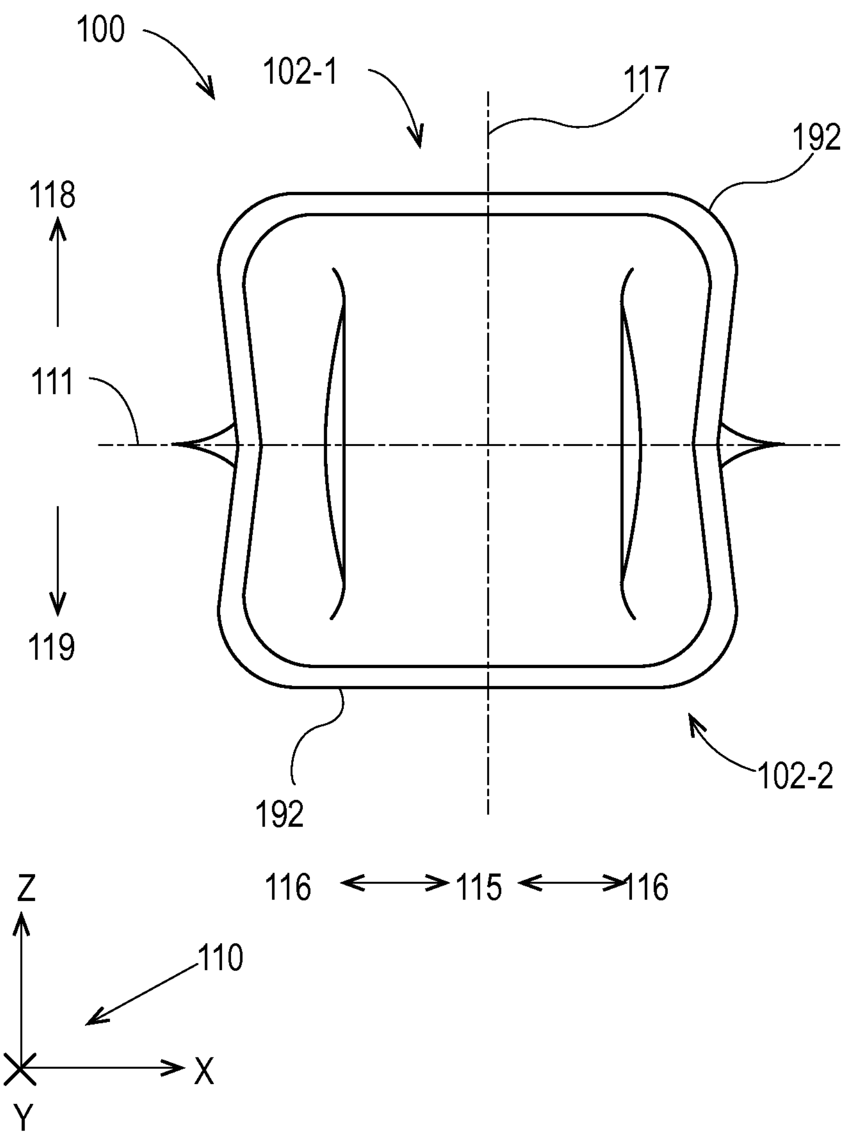
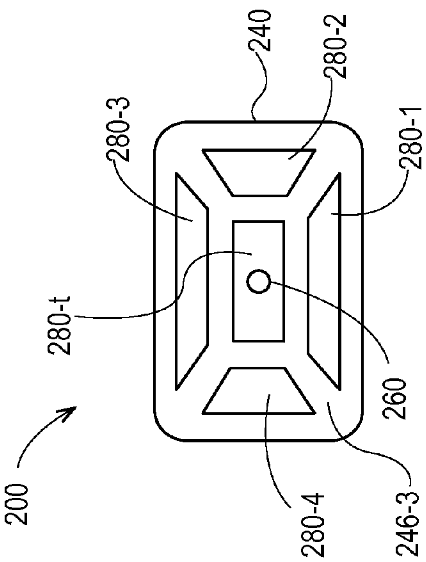


Fig. 1D



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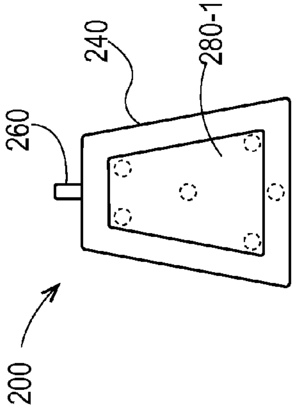

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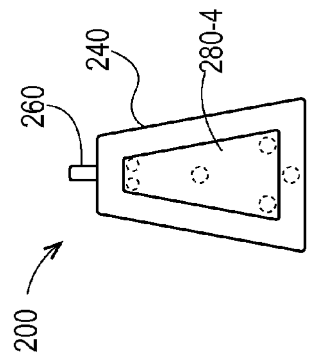

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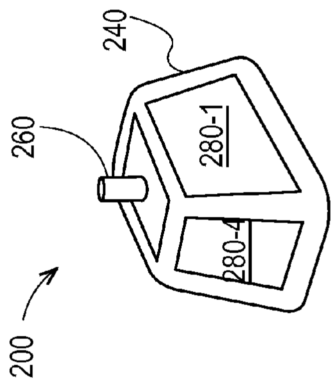

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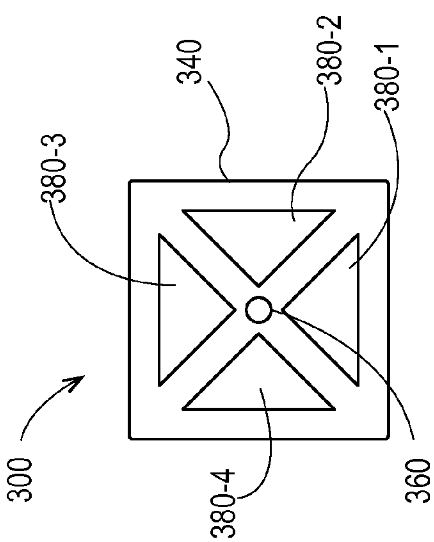

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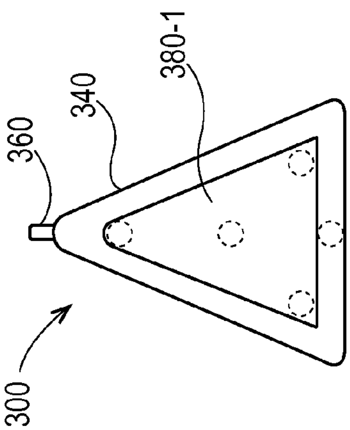

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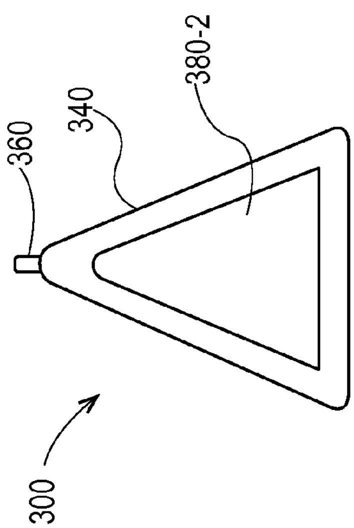

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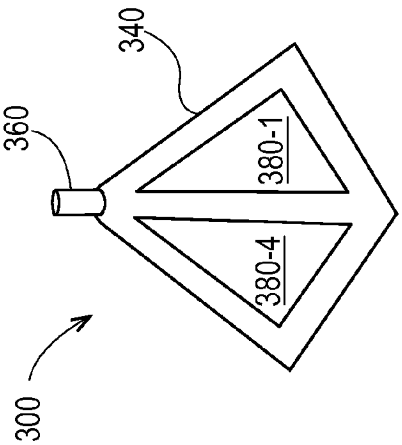

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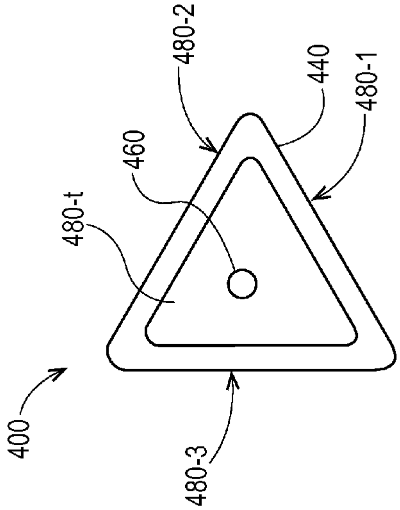

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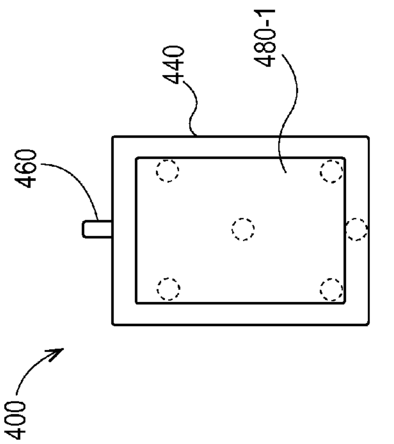

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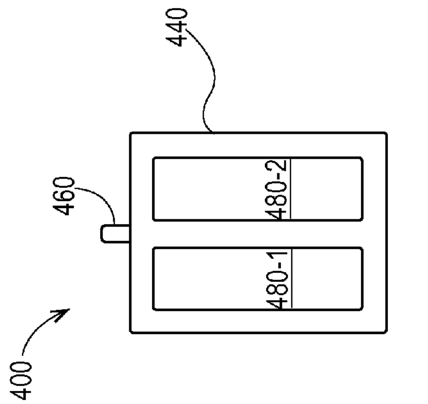

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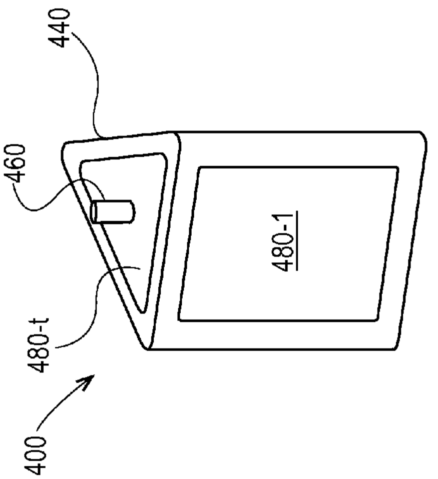

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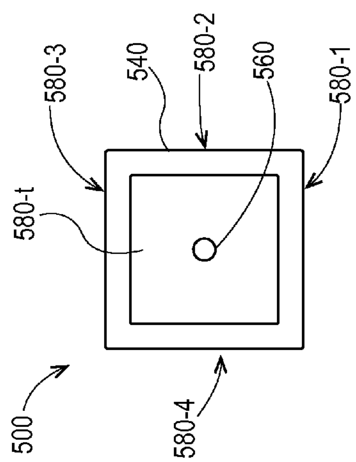

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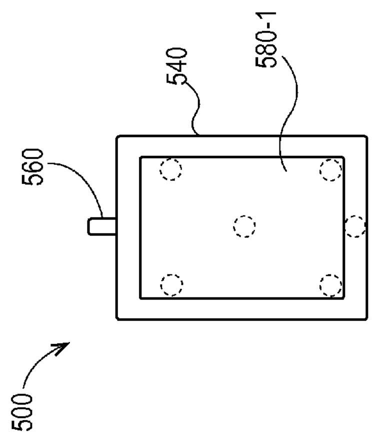

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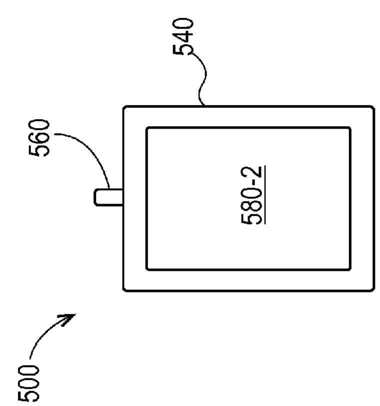

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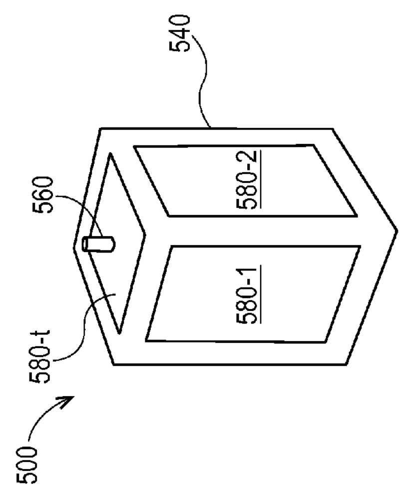

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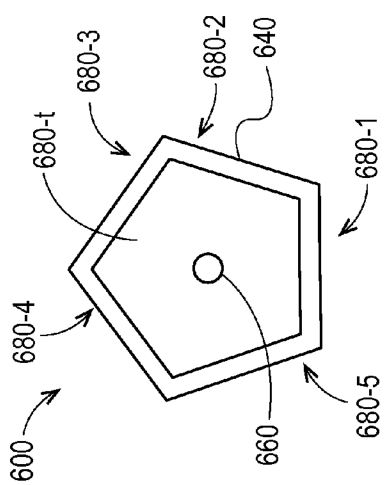

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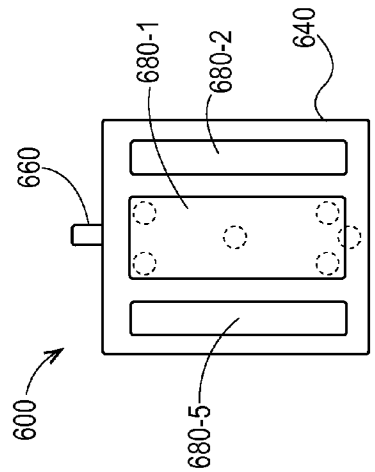

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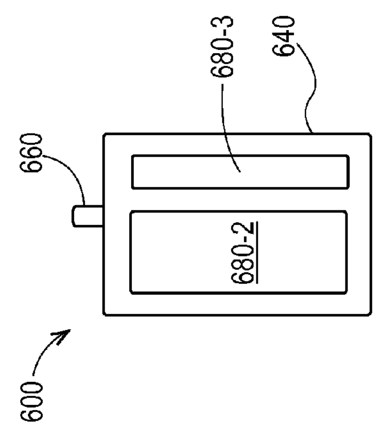

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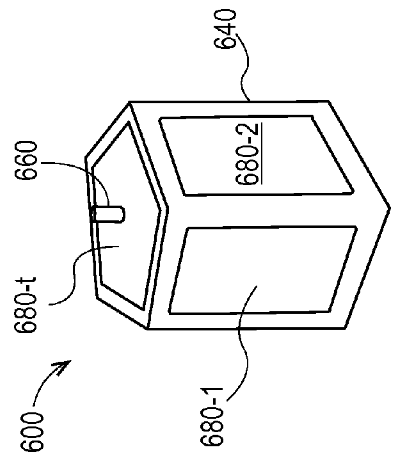

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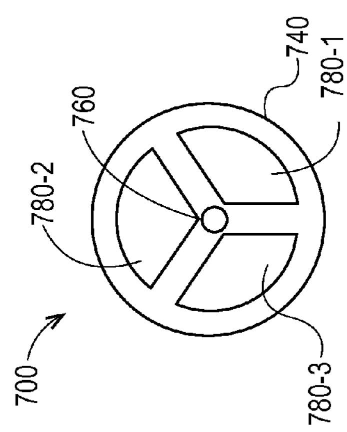

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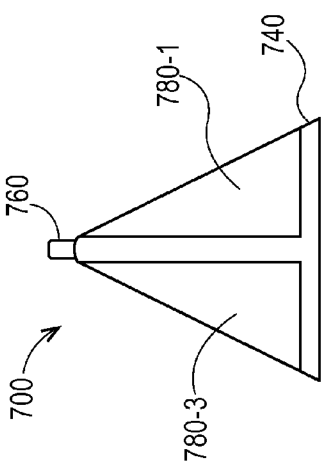

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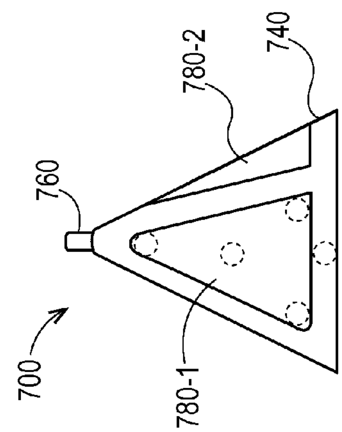

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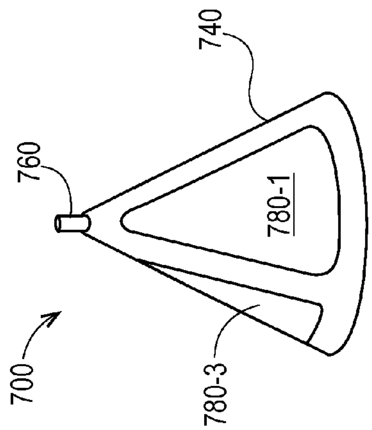

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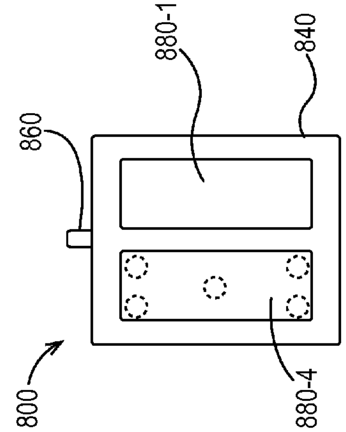

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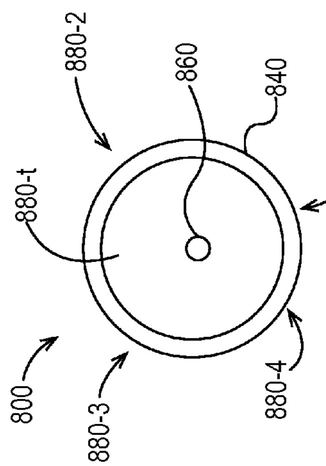

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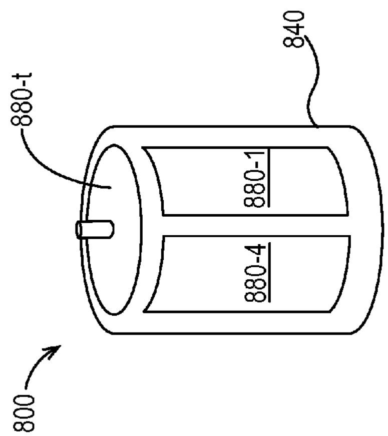

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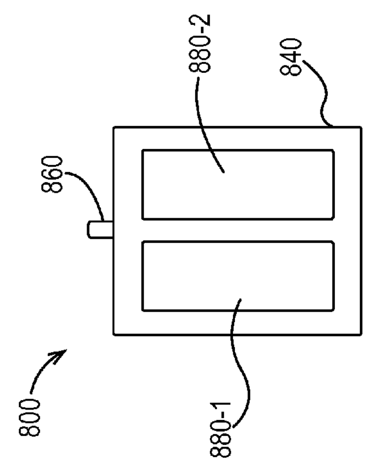

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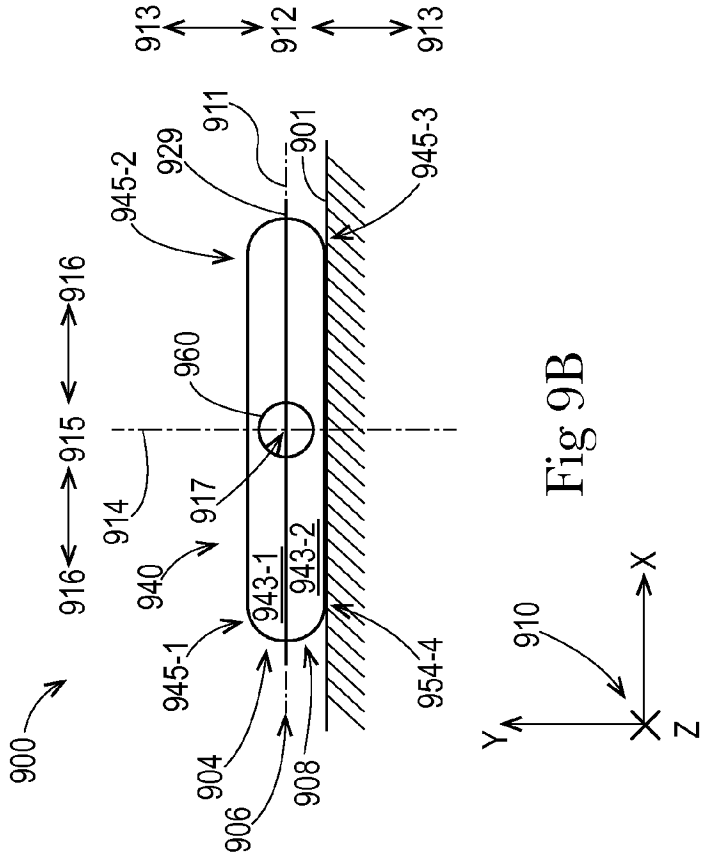
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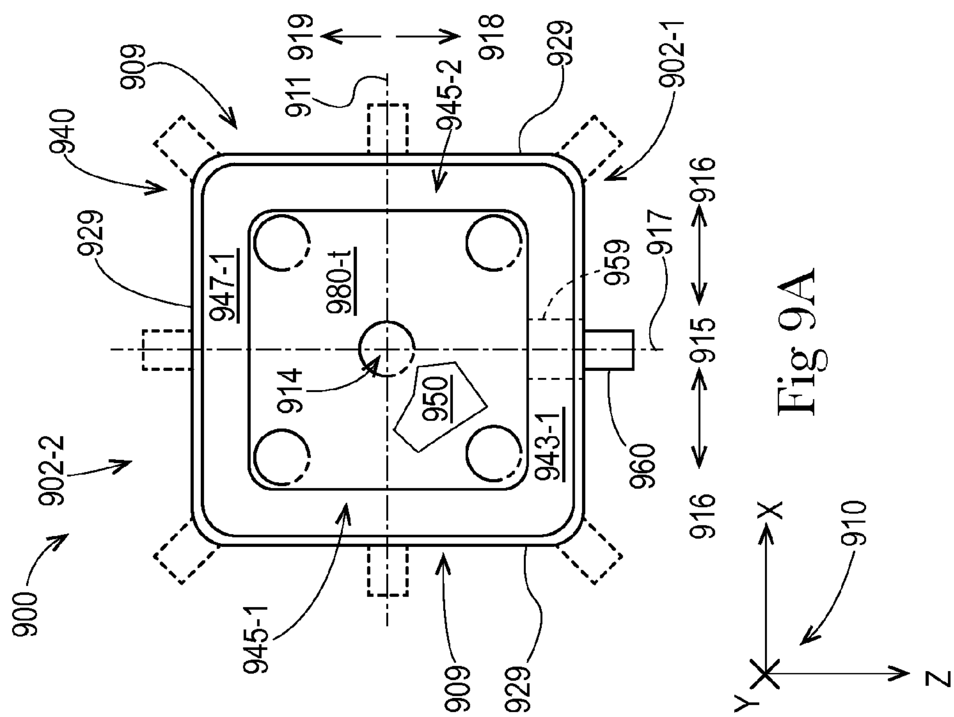
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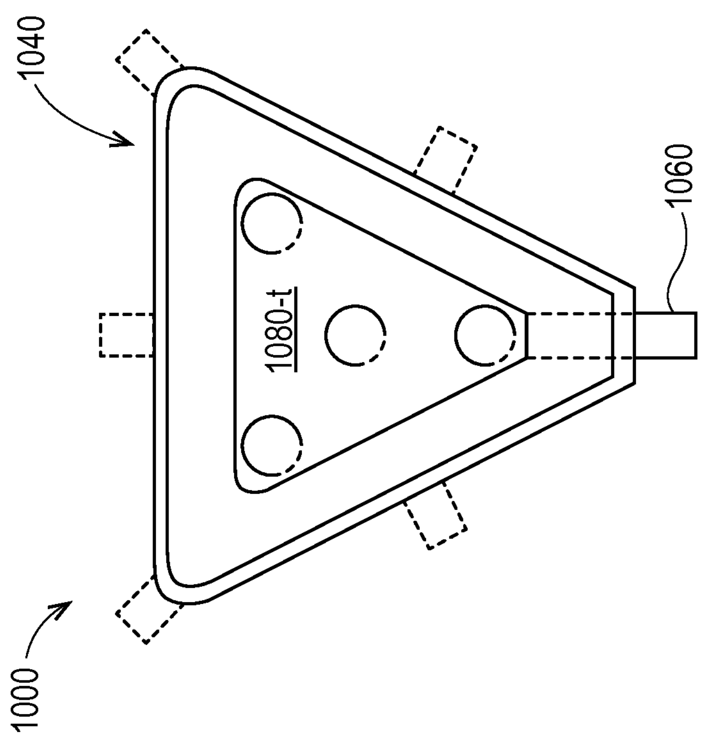
Fig 9A



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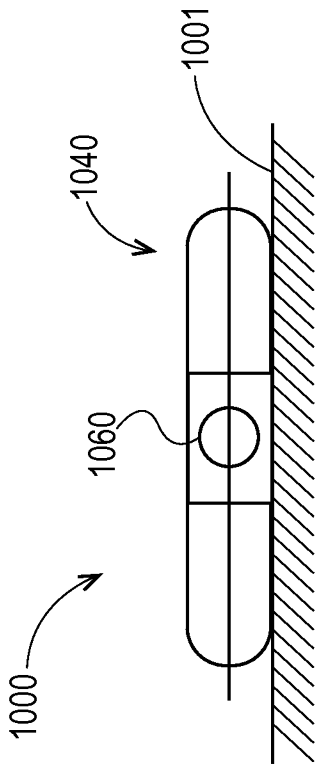

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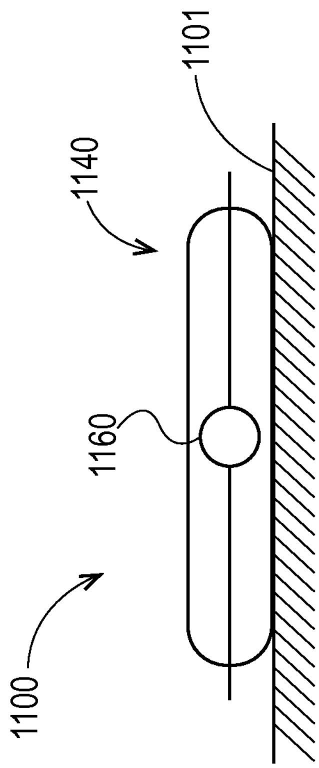
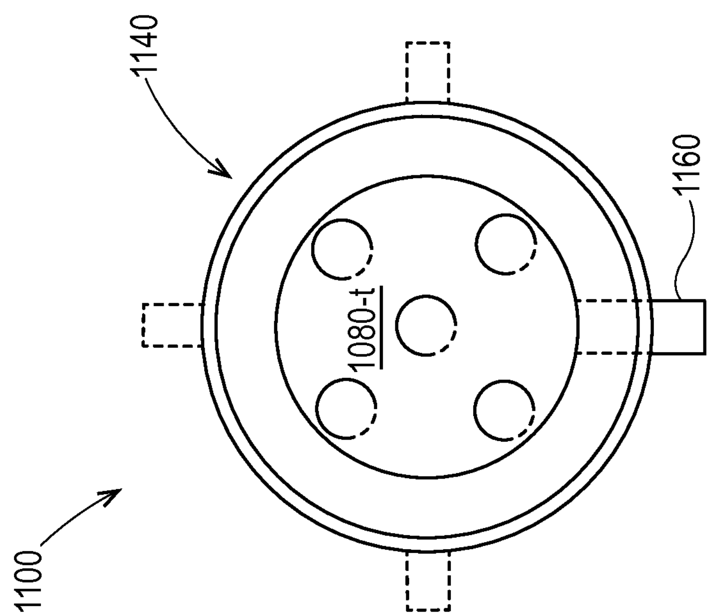


Fig 11B



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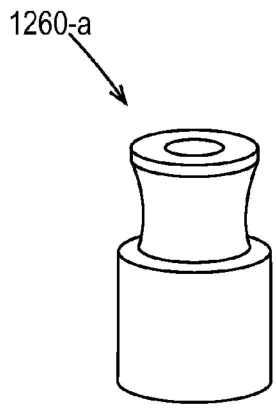
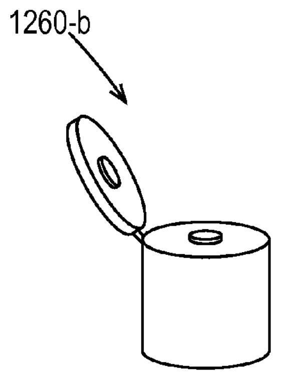


Fig 12A



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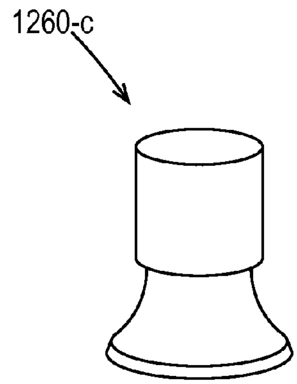

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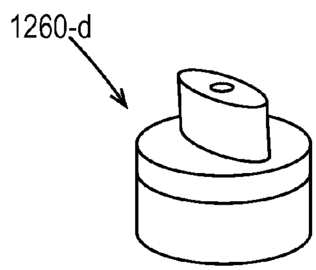

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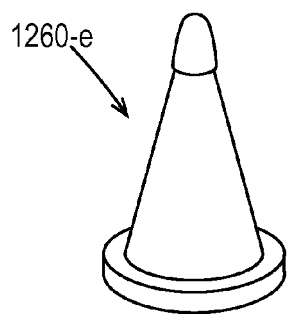

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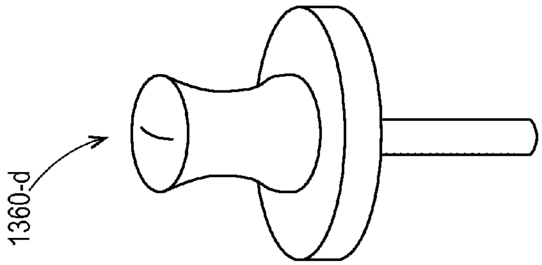

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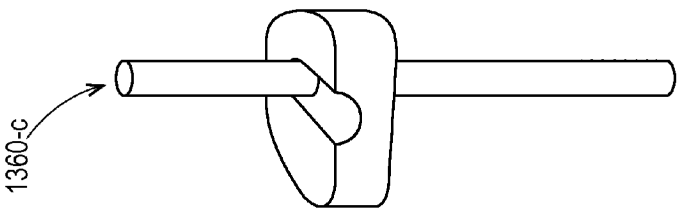
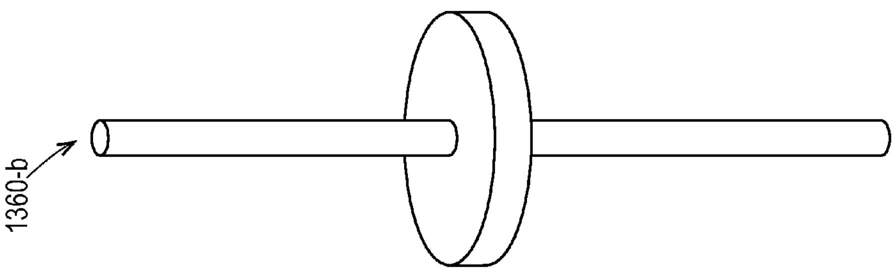


Fig 13C



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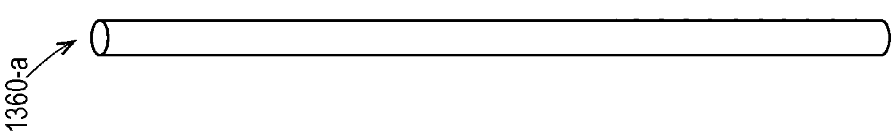

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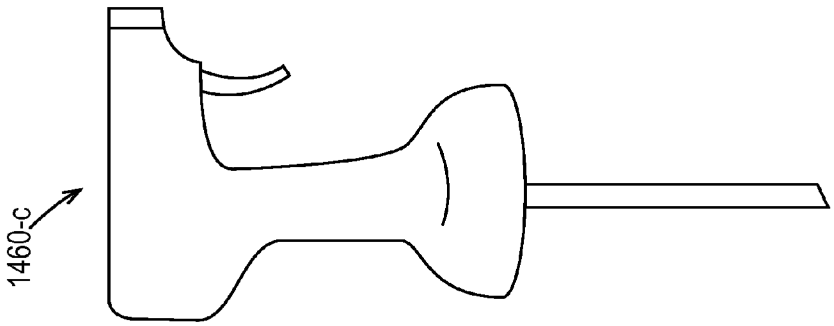

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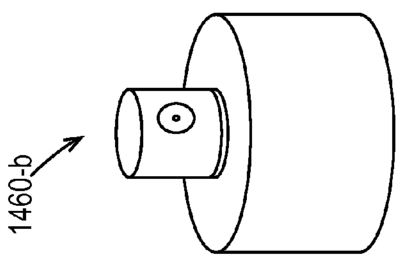

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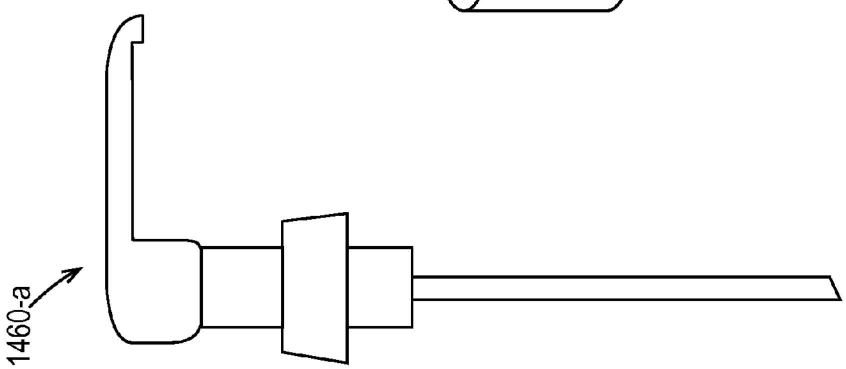

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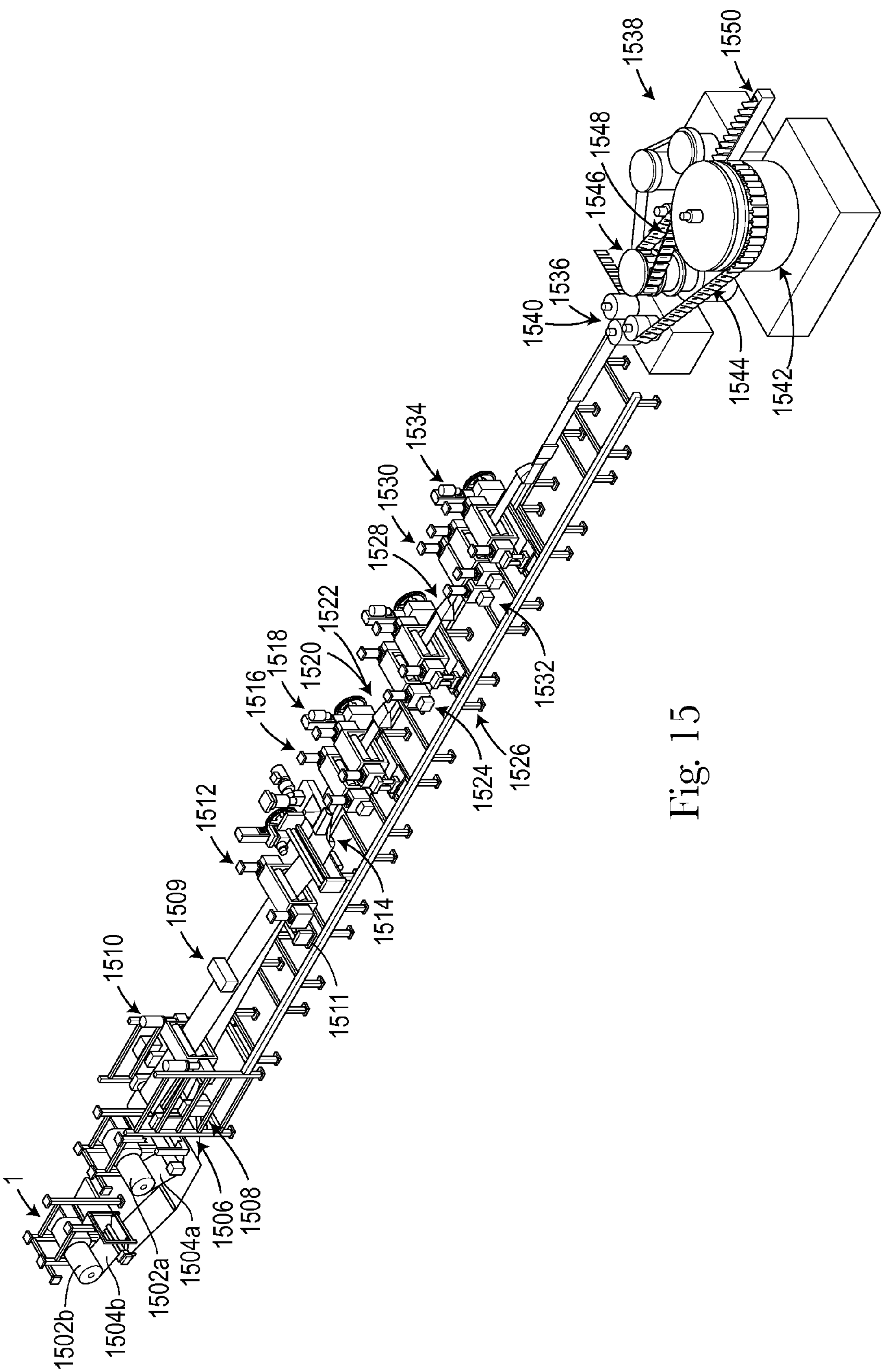
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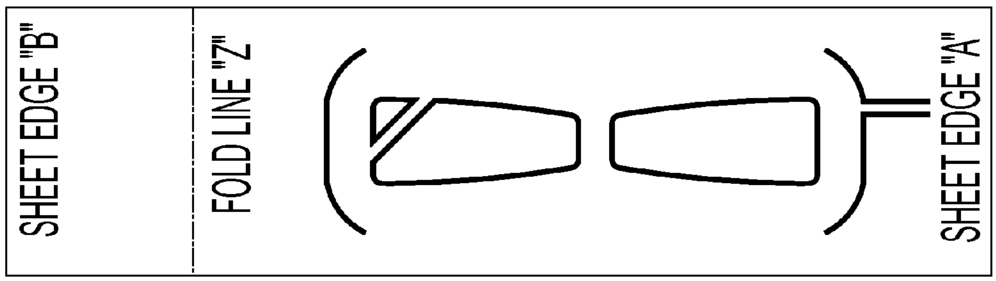
Fig. 15



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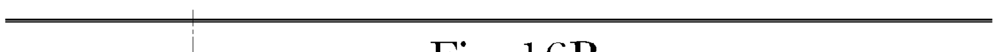

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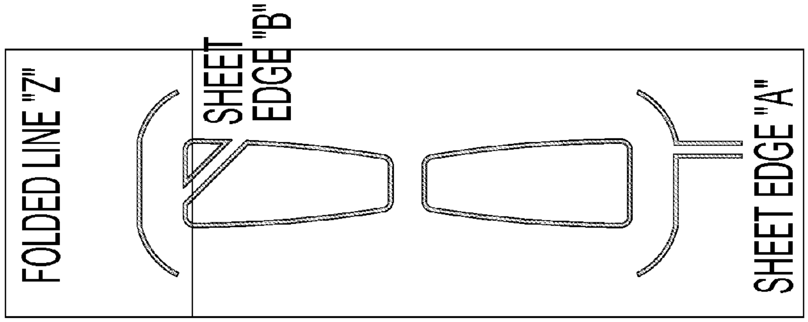


Fig. 17A

Fig. 17B

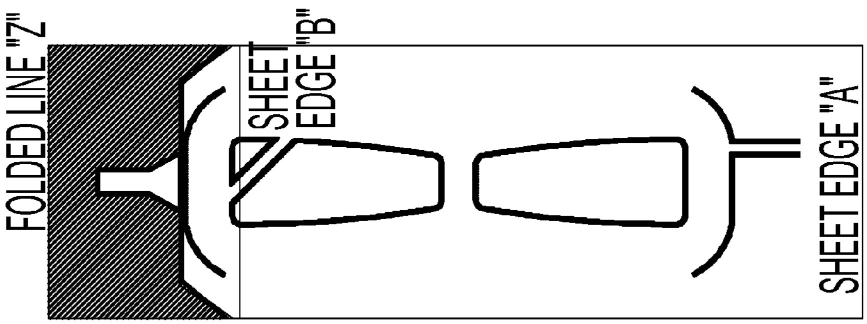


Fig. 18A

Fig. 18B

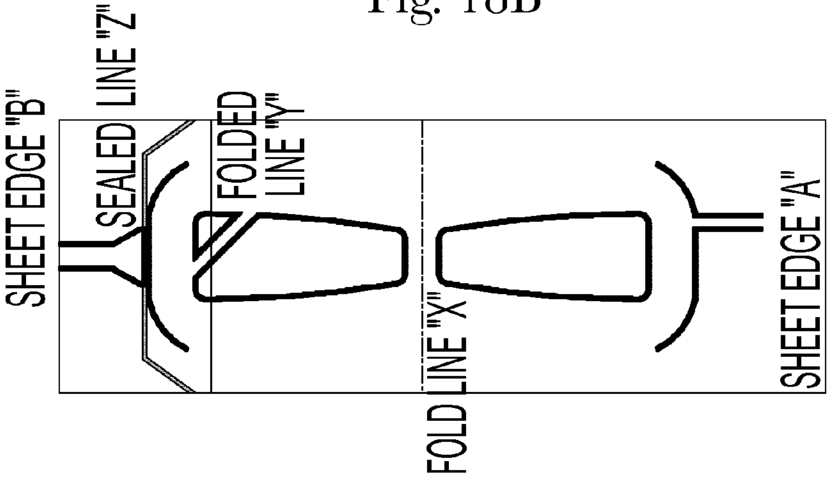


Fig. 19A


Fig. 19B

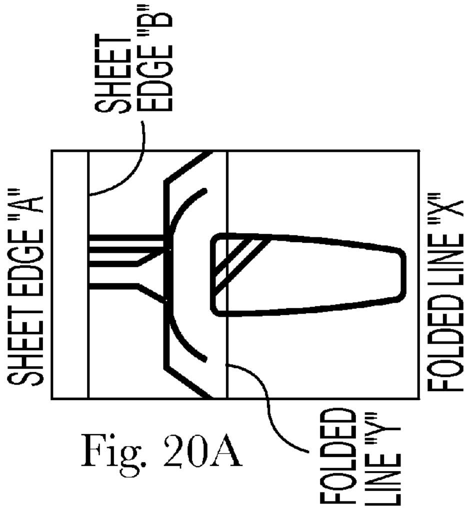


Fig. 20A


Fig. 20B

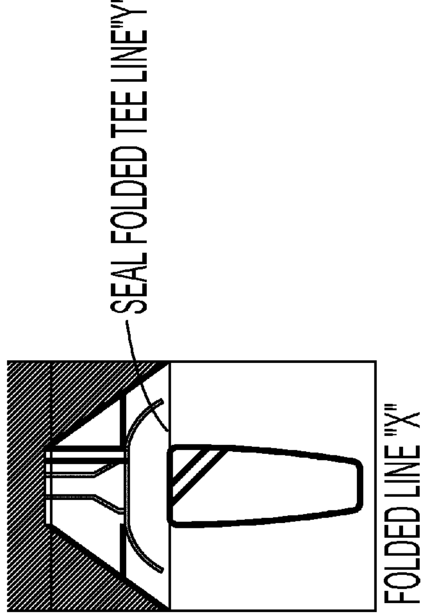
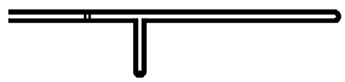


Fig. 22A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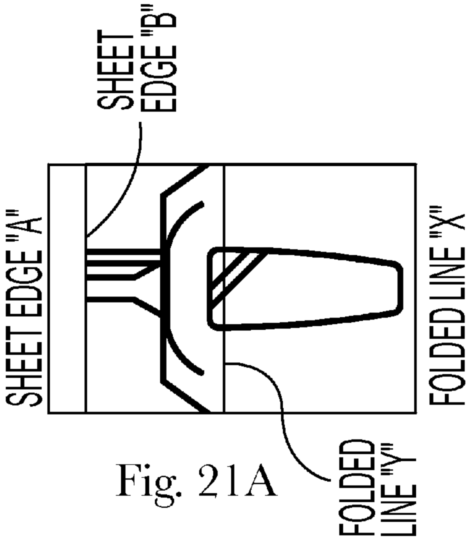

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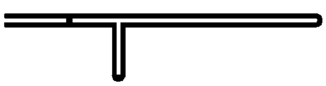
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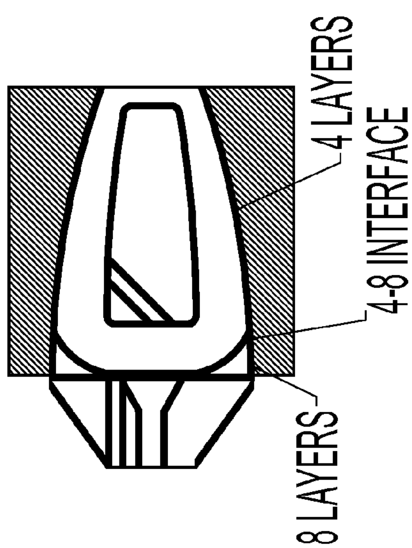

Fig. 23

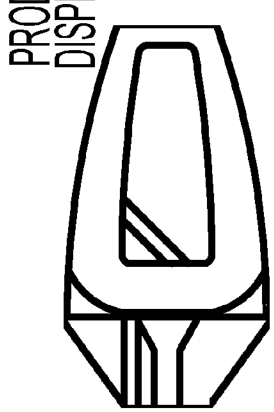

Fig. 24A

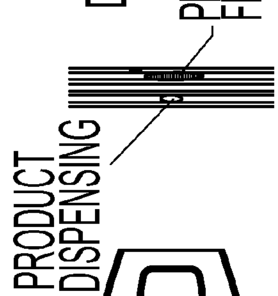

Fig. 24B

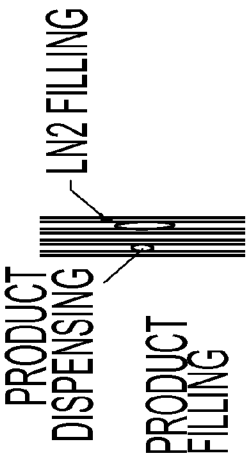

Fig. 24C

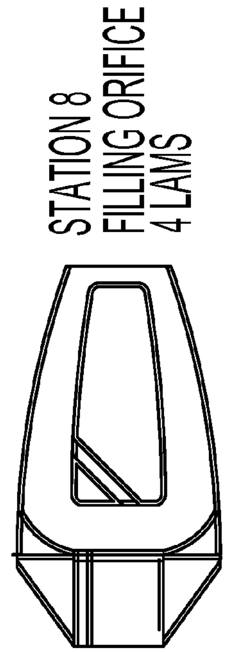

Fig. 25

METHOD OF FORMING A FLEXIBLE CONTAINER

FIELD OF THE INVENTION

[0001] The present disclosure relates in general to containers, and in particular, to methods of forming containers made from flexible material.

BACKGROUND OF THE INVENTION

[0002] Fluent products include liquid products and/or pourable solid products. In various embodiments, a container can be used to receive, contain, and dispense one or more fluent products. And, in various embodiments, a container can be used to receive, contain, and/or dispense individual articles or separately packaged portions of a product. A container can include one or more product volumes. A product volume can be configured to be filled with one or more fluent products. A container receives a fluent product when its product volume is filled. Once filled to a desired volume, a container can be configured to contain the fluent product in its product volume, until the fluent product is dispensed. A container contains a fluent product by providing a barrier around the fluent product. The barrier prevents the fluent product from escaping the product volume. The barrier can also protect the fluent product from the environment outside of the container. A filled product volume is typically closed off by a cap or a seal. A container can be configured to dispense one or more fluent products contained in its product volume(s). Once dispensed, an end user can consume, apply, or otherwise use the fluent product(s), as appropriate. In various embodiments, a container may be configured to be refilled and reused or a container may be configured to be disposed of after a single fill or even after a single use. A container should be configured with sufficient structural integrity, such that it can receive, contain, and dispense its fluent product(s), as intended, without failure.

[0003] A container for fluent product(s) can be handled, displayed for sale, and put into use. A container can be handled in many different ways as it is made, filled, decorated, packaged, shipped, and unpacked. A container can experience a wide range of external forces and environmental conditions as it is handled by machines and people, moved by equipment and vehicles, and contacted by other containers and various packaging materials. A container for fluent product(s) should be configured with sufficient structural integrity, such that it can be handled in any of these ways, or in any other way known in the art, as intended, without failure.

[0004] A container can also be displayed for sale in many different ways as it is offered for purchase. A container can be offered for sale as an individual article of commerce or packaged with one or more other containers or products, which together form an article of commerce. A container can be offered for sale as a primary package with or without a secondary package. A container can be decorated to display characters, graphics, branding, and/or other visual elements when the container is displayed for sale. A container can be configured to be displayed for sale while laying down or standing up on a store shelf, while presented in a merchandising display, while hanging on a display hanger, or while loaded into a display rack or a vending machine. A container for fluent product(s) should be configured with a structure that allows it to be displayed in any of these ways, or in any other way known in the art, as intended, without failure.

[0005] A container can also be put into use in many different ways, by its end user. A container can be configured to be held and/or gripped by an end user, so a container should be appropriately sized and shaped for human hands; and for this purpose, a container can include useful structural features such as a handle and/or a gripping surface. A container can be stored while laying down or standing up on a support surface, while hanging on or from a projection such as a hook or a clip, or while supported by a product holder, or (for refillable or rechargeable containers) positioned in a refilling or recharging station. A container can be configured to dispense fluent product(s) while in any of these storage positions or while being held by the user. A container can be configured to dispense fluent product(s) through the use of gravity, and/or pressure, and/or a dispensing mechanism, such as a pump, or a straw, or through the use of other kinds of dispensers known in the art. Some containers can be configured to be filled and/or refilled by a seller (e.g. a merchant or retailer) or by an end user. A container for fluent product(s) should be configured with a structure that allows it to be put to use in any of these ways, or in any other way known in the art, as intended, without failure. A container can also be configured to be disposed of by the end user, as waste and/or recyclable material, in various ways.

[0006] One conventional type of container for fluent products is a rigid container made from solid material(s). Examples of conventional rigid containers include molded plastic bottles, glass jars, metal cans, cardboard boxes, etc. These conventional rigid containers are well-known and generally useful; however their designs do present several notable difficulties.

[0007] First, some conventional rigid containers for fluent products can be expensive to make. Some rigid containers are made by a process shaping one or more solid materials. Other rigid containers are made with a phase change process, where container materials are heated (to soften/melt), then shaped, then cooled (to harden/solidify). Both kinds of making are energy intensive processes, which can require complex equipment.

[0008] Second, some conventional rigid containers for fluent products can require significant amounts of material. Rigid containers that are designed to stand up on a support surface require solid walls that are thick enough to support the containers when they are filled. This can require significant amounts of material, which adds to the cost of the containers and can contribute to difficulties with their disposal.

[0009] Third, some conventional rigid containers for fluent products can be difficult to decorate. The sizes, shapes, (e.g. curved surfaces) and/or materials of some rigid containers, make it difficult to print directly on their outside surfaces. Labeling requires additional materials and processing, and limits the size and shape of the decoration. Overwrapping provides larger decoration areas, but also requires additional materials and processing, often at significant expense.

[0010] Fourth, some conventional rigid containers for fluent products can be prone to certain kinds of damage. If a rigid container is pushed against a rough surface, then the container can become scuffed, which may obscure printing on the container. If a rigid container is pressed against a hard object, then the container can become dented, which may look unsightly. And if a rigid container is dropped, then the container can rupture, which may cause its fluent product to be lost.

[0011] Fifth, some fluent products in conventional rigid containers can be difficult to dispense. When an end user squeezes a rigid container to dispense its fluent product, the end user must overcome the resistance of the rigid sides, to deform the container. Some users may lack the hand strength to easily overcome that resistance; these users may dispense less than their desired amount of fluent product. Other users may need to apply so much of their hand strength, that they cannot easily control how much they deform the container; these users may dispense more than their desired amount of fluent product.

SUMMARY OF THE INVENTION

[0012] The present disclosure describes various embodiments of containers made from flexible material. Because these containers are made from flexible material, these containers can be less expensive to make, can use less material, and can be easier to decorate, when compared with conventional rigid containers. First, these containers can be less expensive to make, because the conversion of flexible materials (from sheet form to finished goods) generally requires less energy and complexity, than formation of rigid materials (from bulk form to finished goods). Second, these containers can use less material, because they are configured with novel support structures that do not require the use of the thick solid walls used in conventional rigid containers. Third, these flexible containers can be easier to print and/or decorate, because they are made from flexible materials, and flexible materials can be printed and/or decorated as conformable webs, before they are formed into containers. Fourth, these flexible containers can be less prone to scuffing, denting, and rupture, because flexible materials allow their outer surfaces to deform when contacting surfaces and objects, and then to bounce back. Fifth, fluent products in these flexible containers can be more readily and carefully dispensed, because the sides of the flexible containers can be more easily and controllably squeezed by human hands. Even though the containers of the present disclosure are made from flexible material, they can be configured with sufficient structural integrity, such that they can receive, contain, and dispense fluent product(s), as intended, without failure. Also, these containers can be configured with sufficient structural integrity, such that they can withstand external forces and environmental conditions from handling, without failure. Further, these containers can be configured with structures that allow them to be displayed and put into use, as intended, without failure.

[0013] To form a flexible container, an exemplary method comprises joining two flexible materials together to form a joined material and at least partially forming at least one structural support volume from the joined material. The method also comprises forming at least one expansion port in communication with the at least one structural support volume. The method further comprises joining another material to the joined material to at least partially form a product volume and also forming at least one fill port in communication with the product volume.

[0014] In one embodiment, the method may comprise at least partially filling the product volume with a quantity of the fluent product through the fill port. The method may also include expanding the at least one structural support volume by depositing an expansion material into the structural support volume through the expansion port. After at least partially filling the product volume and depositing the expansion material, the method may comprise sealing the fill and expansion ports.

[0015] In one embodiment, the two flexible materials may comprise an inner laminate and an outer laminate wherein neither the inner laminate nor the outer laminate are registered. In another embodiment, the two flexible materials forming the joined material may comprise an inner laminate and an outer laminate wherein at least the outer laminate is registered. In still another embodiment, the two materials may comprise an inner laminate and an outer laminate wherein both the inner and outer laminates are registered. In yet another embodiment, the inner laminate and the outer laminate may suitably comprise the same material or, alternatively, they may comprise different materials.

[0016] In another respect, the inner laminate and the outer laminate may suitably comprise two distinct sheets of material or, alternatively, they may comprise two distinct webs of material.

[0017] Preferably, the flexible container has a top, a bottom, a middle, a front, a back, a left side, and a right side and the fill port and expansion port are formed in at least one of the top, the bottom, the middle, the front, the back, the left side, and the right side for at least partially filling the product volume with a fluent product and depositing an expansion material into the at least one structural support volume. Also, the expansion material may comprise any of various materials capable of occupying the at least one structural support volume including liquid nitrogen which can be deposited through the expansion port into the at least one structural support volume following which the expansion port can be sealed to allow the liquid nitrogen to evaporate to pressurize the at least one structural support volume.

[0018] The exemplary method also may include providing an expansion material fill nozzle to deposit an expansion material through the expansion port into the at least one structural support volume, and causing the expansion material fill nozzle to undergo movement in relation to the expansion port. Specifically, the expansion material fill nozzle may suitably undergo movement in at least one direction to locate the expansion material fill nozzle in proximity to the expansion port for depositing the expansion material into the at least one structural support volume. After depositing the expansion material through the expansion port, the expansion material fill nozzle may suitably undergo movement in at least one direction to locate the expansion material fill nozzle out of proximity to the expansion port, and the expansion port may be sealed.

[0019] As an alternative, an expansion port guide nozzle may be located within the expansion port before utilizing the expansion material fill nozzle to deposit the expansion material into the at least one structural support volume. In one embodiment, the expansion material fill nozzle may be caused to undergo movement into the expansion port guide nozzle while the expansion port guide nozzle is located in the expansion port for depositing the expansion material. With this arrangement, the expansion material fill nozzle may be removed from the expansion port guide nozzle before or at the same time as the expansion port guide nozzle is removed from the expansion port.

[0020] The exemplary method may include providing a fluent product fill nozzle to deposit a fluent product through the fill port into the product volume, and causing the fluent product fill nozzle to undergo movement in relation to the fill port. The fluent product fill nozzle may undergo movement in at least one direction to locate the fluent product fill nozzle in proximity to the fill port for depositing the fluent product into the product volume. After depositing the fluent product through the fill port, the fluent product fill nozzle may suitably undergo movement in at least one direction to locate the fluent product fill nozzle out of proximity to the fill port, and the fill port may be sealed.

[0021] As an alternative, a fill port guide nozzle may be located within the fill port before utilizing the fluent product fill nozzle to deposit the fluent product into the product volume. In one embodiment, the fluent product fill nozzle may be caused to undergo movement into the fill port guide nozzle while the fill port guide nozzle is located in the fill port for depositing the fluent product. With this arrangement, the fluent product fill nozzle may be removed from the fill port guide nozzle before or at the same time as the fill port guide nozzle is removed from the fill port.

[0022] The product volume is filled with a quantity of the fluent product comprising between about 1% and about 100%, preferably, between about 50% and about 100%, and more preferably, between about 75% and about 100%, of the total available volume of the product volume, and the method includes removing excess air from the product volume before sealing the fill port.

[0023] In another respect, the flexible container is preferably formed to have a top and a bottom and to include a base structure formed from the joined material by folding over the joined material at the bottom of the flexible container and forming a seal. A gusset may advantageously be provided in the base structure by forming a seal therein. Further, a product dispensing port which is sealed, openable for dispensing the fluent product, and closable after dispensing the fluent product is advantageously formed to be in communication with the product volume.

[0024] Still other advantages and features will be understood from the accompanying illustrations and the detailed description set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. **1**A illustrates a front view of an embodiment of a stand up flexible container.

[0026] FIG. **1**B illustrates a side view of the stand up flexible container of FIG. **1**A.

[0027] FIG. **1**C illustrates a top view of the stand up flexible container of FIG. **1**A.

[0028] FIG. **1**D illustrates a bottom view of the stand up flexible container of FIG. **1**A.

[0029] FIG. **2**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a frustum.

[0030] FIG. **2**B illustrates a front view of the container of FIG. **2**A.

[0031] FIG. **2**C illustrates a side view of the container of FIG. **2**A.

[0032] FIG. **2**D illustrates an isometric view of the container of FIG. **2**A.

[0033] FIG. **3**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a pyramid.

[0034] FIG. **3**B illustrates a front view of the container of FIG. **3**A.

[0035] FIG. **3**C illustrates a side view of the container of FIG. **3**A.

[0036] FIG. **3**D illustrates an isometric view of the container of FIG. **3**A.

[0037] FIG. **4**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a trigonal prism.

[0038] FIG. **4**B illustrates a front view of the container of FIG. **4**A.

[0039] FIG. **4**C illustrates a side view of the container of FIG. **4**A.

[0040] FIG. **4**D illustrates an isometric view of the container of FIG. **4**A.

[0041] FIG. **5**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a tetragonal prism.

[0042] FIG. **5**B illustrates a front view of the container of FIG. **5**A.

[0043] FIG. **5**C illustrates a side view of the container of FIG. **5**A.

[0044] FIG. **5**D illustrates an isometric view of the container of FIG. **5**A.

[0045] FIG. **6**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a pentagonal prism.

[0046] FIG. **6**B illustrates a front view of the container of FIG. **6**A.

[0047] FIG. **6**C illustrates a side view of the container of FIG. **6**A.

[0048] FIG. **6**D illustrates an isometric view of the container of FIG. **6**A.

[0049] FIG. **7**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a cone.

[0050] FIG. **7**B illustrates a front view of the container of FIG. **7**A.

[0051] FIG. **7**C illustrates a side view of the container of FIG. **7**A.

[0052] FIG. **7**D illustrates an isometric view of the container of FIG. **7**A.

[0053] FIG. **8**A illustrates a top view of a stand up flexible container having a structural support frame that has an overall shape like a cylinder.

[0054] FIG. **8**B illustrates a front view of the container of FIG. **8**A.

[0055] FIG. **8**C illustrates a side view of the container of FIG. **8**A.

[0056] FIG. **8**D illustrates an isometric view of the container of FIG. **8**A.

[0057] FIG. **9**A illustrates a top view of an embodiment of a self-supporting flexible container, having an overall shape like a square.

[0058] FIG. **9**B illustrates an end view of the flexible container of FIG. **9**A.

[0059] FIG. **10**A illustrates a top view of an embodiment of a self-supporting flexible container, having an overall shape like a triangle.

[0060] FIG. **10**B illustrates an end view of the flexible container of FIG. **10**A.

[0061] FIG. **11**A illustrates a top view of an embodiment of a self-supporting flexible container, having an overall shape like a circle.

[0062] FIG. **11**B illustrates an end view of the flexible container of FIG. **11**A.

[0063] FIG. **12**A illustrates an isometric view of push-pull type dispenser.

[0064] FIG. **12**B illustrates an isometric view of dispenser with a flip-top cap.

[0065] FIG. **12**C illustrates an isometric view of dispenser with a screw-on cap.

[0066] FIG. **12**D illustrates an isometric view of rotatable type dispenser.

[0067] FIG. **12**E illustrates an isometric view of nozzle type dispenser with a cap.

[0068] FIG. **13**A illustrates an isometric view of straw dispenser.

[0069] FIG. **13**B illustrates an isometric view of straw dispenser with a lid.

[0070] FIG. **13**C illustrates an isometric view of flip up straw dispenser.

[0071] FIG. **13**D illustrates an isometric view of straw dispenser with bite valve.

[0072] FIG. **14**A illustrates an isometric view of pump type dispenser.

[0073] FIG. **14**B illustrates an isometric view of pump spray type dispenser.

[0074] FIG. **14**C illustrates an isometric view of trigger spray type dispenser.

[0075] FIG. **15** is a perspective view of a production line layout for the method of forming a flexible container for one embodiment.

[0076] FIG. **16**A is a top plan view of a two webs after a sealing step at a first station for forming a flexible container.

[0077] FIG. **16**B is a front elevational view of the sealed webs illustrated in FIG. **16**A.

[0078] FIG. **17**A is a top plan view after performing a folding step at a second station for forming a flexible container.

[0079] FIG. **17**B is a front elevational view of the folded webs illustrated in FIG. **17**A.

[0080] FIG. **18**A is a top plan view after performing a cut/seal step at a third station for forming a flexible container.

[0081] FIG. **18**B is a front elevational view of the cut/seal webs illustrated in FIG. **18**A.

[0082] FIG. **19**A is a top plan view after performing a folding step at a fourth station for forming a flexible container.

[0083] FIG. **19**B is a front elevational view of the folded webs illustrated in FIG. **19**A.

[0084] FIG. **20**A is a top plan view after performing a folding step at a fifth station for forming a flexible container.

[0085] FIG. **20**B is a front elevational view of the folded webs illustrated in FIG. **20**A.

[0086] FIG. **21**A is a top plan view after performing a T-folding step at a sixth station for forming a flexible container.

[0087] FIG. **21**B is a front elevational view of the T-folded webs illustrated in FIG. **21**A.

[0088] FIG. **22**A is a top plan view after performing a T-seal/cut step at a seventh station for forming a flexible container.

[0089] FIG. **22**B is a front elevational view of the T-seal/cut webs illustrated in FIG. **22**A.

[0090] FIG. **23** is a top plan view after performing a seal/cut step at an eight station to complete forming a flexible container.

[0091] FIG. **24**A is a top plan view illustrating a flexible container at a ninth station ready for filling with a fluent product and an expansion material.

[0092] FIG. **24**B is an end elevational view of the flexible container illustrated in FIG. **24**A denoting a fill port for depositing a fluent product.

[0093] FIG. **24**C is an end elevational view of the flexible container illustrated in FIG. **24**B denoting an expansion port for depositing an expansion material.

[0094] FIG. **25** is a top plan view after performing a seal/cut at a 12th station to remove the fill port and the expansion port to finalize the flexible container.

DETAILED DESCRIPTION OF THE INVENTION

[0095] The present disclosure describes various embodiments of containers made from flexible material. Because these containers are made from flexible material, these containers can be less expensive to make, can use less material, and can be easier to decorate, when compared with conventional rigid containers. First, these containers can be less expensive to make, because the conversion of flexible materials (from sheet form to finished goods) generally requires less energy and complexity, than formation of rigid materials (from bulk form to finished goods). Second, these containers can use less material, because they are configured with novel support structures that do not require the use of the thick solid walls used in conventional rigid containers. Third, these flexible containers can be easier to decorate, because their flexible materials can be easily printed before they are formed into containers. Fourth, these flexible containers can be less prone to scuffing, denting, and rupture, because flexible materials allow their outer surfaces to deform when contacting surfaces and objects, and then to bounce back. Fifth, fluent products in these flexible containers can be more readily and carefully dispensed, because the sides of flexible containers can be more easily and controllably squeezed by human hands.

[0096] Even though the containers of the present disclosure are made from flexible material, they can be configured with sufficient structural integrity, such that they can receive, contain, and dispense fluent product(s), as intended, without failure. Also, these containers can be configured with sufficient structural integrity, such that they can withstand external forces and environmental conditions from handling, without failure. Further, these containers can be configured with structures that allow them to be displayed for sale and put into use, as intended, without failure.

[0097] As used herein, the term "about" modifies a particular value, by referring to a range equal to the particular value, plus or minus twenty percent (+/−20%). For any of the embodiments of flexible containers, disclosed herein, any disclosure of a particular value, can, in various alternate embodiments, also be understood as a disclosure of a range equal to about that particular value (i.e. +/−20%).

[0098] As used herein, the term "ambient conditions" refers to a temperature within the range of 15-35 degrees Celsius and a relative humidity within the range of 35-75%.

[0099] As used herein, the term "approximately" modifies a particular value, by referring to a range equal to the particular value, plus or minus fifteen percent (+/−15%). For any of the embodiments of flexible containers, disclosed herein, any disclosure of a particular value, can, in various alternate embodiments, also be understood as a disclosure of a range equal to approximately that particular value (i.e. +/−15%).

[0100] As used herein, when referring to a sheet of material, the term "basis weight" refers to a measure of mass per area, in units of grams per square meter (gsm). For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any of the flexible materials can be configured to have a basis weight of 10-1000 gsm, or any integer value for gsm from 10-1000, or within any range formed by any of these values, such as 20-800 gsm, 30-600 gsm, 40-400 gsm, or 50-200, etc.

[0101] As used herein, when referring to a flexible container, the term "bottom" refers to the portion of the container that is located in the lowermost 30% of the overall height of the container, that is, from 0-30% of the overall height of the container. As used herein, the term bottom can be further limited by modifying the term bottom with a particular percentage value, which is less than 30%. For any of the embodiments of flexible containers, disclosed herein, a reference to the bottom of the container can, in various alternate embodiments, refer to the bottom 25% (i.e. from 0-25% of the overall height), the bottom 20% (i.e. from 0-20% of the overall height), the bottom 15% (i.e. from 0-15% of the overall height), the bottom 10% (i.e. from 0-10% of the overall height), or the bottom 5% (i.e. from 0-5% of the overall height), or any integer value for percentage between 0% and 30%.

[0102] As used herein, the term "branding" refers to a visual element intended to distinguish a product from other products. Examples of branding include one of more of any of the following: trademarks, trade dress, logos, icons, and the like. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any surface of the flexible container can include one or more brandings of any size, shape, or configuration, disclosed herein or known in the art, in any combination.

[0103] As used herein, the term "character" refers to a visual element intended to convey information. Examples of characters include one or more of any of the following: letters, numbers, symbols, and the like. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any surface of the flexible container can include one or more characters of any size, shape, or configuration, disclosed herein or known in the art, in any combination.

[0104] As used herein, the term "closed" refers to a state of a product volume, wherein fluent products within the product volume are prevented from escaping the product volume (e.g. by one or more materials that form a barrier, and by a cap), but the product volume is not necessarily hermetically sealed. For example, a closed container can include a vent, which allows a head space in the container to be in fluid communication with air in the environment outside of the container.

[0105] As used herein, the term "directly connected" refers to a configuration wherein elements are attached to each other without any intermediate elements therebetween, except for any means of attachment (e.g. adhesive).

[0106] As used herein, when referring to a flexible container, the term "dispenser" refers to a structure configured to dispense fluent product(s) from a product volume and/or from a mixing volume to the environment outside of the container. For any of the flexible containers disclosed herein, any dispenser can be configured in any way disclosed herein or known in the art, including any suitable size, shape, and flow rate. For example, a dispenser can be a push-pull type dispenser, a dispenser with a flip-top cap, a dispenser with a screw-on cap, a rotatable type dispenser, dispenser with a cap, a pump type dispenser, a pump spray type dispenser, a trigger spray type dispenser, a straw dispenser, a flip up straw dispenser, a straw dispenser with bite valve, a dosing dispenser, etc. A dispenser can be a parallel dispenser, providing multiple flow channels in fluid communication with multiple product volumes, wherein those flow channels remain separate until the point of dispensing, thus allowing fluent products from multiple product volumes to be dispensed as separate fluent products, dispensed together at the same time. A dispenser can be a mixing dispenser, providing one or more flow channels in fluid communication with multiple product volumes, with multiple flow channels combined before the point of dispensing, thus allowing fluent products from multiple product volumes to be dispensed as the fluent products mixed together. As another example, a dispenser can be formed by a frangible opening. As further examples, a dispenser can utilize one or more valves and/or dispensing mechanisms disclosed in the art, such as those disclosed in: published US patent application 2003/0096068, entitled "One-way valve for inflatable package"; U.S. Pat. No. 4,988, 016 entitled "Self-sealing container"; and U.S. Pat. No. 7,207,717, entitled "Package having a fluid actuated closure"; each of which is hereby incorporated by reference. Still further, any of the dispensers disclosed herein, may be incorporated into a flexible container either directly, or in combination with one or more other materials or structures (such as a fitment), or in any way known in the art. In some alternate embodiments, dispensers disclosed herein can be configured for both dispensing and filling, to allow filling of product volume(s) through one or more dispensers. In other alternate embodiments, a product volume can include one or more filling structure(s) (e.g. for adding water to a mixing volume) in addition to or instead of one or more dispenser(s). Any location for a dispenser, disclosed herein can alternatively be used as a location for a filling structure.

[0107] As used herein, when referring to a flexible container, the term "disposable" refers to a container which, after dispensing a product to an end user, is not configured to be refilled with an additional amount of the product, but is configured to be disposed of (i.e. as waste, compost, and/or recyclable material). Part, parts, or all of any of the embodiments of flexible containers, disclosed herein, can be configured to be disposable.

[0108] As used herein, when referring to a flexible container, the term "durable" refers to a container that is reusable more than non-durable containers.

[0109] As used herein, when referring to a flexible container, the term "effective base contact area" refers to a particular area defined by a portion of the bottom of the container, when the container (with all of its product volume(s) filled 100% with water) is standing upright and its bottom is resting on a horizontal support surface. The effective base contact area lies in a plane defined by the horizontal support surface. The effective base contact area is a continuous area bounded on all sides by an outer periphery.

[0110] The outer periphery is formed from an actual contact area and from a series of projected areas from defined cross-sections taken at the bottom of the container. The actual contact area is the one or more portions of the bottom of the container that contact the horizontal support surface, when the effective base contact area is defined. The effective base contact area includes all of the actual contact area. However, in some embodiments, the effective base contact area may extend beyond the actual contact area.

[0111] The series of projected area are formed from five horizontal cross-sections, taken at the bottom of the flexible container. These cross-sections are taken at 1%, 2%, 3%, 4%, and 5% of the overall height. The outer extent of each of these cross-sections is projected vertically downward onto the horizontal support surface to form five (overlapping) projected areas, which, together with the actual contact area, form a single combined area. This is not a summing up of the values for these areas, but is the formation of a single combined area that includes all of these (projected and actual) areas, overlapping each other, wherein any overlapping portion makes only one contribution to the single combined area.

[0112] The outer periphery of the effective base contact area is formed as described below. In the following description, the terms convex, protruding, concave, and recessed are understood from the perspective of points outside of the combined area. The outer periphery is formed by a combination of the outer extent of the combined area and any chords, which are straight line segments constructed as described below.

[0113] For each continuous portion of the combined area that has an outer perimeter with a shape that is concave or recessed, a chord is constructed across that portion. This chord is the shortest straight line segment that can be drawn tangent to the combined area on both sides of the concave/recessed portion.

[0114] For a combined area that is discontinuous (formed by two or more separate portions), one or more chords are constructed around the outer perimeter of the combined area, across the one or more discontinuities (open spaces disposed between the portions). These chords are straight lines segments drawn tangent to the outermost separate portions of the combined area. These chords are drawn to create the largest possible effective base contact area.

[0115] Thus, the outer periphery is formed by a combination of the outer extent of the combined area and any chords, constructed as described above, which all together enclose the effective base area. Any chords that are bounded by the combined area and/or one or more other chords, are not part of the outer periphery and should be ignored.

[0116] Any of the embodiments of flexible containers, disclosed herein, can be configured to have an effective base contact area from 1 to 50,000 square centimeters (cm^2), or any integer value for cm^2 between 1 and 50,000 cm^2, or within any range formed by any of the preceding values, such as: from 2 to 25,000 cm^2, 3 to 10,000 cm^2, 4 to 5,000 cm^2, 5 to 2,500 cm^2, from 10 to 1,000 cm^2, from 20 to 500 cm^2, from 30 to 300 cm^2, from 40 to 200 cm^2, or from 50 to 100 cm^2, etc.

[0117] As used herein, when referring to a flexible container, the term "expanded" refers to the state of one or more flexible materials that are configured to be formed into a structural support volume, after the structural support volume is made rigid by one or more expansion materials. An expanded structural support volume has an overall width that is significantly greater than the combined thickness of its one or more flexible materials, before the structural support volume is filled with the one or more expansion materials. Examples of expansion materials include liquids (e.g. water), gases (e.g. compressed air), fluent products, foams (that can expand after being added into a structural support volume), co-reactive materials (that produce gas), or phase change materials (that can be added in solid or liquid form, but which turn into a gas; for example, liquid nitrogen or dry ice), or other suitable materials known in the art, or combinations of any of these (e.g. fluent product and liquid nitrogen). In various embodiments, expansion materials can be added at atmospheric pressure, or added under pressure greater than atmospheric pressure, or added to provide a material change that will increase pressure to something above atmospheric pressure. For any of the embodiments of flexible containers, disclosed herein, its one or more flexible materials can be expanded at various points in time, with respect to its manufacture, sale, and use, including, for example: before or after its product volume(s) are filled with fluent product(s), before or after the flexible container is shipped to a seller, and before or after the flexible container is purchased by an end user.

[0118] As used herein, when referring to a product volume of a flexible container, the term "filled" refers to the state when the product volume contains an amount of fluent product(s) that is equal to a full capacity for the product volume, with an allowance for head space, under ambient conditions. As used herein, the term filled can be modified by using the term filled with a particular percentage value, wherein 100% filled represents the maximum capacity of the product volume.

[0119] As used herein, the term "flat" refers to a surface that is without significant projections or depressions.

[0120] As used herein, the term "flexible container" refers to a container configured to have a product volume, wherein one or more flexible materials form 50-100% of the overall surface area of the one or more materials that define the three-dimensional space of the product volume. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, the flexible container can be configured to have a product volume, wherein one or more flexible materials form a particular percentage of the overall area of the one or more materials that define the three-dimensional space, and the particular percentage is any integer value for percentage between 50% and 100%, or within any range formed by any of these values, such as: 60-100%, or 70-100%, or 80-100%, or 90-100%, etc. One kind of flexible container is a film-based container, which is a flexible container made from one or more flexible materials, which include a film.

[0121] For any of the embodiments of flexible containers, disclosed herein, in various embodiments, the middle of the flexible container (apart from any fluent product) can be configured to have an overall middle mass, wherein one or more flexible materials form a particular percentage of the overall middle mass, and the particular percentage is any integer value for percentage between 50% and 100%, or within any range formed by any of the preceding values, such as: 60-100%, or 70-100%, or 80-100%, or 90-100%, etc.

[0122] For any of the embodiments of flexible containers, disclosed herein, in various embodiments, the entire flexible container (apart from any fluent product) can be configured to have an overall mass, wherein one or more flexible materials form a particular percentage of the overall mass, and the particular percentage is any integer value for percentage between 50% and 100%, or within any range formed by any of the preceding values, such as: 60-100%, or 70-100%, or 80-100%, or 90-100%, etc.

[0123] As used herein, when referring to a flexible container, the term "flexible material" refers to a thin, easily deformable, sheet-like material, having a flexibility factor within the range of 1,000-2,500,000 N/m. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any of the flexible materials can be configured to have a flexibility factor of 1,000-2,500,000 N/m, or any integer value for flexibility factor from 1,000-2,500,000 N/m, or within any range formed by any of these values, such as 1,000-1,500,000 N/m, 1,500-1,000,000 N/m, 2,500-800,000 N/m, 5,000-700,000 N/m, 10,000-600,000 N/m, 15,000-500,000 N/m, 20,000-400,000 N/m, 25,000-300,000 N/m, 30,000-200,000 N/m, 35,000-100,000 N/m, 40,000-90,000 N/m, or 45,000-85,000 N/m, etc. Throughout the present disclosure the terms "flexible material", "flexible sheet", "sheet", and "sheet-like material" are used interchangeably and are intended to have the same meaning. Examples of materials that can be flexible materials include one or more of any of the following: films (such as plastic films), elastomers, foamed sheets, foils, fabrics (including wovens and nonwovens), biosourced materials, and papers, in any configuration, as separate material(s), or as layer(s) of a laminate, or as part(s) of a composite material, in a microlayered or nanolayered structure, and in any combination, as described herein or as known in the art. In various embodiments, part, parts, or all of a flexible material can be coated or uncoated, treated or untreated, processed or unprocessed, in any manner known in the art. In various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of a flexible material can made of sustainable, bio-sourced, recycled, recyclable, and/or biodegradable material. Part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the flexible materials described herein can be partially or completely translucent, partially or completely transparent, or partially or completely opaque. The flexible materials used to make the containers disclosed herein can be formed in any manner known in the art, and can be joined together using any kind of joining or sealing method known in the art, including, for example, heat sealing (e.g. conductive sealing, impulse sealing, ultrasonic sealing, etc.), welding, crimping, bonding, adhering, and the like, and combinations of any of these.

[0124] As used herein, when referring to a flexible container, the term "flexibility factor" refers to a material parameter for a thin, easily deformable, sheet-like material, wherein the parameter is measured in Newtons per meter, and the flexibility factor is equal to the product of the value for the Young's modulus of the material (measured in Pascals) and the value for the overall thickness of the material (measured in meters).

[0125] As used herein, when referring to a flexible container, the term "fluent product" refers to one or more liquids and/or pourable solids, and combinations thereof. Examples of fluent products include one or more of any of the following: bites, bits, creams, chips, chunks, crumbs, crystals, emulsions, flakes, gels, grains, granules, jellies, kibbles, liquid solutions, liquid suspensions, lotions, nuggets, ointments, particles, particulates, pastes, pieces, pills, powders, salves, shreds, sprinkles, and the like, either individually or in any combination. Throughout the present disclosure the terms "fluent product" and "flowable product" are used interchangeably and are intended to have the same meaning. Any of the product volumes disclosed herein can be configured to include one or more of any fluent product disclosed herein, or known in the art, in any combination.

[0126] As used herein, when referring to a flexible container, the term "formed" refers to the state of one or more materials that are configured to be formed into a product volume, after the product volume is provided with its defined three-dimensional space.

[0127] As used herein, the term "graphic" refers to a visual element intended to provide a decoration or to communicate information. Examples of graphics include one or more of any of the following: colors, patterns, designs, images, and the like. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any surface of the flexible container can include one or more graphics of any size, shape, or configuration, disclosed herein or known in the art, in any combination.

[0128] As used herein, when referring to a flexible container, the term "height area ratio" refers to a ratio for the container, with units of per centimeter (cm^{-1}), which is equal to the value for the overall height of the container (with all of its product volume(s) filled 100% with water, and with overall height measured in centimeters) divided by the value for the effective base contact area of the container (with all of its product volume(s) filled 100% with water, and with effective base contact area measured in square centimeters). For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any of the flexible containers, can be configured to have a height area ratio from 0.3 to 3.0 per centimeter, or any value in increments of 0.05 cm^{-1} between 0.3 and 3.0 per centimeter, or within any range formed by any of the preceding values, such as: from 0.35 to 2.0 cm^{-1}, from 0.4 to 1.5 cm^{-1}, from 0.4 to 1.2 cm^{-1}, or from 0.45 to 0.9 cm^{-1}, etc.

[0129] As used herein, the term "indicia" refers to one or more of characters, graphics, branding, or other visual elements, in any combination. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any surface of the flexible container can include one or more indicia of any size, shape, or configuration, disclosed herein or known in the art, in any combination.

[0130] As used herein, the term "indirectly connected" refers to a configuration wherein elements are attached to each other with one or more intermediate elements therebetween.

[0131] As used herein, the term "joined" refers to a configuration wherein elements are either directly connected or indirectly connected.

[0132] As used herein, the term "lateral" refers to a direction, orientation, or measurement that is parallel to a lateral centerline of a container, when the container is standing upright on a horizontal support surface, as described herein. A lateral orientation may also be referred to a "horizontal" orientation, and a lateral measurement may also be referred to as a "width."

[0133] As used herein, the term "like-numbered" refers to similar alphanumeric labels for corresponding elements, as described below. Like-numbered elements have labels with the same last two digits; for example, one element with a label ending in the digits **20** and another element with a label ending in the digits **20** are like-numbered. Like-numbered elements can have labels with a differing first digit, wherein that first digit matches the number for its figure; as an example, an element of FIG. **3** labeled **320** and an element of FIG. **4** labeled **420** are like-numbered. Like-numbered elements can have labels with a suffix (i.e. the portion of the label following the dash symbol) that is the same or possibly different (e.g. corresponding with a particular embodiment); for example, a first embodiment of an element in FIG. **3**A labeled **320**-*a* and a second embodiment of an element in FIG. **3**B labeled **320**-*b*, are like numbered.

[0134] As used herein, the term "longitudinal" refers to a direction, orientation, or measurement that is parallel to a longitudinal centerline of a container, when the container is standing upright on a horizontal support surface, as described herein. A longitudinal orientation may also be referred to a "vertical" orientation. When expressed in relation to a horizontal support surface for a container, a longitudinal measurement may also be referred to as a "height", measured above the horizontal support surface.

[0135] As used herein, when referring to a flexible container, the term "middle" refers to the portion of the container that is located in between the top of the container and the bottom of the container. As used herein, the term middle can be modified by describing the term middle with reference to a particular percentage value for the top and/or a particular percentage value for the bottom. For any of the embodiments of flexible containers, disclosed herein, a reference to the middle of the container can, in various alternate embodiments, refer to the portion of the container that is located between any particular percentage value for the top, disclosed herein, and/or any particular percentage value for the bottom, disclosed herein, in any combination.

[0136] As used herein, the term "mixing volume" refers to a type product volume that is configured to receive one or more fluent product(s) from one or more product volumes and/or from the environment outside of the container.

[0137] As used herein, when referring to a product volume, the term "multiple dose" refers to a product volume that is sized to contain a particular amount of product that is about equal to two or more units of typical consumption, application, or use by an end user. Any of the embodiments of flexible containers, disclosed herein, can be configured to have one or more multiple dose product volumes. A container with only one product volume, which is a multiple dose product volume, is referred to herein as a "multiple dose container."

[0138] As used herein, the term "nearly" modifies a particular value, by referring to a range equal to the particular value, plus or minus five percent (+/−5%). For any of the embodiments of flexible containers, disclosed herein, any disclosure of a particular value, can, in various alternate embodiments, also be understood as a disclosure of a range equal to approximately that particular value (i.e. +/−5%).

[0139] As used herein, when referring to a flexible container, the term "non-durable" refers to a container that is temporarily reusable, or disposable, or single use.

[0140] As used herein, when referring to a flexible container, the term "nonstructural panel" refers to a layer of one or more adjacent sheets of flexible material, the layer having an outermost major surface that faces outward, toward the environment outside of the flexible container, and an innermost major surface that faces inward, toward product volume (s) disposed within the flexible container; a nonstructural panel is configured such that, the layer, does not independently provide substantial support in making the container self-supporting and/or standing upright.

[0141] As used herein, when referring to a flexible container, the term "overall height" refers to a distance that is measured while the container is standing upright on a horizontal support surface, the distance measured vertically from the upper side of the support surface to a point on the top of the container, which is farthest away from the upper side of the support surface. Any of the embodiments of flexible containers, disclosed herein, can be configured to have an overall height from 2.0 cm to 100.0 cm, or any value in increments of 0.1 cm between 2.0 and 100.0 cm, or within any range formed by any of the preceding values, such as: from 4.0 to 90.0 cm, from 5.0 to 80.0 cm, from 6.0 to 70.0 cm, from 7.0 to 60.0 cm, from 8.0 to 50.0 cm, from 9.0 to 40.0 cm, or from 10.0 to 30.0, etc.

[0142] As used herein "opening and filling station" or "opening station" or "opening and filling" refers to the various methods and means to open any port to allow a fluent material to be deposited within a location. Examples include but are not limited to opening via a blast of gas or fluid, mechanical opening, opening through gripping, gripping and articulation, opening via vacuum gripping, manual opening, opening via a guide tool (such as a rail, probe, etc.), and any combinations of the above.

[0143] As used herein, when referring to a sheet of flexible material, the term "overall thickness" refers to a linear dimension measured perpendicular to the outer major surfaces of the sheet, when the sheet is lying flat. For any of the embodiments of flexible containers, disclosed herein, in various embodiments, any of the flexible materials can be configured to have an overall thickness 5-500 micrometers (μm), or any integer value for micrometers from 5-500, or within any range formed by any of these values, such as 10-500 μm, 20-400 μm, 30-300 μm, 40-200 μm, or 50-100 μm, etc.

[0144] As used herein, the term "product volume" refers to an enclosable three-dimensional space that is configured to receive and directly contain one or more fluent product(s), wherein that space is defined by one or more materials that form a barrier that prevents the fluent product(s) from escaping the product volume. By directly containing the one or more fluent products, the fluent products come into contact with the materials that form the enclosable three-dimensional space; there is no intermediate material or container, which prevents such contact. Throughout the present disclosure the terms "product volume" and "product receiving volume" are used interchangeably and are intended to have the same meaning. Any of the embodiments of flexible containers, disclosed herein, can be configured to have any number of product volumes including one product volume, two product volumes, three product volumes, four product volumes, five product volumes, six product volumes, or even more product volumes. In some embodiments, one or more product volumes can be enclosed within another product volume. Any of the product volumes disclosed herein can have a product volume of any size, including from 0.001 liters to 100.0 liters, or any value in increments of 0.001 liters between 0.001 liters and 3.0 liters, or any value in increments of 0.01 liters between 3.0 liters and 10.0 liters, or any value in increments of 1.0 liters between 10.0 liters and 100.0 liters, or within any range formed by any of the preceding values, such as: from 0.001 to 2.2 liters, 0.01 to 2.0 liters, 0.05 to 1.8 liters, 0.1 to 1.6 liters, 0.15 to 1.4 liters, 0.2 to 1.2 liters, 0.25 to 1.0 liters, etc. A product volume can have any shape in any orientation. A product volume can be included in a container that has a structural support frame, and a product volume can be included in a container that does not have a structural support frame.

[0145] As used herein, when referring to a flexible container, the term "resting on a horizontal support surface" refers to the container resting directly on the horizontal support surface, without other support.

[0146] As used herein, the term "sealed," when referring to a product volume, refers to a state of the product volume wherein fluent products within the product volume are prevented from escaping the product volume (e.g. by one or more materials that form a barrier, and by a seal), and the product volume is hermetically sealed.

[0147] As used herein, when referring to a flexible container, the term "self-supporting" refers to a container that includes a product volume and a structural support frame, wherein, when the container is resting on a horizontal support surface, in at least one orientation, the structural support frame is configured to prevent the container from collapsing and to give the container an overall height that is significantly greater than the combined thickness of the materials that form the container, even when the product volume is unfilled. Any of the embodiments of flexible containers, disclosed herein, can be configured to be self-supporting.

[0148] As used herein, when referring to a flexible container, the term “single use” refers to a closed container which, after being opened by an end user, is not configured to be reclosed. Any of the embodiments of flexible containers, disclosed herein, can be configured to be single use.

[0149] As used herein, when referring to a product volume, the term “single dose” refers to a product volume that is sized to contain a particular amount of product that is about equal to one unit of typical consumption, application, or use by an end user. Any of the embodiments of flexible containers, disclosed herein, can be configured to have one or more single dose product volumes. A container with only one product volume, which is a single dose product volume, is referred to herein as a “single dose container.”

[0150] As used herein, when referring to a flexible container, the terms “stand up,” “stands up,” “standing up”, “stand upright”, “stands upright”, and “standing upright” refer to a particular orientation of a self-supporting flexible container, when the container is resting on a horizontal support surface. This standing upright orientation can be determined from the structural features of the container and/or indicia on the container. In a first determining test, if the flexible container has a clearly defined base structure that is configured to be used on the bottom of the container, then the container is determined to be standing upright when this base structure is resting on the horizontal support surface. If the first test cannot determine the standing upright orientation, then, in a second determining test, the container is determined to be standing upright when the container is oriented to rest on the horizontal support surface such that the indicia on the flexible container are best positioned in an upright orientation. If the second test cannot determine the standing upright orientation, then, in a third determining test, the container is determined to be standing upright when the container is oriented to rest on the horizontal support surface such that the container has the largest overall height. If the third test cannot determine the standing upright orientation, then, in a fourth determining test, the container is determined to be standing upright when the container is oriented to rest on the horizontal support surface such that the container has the largest height area ratio. If the fourth test cannot determine the standing upright orientation, then, any orientation used in the fourth determining test can be considered to be a standing upright orientation.

[0151] As used herein, when referring to a flexible container, the term “stand up container” refers to a self-supporting container, wherein, when the container (with all of its product volume(s) filled 100% with water) is standing up, the container has a height area ratio from 0.4 to 1.5 cm^{-1}. Any of the embodiments of flexible containers, disclosed herein, can be configured to be stand up containers.

[0152] As used herein, when referring to a flexible container, the term “structural support frame” refers to a rigid structure formed of one or more structural support members, joined together, around one or more sizable empty spaces and/or one or more nonstructural panels, and generally used as a major support for the product volume(s) in the flexible container and in making the container self-supporting and/or standing upright. In each of the embodiments disclosed herein, when a flexible container includes a structural support frame and one or more product volumes, the structural support frame is considered to be supporting the product volumes of the container, unless otherwise indicated.

[0153] As used herein, when referring to a flexible container, the term “structural support member” refers to a rigid, physical structure, which includes one or more expanded structural support volumes, and which is configured to be used in a structural support frame, to carry one or more loads (from the flexible container) across a span. A structure that does not include at least one expanded structural support volume, is not considered to be a structural support member, as used herein.

[0154] A structural support member has two defined ends, a middle between the two ends, and an overall length from its one end to its other end. A structural support member can have one or more cross-sectional areas, each of which has an overall width that is less than its overall length.

[0155] A structural support member can be configured in various forms. A structural support member can include one, two, three, four, five, six or more structural support volumes, arranged in various ways. For example, a structural support member can be formed by a single structural support volume. As another example, a structural support member can be formed by a plurality of structural support volumes, disposed end to end, in series, wherein, in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of some or all of the structural support volumes can be partly or fully in contact with each other, partly or fully directly connected to each other, and/or partly or fully joined to each other. As a further example, a structural support member can be formed by a plurality of support volumes disposed side by side, in parallel, wherein, in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of some or all of the structural support volumes can be partly or fully in contact with each other, partly or fully directly connected to each other, and/or partly or fully joined to each other.

[0156] In some embodiments, a structural support member can include a number of different kinds of elements. For example, a structural support member can include one or more structural support volumes along with one or more mechanical reinforcing elements (e.g. braces, collars, connectors, joints, ribs, etc.), which can be made from one or more rigid (e.g. solid) materials.

[0157] Structural support members can have various shapes and sizes. Part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of a structural support member can be straight, curved, angled, segmented, or other shapes, or combinations of any of these shapes. Part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of a structural support member can have any suitable cross-sectional shape, such as circular, oval, square, triangular, star-shaped, or modified versions of these shapes, or other shapes, or combinations of any of these shapes. A structural support member can have an overall shape that is tubular, or convex, or concave, along part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of a length. A structural support member can have any suitable cross-sectional area, any suitable overall width, and any suitable overall length. A structural support member can be substantially uniform along part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of its length, or can vary, in any way described herein, along part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of its length. For example, a cross-sectional area of a structural support member can increase or decrease along part, parts, or all of its length. Part, parts, or all of any of the embodiments of structural support members of the present disclosure, can be configured according to any embodiment disclosed herein, including any workable combination of structures, features, materials, and/or connections from any number of any of the embodiments disclosed herein.

[0158] As used herein, when referring to a flexible container, the term "structural support volume" refers to a fillable space made from one or more flexible materials, wherein the space is configured to be at least partially filled with one or more expansion materials, which create tension in the one or more flexible materials, and form an expanded structural support volume. One or more expanded structural support volumes can be configured to be included in a structural support member. A structural support volume is distinct from structures configured in other ways, such as: structures without a fillable space (e.g. an open space), structures made from inflexible (e.g. solid) materials, structures with spaces that are not configured to be filled with an expansion material (e.g. an unattached area between adjacent layers in a multi-layer panel), and structures with flexible materials that are not configured to be expanded by an expansion material (e.g. a space in a structure that is configured to be a non-structural panel). Throughout the present disclosure the terms "structural support volume" and "expandable chamber" are used interchangeably and are intended to have the same meaning.

[0159] In some embodiments, a structural support frame can include a plurality of structural support volumes, wherein some of or all of the structural support volumes are in fluid communication with each other. In other embodiments, a structural support frame can include a plurality of structural support volumes, wherein some of or none of the structural support volumes are in fluid communication with each other. Any of the structural support frames of the present disclosure can be configured to have any kind of fluid communication disclosed herein.

[0160] As used herein, the term "substantially" modifies a particular value, by referring to a range equal to the particular value, plus or minus ten percent (+/−10%). For any of the embodiments of flexible containers, disclosed herein, any disclosure of a particular value, can, in various alternate embodiments, also be understood as a disclosure of a range equal to approximately that particular value (i.e. +/−10%).

[0161] As used herein, when referring to a flexible container, the term "temporarily reusable" refers to a container which, after dispensing a product to an end user, is configured to be refilled with an additional amount of a product, up to ten times, before the container experiences a failure that renders it unsuitable for receiving, containing, or dispensing the product. As used herein, the term temporarily reusable can be further limited by modifying the number of times that the container can be refilled before the container experiences such a failure. For any of the embodiments of flexible containers, disclosed herein, a reference to temporarily reusable can, in various alternate embodiments, refer to temporarily reusable by refilling up to eight times before failure, by refilling up to six times before failure, by refilling up to four times before failure, or by refilling up to two times before failure, or any integer value for refills between one and ten times before failure. Any of the embodiments of flexible containers, disclosed herein, can be configured to be temporarily reusable, for the number of refills disclosed herein.

[0162] As used herein, the term "thickness" refers to a measurement that is parallel to a third centerline of a container, when the container is standing upright on a horizontal support surface, as described herein. A thickness may also be referred to as a "depth."

[0163] As used herein, the term "register" or "registered" when used alone or in combination with another term such as "cut", "seal", or the like, shall be understood to broadly include the teachings and disclosure of commonly owned U.S. Pat. No. 6,444,064 for Registration System for Phasing Simultaneously Advancing Webs of Material Having Variable Pitch Lengths, issued Sep. 3, 2002, which is fully incorporated herein by reference.

[0164] In the case of a flexible container formed from two webs, if there is artwork on one web, the web having the artwork will be registered to the production line or machine. If the flexible container is formed from two webs each having artwork, both webs will be registered to the production line or machine as well as to each other. If the flexible container is formed from two webs having no artwork, neither of the webs need be registered to the production line or machine nor to each other.

[0165] Where the flexible container is formed from two webs and holes are formed, seals are created, folds are made, materials are cut and/or other handling and manipulating operations are performed, one or both of the webs can be registered to the production line or machine and/or to each other.

[0166] As used herein, the term "transverse direction", when used in relation to machine direction, shall be understood to mean a non-machine direction angle, i.e., an angle to the machine direction, which could be at a right angle, or at any other angle from about 5 to about 175 degrees, from machine direction It is understood that this could be mirrored on either side of the machine direction, i.e. about 185 to about 355 degrees.

[0167] As used herein, the term "machine direction", is used to describe the machine direction, and include any direction from about 0 to about 5 degrees or about 175 to about 180 degrees away from the machine direction. It is understood that this could be mirrored on either side of the machine direction, i.e. about 180 to about 185 and about 355 to about 360 degrees.

[0168] As used herein, the terms filling, or fill, or any variation thereof, when used in connection with a fill port, a product volume, and expansion port or a structural support volume shall be understood to mean filling with a fluent product, and expansion material, or any other substance from any location associated with a flexible container, e.g. a top, a bottom, a front, a back, a left side, a right side, etc. including at a seam, between layers, and/or through a hole/orifice/nozzle, and/or through a heat seal, and/or through a layer or layers, e.g. through a nonstructural panel, a structural support volume, or otherwise.

[0169] As used herein, the term "port", and/or "fill port", and/or "expansion port", and/or "product dispensing port" shall be understood to mean an opening and/or a valve at any location, e.g. a top, a bottom, a front, a back, a left side, a right side, etc. including at a seam, between layers, and/or through a hole/orifice/nozzle, and/or through a heat seal, and/or through a layer or layers, e.g. through a nonstructural panel, a structural support volume, or otherwise.

[0170] As used herein, the term "product dispensing port" shall be understood to mean an opening and/or a valve that may be sealed, openable, recloseable, and/or re-sealable which is in fluid communication with the product volume to enable dispensing of a fluent material from the product volume to the exterior of the flexible container. The product dispensing port may also serve as the fill port in some embodiments and vice versa.

[0171] As used herein, the term "cut and seal" and/or "cut/seal", or any variation thereof, shall be understood to mean any operation involving performing a cutting step and a sealing step at substantially the same time, e.g., with a hot wire, a shaped and/or sharpened heat seal die, laser cut/seal, hot air knife, etc. to minimize the total number of operations while inherently causing the seal and the cut to be registered.

[0172] As used herein, the term "cut" is meant to include any method for separating materials. This can include but is not limited to: die cutting, laser cutting, water jet cutting, hot wire cutting, air knife cutting, hand cutting with scissors, knife cutting, and the like.

[0173] As used herein, when referring to a flexible container, the term "top" refers to the portion of the container that is located in the uppermost 20% of the overall height of the container, that is, from 80-100% of the overall height of the container. As used herein, the term top can be further limited by modifying the term top with a particular percentage value, which is less than 20%. For any of the embodiments of flexible containers, disclosed herein, a reference to the top of the container can, in various alternate embodiments, refer to the top 15% (i.e. from 85-100% of the overall height), the top 10% (i.e. from 90-100% of the overall height), or the top 5% (i.e. from 95-100% of the overall height), or any integer value for percentage between 0% and 20%.

[0174] As used herein, when referring to a flexible container, the term "unexpanded" refers to the state of one or more materials that are configured to be formed into a structural support volume, before the structural support volume is made rigid by an expansion material.

[0175] As used herein, when referring to a product volume of a flexible container, the term "unfilled" refers to the state of the product volume when it does not contain a fluent product.

[0176] As used herein, when referring to a flexible container, the term "unformed" refers to the state of one or more materials that are configured to be formed into a product volume, before the product volume is provided with its defined three-dimensional space. For example, an article of manufacture could be a container blank with an unformed product volume, wherein sheets of flexible material, with portions joined together, are laying flat against each other.

[0177] Flexible containers, as described herein, may be used across a variety of industries for a variety of products. For example, flexible containers, as described herein, may be used across the consumer products industry, including the following products: soft surface cleaners, hard surface cleaners, glass cleaners, ceramic tile cleaners, toilet bowl cleaners, wood cleaners, multi-surface cleaners, surface disinfectants, dishwashing compositions, laundry detergents, fabric conditioners, fabric dyes, surface protectants, surface disinfectants, cosmetics, facial powders, body powders, hair treatment products (e.g. mousse, hair spray, styling gels), shampoo, hair conditioner (leave-in or rinse-out), cream rinse, hair dye, hair coloring product, hair shine product, hair serum, hair anti-frizz product, hair split-end repair products, permanent waving solution, antidandruff formulation, bath gels, shower gels, body washes, facial cleaners, skin care products (e.g. sunscreen, sun block lotions, lip balm, skin conditioner, cold creams, moisturizers), body sprays, soaps, body scrubs, exfoliants, astringent, scrubbing lotions, depilatories, antiperspirant compositions, deodorants, shaving products, pre-shaving products, after shaving products, toothpaste, mouthwash, etc. As further examples, flexible containers, as described herein, may be used across other industries, including foods, beverages, pharmaceuticals, commercial products, industrial products, medical, etc.

[0178] FIGS. **1**A-**1**D illustrates various views of an embodiment of a stand up flexible container **100**. FIG. **1**A illustrates a front view of the container **100**. The container **100** is standing upright on a horizontal support surface **101**.

[0179] In FIG. **1**A, a coordinate system **110**, provides lines of reference for referring to directions in the figure. The coordinate system **110** is a three-dimensional Cartesian coordinate system with an X-axis, a Y-axis, and a Z-axis, wherein each axis is perpendicular to the other axes, and any two of the axes define a plane. The X-axis and the Z-axis are parallel with the horizontal support surface **101** and the Y-axis is perpendicular to the horizontal support surface **101**.

[0180] FIG. **1**A also includes other lines of reference, for referring to directions and locations with respect to the container **100**. A lateral centerline **111** runs parallel to the X-axis. An XY plane at the lateral centerline **111** separates the container **100** into a front half and a back half. An XZ plane at the lateral centerline **111** separates the container **100** into an upper half and a lower half. A longitudinal centerline **114** runs parallel to the Y-axis. A YZ plane at the longitudinal centerline **114** separates the container **100** into a left half and a right half. A third centerline **117** runs parallel to the Z-axis. The lateral centerline **111**, the longitudinal centerline **114**, and the third centerline **117** all intersect at a center of the container **100**.

[0181] A disposition with respect to the lateral centerline **111** defines what is longitudinally inboard **112** and longitudinally outboard **113**. When a first location is nearer to the lateral centerline **111** than a second location, the first location is considered to be disposed longitudinally inboard **112** to the second location. And, the second location is considered to be disposed longitudinally outboard **113** from the first location. The term lateral refers to a direction, orientation, or measurement that is parallel to the lateral centerline **111**. A lateral orientation may also be referred to a horizontal orientation, and a lateral measurement may also be referred to as a width.

[0182] A disposition with respect to the longitudinal centerline **114** defines what is laterally inboard **115** and laterally outboard **116**. When a first location is nearer to the longitudinal centerline **114** than a second location, the first location is considered to be disposed laterally inboard **115** to the second location. And, the second location is considered to be disposed laterally outboard **116** from the first location. The term longitudinal refers to a direction, orientation, or measurement that is parallel to the longitudinal centerline **114**. A longitudinal orientation may also be referred to a vertical orientation.

[0183] A longitudinal direction, orientation, or measurement may also be expressed in relation to a horizontal support surface for the container **100**. When a first location is nearer to the support surface than a second location, the first location can be considered to be disposed lower than, below, beneath, or under the second location. And, the second location can be considered to be disposed higher than, above, or upward from the first location. A longitudinal measurement may also be referred to as a height, measured above the horizontal support surface **100**.

[0184] A measurement that is made parallel to the third centerline **117** is referred to a thickness or depth. A disposition in the direction of the third centerline **117** and toward a front **102-1** of the container is referred to as forward **118** or in front of. A disposition in the direction of the third centerline **117** and toward a back **102-2** of the container is referred to as backward **119** or behind.

[0185] These terms for direction, orientation, measurement, and disposition, as described above, are used for all of the embodiments of the present disclosure, whether or not a support surface, reference line, or coordinate system is shown in a figure.

[0186] The container **100** includes a top **104**, a middle **106**, and a bottom **108**, the front **102-1**, the back **102-2**, and left and right sides **109**. The top **104** is separated from the middle **106** by a reference plane **105**, which is parallel to the XZ plane. The middle **106** is separated from the bottom **108** by a reference plane **107**, which is also parallel to the XZ plane. The container **100** has an overall height of **100**-*oh*. In the embodiment of FIG. **1**A, the front **102-1** and the back **102-2** of the container are joined together at a seal **129**, which extends around the outer periphery of the container **100**, across the top **104**, down the side **109**, and then, at the bottom of each side **109**, splits outward to follow the front and back portions of the base **190**, around their outer extents.

[0187] The container **100** includes a structural support frame **140**, a product volume **150**, a dispenser **160**, panels **180-1** and **180-2**, and a base structure **190**. A portion of panel **180-1** is illustrated as broken away, in order to show the product volume **150**. The product volume **150** is configured to contain one or more fluent products. The dispenser **160** allows the container **100** to dispense these fluent product(s) from the product volume **150** through a flow channel **159** then through the dispenser **160**, to the environment outside of the container **100**. In the embodiment of FIGS. **1**A-**1**D, the dispenser **160** is disposed in the center of the uppermost part of the top **104**, however, in various alternate embodiments, the dispenser **160** can be disposed anywhere else on the top **140**, middle **106**, or bottom **108**, including anywhere on either of the sides **109**, on either of the panels **180-1** and **180-2**, and on any part of the base **190** of the container **100**. The structural support frame **140** supports the mass of fluent product(s) in the product volume **150**, and makes the container **100** stand upright. The panels **180-1** and **180-2** are relatively flat surfaces, overlaying the product volume **150**, and are suitable for displaying any kind of indicia. However, in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of either or both of the panels **180-1** and **180-2** can include one or more curved surfaces. The base structure **190** supports the structural support frame **140** and provides stability to the container **100** as it stands upright.

[0188] The structural support frame **140** is formed by a plurality of structural support members. The structural support frame **140** includes top structural support members **144-1** and **144-2**, middle structural support members **146-1**, **146-2**, **146-3**, and **146-4**, as well as bottom structural support members **148-1** and **148-2**.

[0189] The top structural support members **144-1** and **144-2** are disposed on the upper part of the top **104** of the container **100**, with the top structural support member **144-1** disposed in the front **102-1** and the top structural support member **144-2** disposed in the back **102-2**, behind the top structural support member **144-1**. The top structural support members **144-1** and **144-2** are adjacent to each other and can be in contact with each other along the laterally outboard portions of their lengths. In various embodiments, the top structural support members **144-1** and **144-2** can be in contact with each other at one or more relatively smaller locations and/or at one or more relatively larger locations, along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths, so long as there is a flow channel **159** between the top structural support members **144-1** and **144-2**, which allows the container **100** to dispense fluent product(s) from the product volume **150** through the flow channel **159** then through the dispenser **160**. The top structural support members **144-1** and **144-2** are not directly connected to each other. However, in various alternate embodiments, the top structural support members **144-1** and **144-2** can be directly connected and/or joined together along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths.

[0190] The top structural support members **144-1** and **144-2** are disposed substantially above the product volume **150**. Overall, each of the top structural support members **144-1** and **144-2** is oriented about horizontally, but with its ends curved slightly downward. And, overall each of the top structural support members **144-1** and **144-2** has a cross-sectional area that is substantially uniform along its length; however the cross-sectional area at their ends are slightly larger than the cross-sectional area in their middles.

[0191] The middle structural support members **146-1**, **146-2**, **146-3**, and **146-4** are disposed on the left and right sides **109**, from the top **104**, through the middle **106**, to the bottom **108**. The middle structural support member **146-1** is disposed in the front **102-1**, on the left side **109**; the middle structural support member **146-4** is disposed in the back **102-2**, on the left side **109**, behind the middle structural support member **146-1**. The middle structural support members **146-1** and **146-4** are adjacent to each other and can be in contact with each other along substantially all of their lengths. In various embodiments, the middle structural support members **146-1** and **146-4** can be in contact with each other at one or more relatively smaller locations and/or at one or more relatively larger locations, along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths. The middle structural support members **146-1** and **146-4** are not directly connected to each other. However, in various alternate embodiments, the middle structural support members **146-1** and **146-4** can be directly connected and/or joined together along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths.

[0192] The middle structural support member **146-2** is disposed in the front **102-1**, on the right side **109**; the middle structural support member **146-3** is disposed in the back **102-2**, on the right side **109**, behind the middle structural support member **146-2**. The middle structural support members **146-2** and **146-3** are adjacent to each other and can be in contact with each other along substantially all of their lengths. In various embodiments, the middle structural support members **146-2** and **146-3** can be in contact with each other at one or more relatively smaller locations and/or at one or more relatively larger locations, along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths. The middle structural support members **146-2** and **146-3** are not directly connected to each other. However, in various alternate embodiments, the middle structural support members **146-2** and **146-3** can be directly connected and/or joined together along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths.

[0193] The middle structural support members **146-1**, **146-2**, **146-3**, and **146-4** are disposed substantially laterally outboard from the product volume **150**. Overall, each of the middle structural support members **146-1**, **146-2**, **146-3**, and **146-4** is oriented about vertically, but angled slightly, with its upper end laterally inboard to its lower end. And, overall each of the middle structural support members **146-1**, **146-2**, **146-3**, and **146-4** has a cross-sectional area that changes along its length, increasing in size from its upper end to its lower end.

[0194] The bottom structural support members **148-1** and **148-2** are disposed on the bottom **108** of the container **100**, with the bottom structural support member **148-1** disposed in the front **102-1** and the bottom structural support member **148-2** disposed in the back **102-2**, behind the top structural support member **148-1**. The bottom structural support members **148-1** and **148-2** are adjacent to each other and can be in contact with each other along substantially all of their lengths. In various embodiments, the bottom structural support members **148-1** and **148-2** can be in contact with each other at one or more relatively smaller locations and/or at one or more relatively larger locations, along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths. The bottom structural support members **148-1** and **148-2** are not directly connected to each other. However, in various alternate embodiments, the bottom structural support members **148-1** and **148-2** can be directly connected and/or joined together along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths.

[0195] The bottom structural support members **148-1** and **148-2** are disposed substantially below the product volume **150**, but substantially above the base structure **190**. Overall, each of the bottom structural support members **148-1** and **148-2** is oriented about horizontally, but with its ends curved slightly upward. And, overall each of the bottom structural support members **148-1** and **148-2** has a cross-sectional area that is substantially uniform along its length.

[0196] In the front portion of the structural support frame **140**, the left end of the top structural support member **144-1** is joined to the upper end of the middle structural support member **146-1**; the lower end of the middle structural support member **146-1** is joined to the left end of the bottom structural support member **148-1**; the right end of the bottom structural support member **148-1** is joined to the lower end of the middle structural support member **146-2**; and the upper end of the middle structural support member **146-2** is joined to the right end of the top structural support member **144-1**. Similarly, in the back portion of the structural support frame **140**, the left end of the top structural support member **144-2** is joined to the upper end of the middle structural support member **146-4**; the lower end of the middle structural support member **146-4** is joined to the left end of the bottom structural support member **148-2**; the right end of the bottom structural support member **148-2** is joined to the lower end of the middle structural support member **146-3**; and the upper end of the middle structural support member **146-3** is joined to the right end of the top structural support member **144-2**. In the structural support frame **140**, the ends of the structural support members, which are joined together, are directly connected, all around the periphery of their walls. However, in various alternative embodiments, any of the structural support members **144-1**, **144-2**, **146-1**, **146-2**, **146-3**, **146-4**, **148-1**, and **148-2** can be joined together in any way described herein or known in the art.

[0197] In alternative embodiments of the structural support frame **140**, adjacent structural support members can be combined into a single structural support member, wherein the combined structural support member can effectively substitute for the adjacent structural support members, as their functions and connections are described herein. In other alternative embodiments of the structural support frame **140**, one or more additional structural support members can be added to the structural support members in the structural support frame **140**, wherein the expanded structural support frame can effectively substitute for the structural support frame **140**, as its functions and connections are described herein. Also, in some alternative embodiments, a flexible container may not include a base structure.

[0198] FIG. **1**B illustrates a side view of the stand up flexible container **100** of FIG. **1**A.

[0199] FIG. **1**C illustrates a top view of the stand up flexible container **100** of FIG. **1**A.

[0200] FIG. **1**D illustrates a bottom view of the stand up flexible container **100** of FIG. **1**A.

[0201] FIGS. **2**A-**8**D illustrate embodiments of stand-up flexible containers having various overall shapes. Any of the embodiments of FIGS. **2**A-**8**D can be configured according to any of the embodiments disclosed herein, including the embodiments of FIGS. **1**A-**1**D. Any of the elements (e.g. structural support frames, structural support members, panels, dispensers, etc.) of the embodiments of FIGS. **2**A-**8**D, can be configured according to any of the embodiments disclosed herein. While each of the embodiments of FIGS. **2**A-**8**D illustrates a container with one dispenser, in various embodiments, each container can include multiple dispensers, according to any embodiment described herein. FIGS. **2**A-**8**D illustrate exemplary additional/alternate locations for dispenser with phantom line outlines. Part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of each of the panels in the embodiments of FIGS. **2**A-**8**D is suitable to display any kind of indicia. Each of the side panels in the embodiments of FIGS. **2**A-**8**D is configured to be a nonstructural panel, overlaying product volume(s) disposed within the flexible container, however, in various embodiments, one or more of any kind of decorative or structural element (such as a rib, protruding from an outer surface) can be joined to part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of these side panels. For clarity, not all structural details of these flexible containers are shown in FIGS. **2**A-**8**D, however any of the embodiments of FIGS. **2**A-**8**D can be configured to include any structure or feature for flexible containers, disclosed herein. For example, any of the embodiments of FIGS. **2**A-**8**D can be configured to include any kind of base structure disclosed herein.

[0202] FIG. **2**A illustrates a front view of a stand up flexible container **200** having a structural support frame **240** that has an overall shape like a frustum. In the embodiment of FIG. **2**A, the frustum shape is based on a four-sided pyramid, however, in various embodiments, the frustum shape can be based on a pyramid with a different number of sides, or the frustum shape can be based on a cone. The support frame **240** is formed by structural support members disposed along the edges of the frustum shape and joined together at their ends. The structural support members define a rectangular shaped top panel **280**-*t*, trapezoidal shaped side panels **280-1**, **280-2**, **280-3**, and **280-4**, and a rectangular shaped bottom panel (not shown). Each of the side panels **280-1**, **280-2**, **280-3**, and **280-4** is about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **200** includes a dispenser **260**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **200**. In the embodiment of FIG. **2**A, the dispenser **260** is disposed in the center of the top panel **280**-*t*, however, in various alternate embodiments, the dispenser **260** can be disposed anywhere else on the top, sides, or bottom, of the container **200**, according to any embodiment described or illustrated herein. FIG. **2**B illustrates a front view of the container **200** of FIG. **2**A, including exemplary additional/alternate locations for a dispenser, any of which can also apply to the back of the container. FIG. **2**C illustrates a side view of the container **200** of FIG. **2**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can apply to either side of the container. FIG. **2**D illustrates an isometric view of the container **200** of FIG. **2**A.

[0203] FIG. **3**A illustrates a front view of a stand up flexible container **300** having a structural support frame **340** that has an overall shape like a pyramid. In the embodiment of FIG. **3**A, the pyramid shape is based on a four-sided pyramid, however, in various embodiments, the pyramid shape can be based on a pyramid with a different number of sides. The support frame **340** is formed by structural support members disposed along the edges of the pyramid shape and joined together at their ends. The structural support members define triangular shaped side panels **380-1**, **380-2**, **380-3**, and **380-4**, and a square shaped bottom panel (not shown). Each of the side panels **380-1**, **380-2**, **380-3**, and **380-4** is about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **300** includes a dispenser **360**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **300**. In the embodiment of FIG. **3**A, the dispenser **360** is disposed at the apex of the pyramid shape, however, in various alternate embodiments, the dispenser **360** can be disposed anywhere else on the top, sides, or bottom, of the container **300**. FIG. **3**B illustrates a front view of the container **300** of FIG. **3**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can also apply to any side of the container. FIG. **3**C illustrates a side view of the container **300** of FIG. **3**A. FIG. **3**D illustrates an isometric view of the container **300** of FIG. **3**A.

[0204] FIG. **4**A illustrates a front view of a stand up flexible container **400** having a structural support frame **440** that has an overall shape like a trigonal prism. In the embodiment of FIG. **4**A, the prism shape is based on a triangle. The support frame **440** is formed by structural support members disposed along the edges of the prism shape and joined together at their ends. The structural support members define a triangular shaped top panel **480**-*t*, rectangular shaped side panels **480-1**, **480-2**, and **480-3**, and a triangular shaped bottom panel (not shown). Each of the side panels **480-1**, **480-2**, and **480-3** is about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **400** includes a dispenser **460**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **400**. In the embodiment of FIG. **4**A, the dispenser **460** is disposed in the center of the top panel **480**-*t*, however, in various alternate embodiments, the dispenser **460** can be disposed anywhere else on the top, sides, or bottom, of the container **400**. FIG. **4**B illustrates a front view of the container **400** of FIG. **4**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can also apply to any side of the container **400**. FIG. **4**C illustrates a side view of the container **400** of FIG. **4**A. FIG. **4**D illustrates an isometric view of the container **400** of FIG. **4**A.

[0205] FIG. **5**A illustrates a front view of a stand up flexible container **500** having a structural support frame **540** that has an overall shape like a tetragonal prism. In the embodiment of FIG. **5**A, the prism shape is based on a square. The support frame **540** is formed by structural support members disposed along the edges of the prism shape and joined together at their ends. The structural support members define a square shaped top panel **580**-*t*, rectangular shaped side panels **580-1**, **580-2**, **580-3**, and **580-4**, and a square shaped bottom panel (not shown). Each of the side panels **580-1**, **580-2**, **580-3**, and **580-4** is about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **500** includes a dispenser **560**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **500**. In the embodiment of FIG. **5**A, the dispenser **560** is disposed in the center of the top panel **580**-*t*, however, in various alternate embodiments, the dispenser **560** can be disposed anywhere else on the top, sides, or bottom, of the container **500**. FIG. **5**B illustrates a front view of the container **500** of FIG. **5**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can also apply to any side of the container **500**. FIG. **5**C illustrates a side view of the container **500** of FIG. **5**A. FIG. **5**D illustrates an isometric view of the container **500** of FIG. **5**A.

[0206] FIG. **6**A illustrates a front view of a stand up flexible container **600** having a structural support frame **640** that has an overall shape like a pentagonal prism. In the embodiment of FIG. **6**A, the prism shape is based on a pentagon. The support frame **640** is formed by structural support members disposed along the edges of the prism shape and joined together at their ends. The structural support members define a pentagon shaped top panel **680**-*t*, rectangular shaped side panels **680-1**, **680-2**, **680-3**, **680-4**, and **680-5**, and a pentagon shaped bottom panel (not shown). Each of the side panels **680-1**, **680-2**, **680-3**, **680-4**, and **680-5** is about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **600** includes a dispenser **660**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **600**. In the embodiment of FIG. **6**A, the dispenser **660** is disposed in the center of the top panel **680**-*t*, however, in various alternate embodiments, the dispenser **660** can be disposed anywhere else on the top, sides, or bottom, of the container **600**. FIG. **6**B illustrates a front view of the container **600** of FIG. **6**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can also apply to any side of the container **600**. FIG. **6**C illustrates a side view of the container **600** of FIG. **6**A. FIG. **6**D illustrates an isometric view of the container **600** of FIG. **6**A.

[0207] FIG. **7**A illustrates a front view of a stand up flexible container **700** having a structural support frame **740** that has an overall shape like a cone. The support frame **740** is formed by curved structural support members disposed around the base of the cone and by straight structural support members extending linearly from the base to the apex, wherein the structural support members are joined together at their ends. The structural support members define curved somewhat triangular shaped side panels **780-1**, **780-2**, and **780-3**, and a circular shaped bottom panel (not shown). Each of the side panels **780-1**, **780-2**, and **780-3**, is curved, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **700** includes a dispenser **760**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **700**. In the embodiment of FIG. **7**A, the dispenser **760** is disposed at the apex of the conical shape, however, in various alternate embodiments, the dispenser **760** can be disposed anywhere else on the top, sides, or bottom, of the container **700**. FIG. **7**B illustrates a front view of the container **700** of FIG. **7**A. FIG. **7**C illustrates a side view of the container **700** of FIG. **7**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can also apply to any side panel of the container **700**. FIG. **7**D illustrates an isometric view of the container **700** of FIG. **7**A.

[0208] FIG. **8**A illustrates a front view of a stand up flexible container **800** having a structural support frame **840** that has an overall shape like a cylinder. The support frame **840** is formed by curved structural support members disposed around the top and bottom of the cylinder and by straight structural support members extending linearly from the top to the bottom, wherein the structural support members are joined together at their ends. The structural support members define a circular shaped top panel **880**-*t*, curved somewhat rectangular shaped side panels **880-1**, **880-2**, **880-3**, and **880-4**, and a circular shaped bottom panel (not shown). Each of the side panels **880-1**, **880-2**, **880-3**, and **880-4**, is curved, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **800** includes a dispenser **860**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **800**. In the embodiment of FIG. **8**A, the dispenser **860** is disposed in the center of the top panel **880**-*t*, however, in various alternate embodiments, the dispenser **860** can be disposed anywhere else on the top, sides, or bottom, of the container **800**. FIG. **8**B illustrates a front view of the container **800** of FIG. **8**A, including exemplary additional/alternate locations for a dispenser (shown as phantom lines), any of which can also apply to any side panel of the container **800**. FIG. **8**C illustrates a side view of the container **800** of FIG. **8**A. FIG. **8**D illustrates an isometric view of the container **800** of FIG. **8**A.

[0209] In additional embodiments, any stand up flexible container with a structural support frame, as disclosed herein, can be configured to have an overall shape that corresponds with any other known three-dimensional shape, including any kind of polyhedron, any kind of prismatoid, and any kind of prism (including right prisms and uniform prisms).

[0210] FIG. **9**A illustrates a top view of an embodiment of a self-supporting flexible container **900**, having an overall shape like a square. FIG. **9**B illustrates an end view of the flexible container **900** of FIG. **9**A. The container **900** is resting on a horizontal support surface **901**.

[0211] In FIG. **9**B, a coordinate system **910**, provides lines of reference for referring to directions in the figure. The coordinate system **910** is a three-dimensional Cartesian coordinate system, with an X-axis, a Y-axis, and a Z-axis. The X-axis and the Z-axis are parallel with the horizontal support surface **901** and the Y-axis is perpendicular to the horizontal support surface **901**.

[0212] FIG. **9**A also includes other lines of reference, for referring to directions and locations with respect to the container **100**. A lateral centerline **911** runs parallel to the X-axis. An XY plane at the lateral centerline **911** separates the container **100** into a front half and a back half. An XZ plane at the lateral centerline **911** separates the container **100** into an upper half and a lower half. A longitudinal centerline **914** runs parallel to the Y-axis. A YZ plane at the longitudinal centerline **914** separates the container **900** into a left half and a right half. A third centerline **917** runs parallel to the Z-axis. The lateral centerline **911**, the longitudinal centerline **914**, and the third centerline **917** all intersect at a center of the container **900**. These terms for direction, orientation, measurement, and disposition, in the embodiment of FIGS. **9**A-**9**B are the same as the like-numbered terms in the embodiment of FIGS. **1**A-**1**D.

[0213] The container **900** includes a top **904**, a middle **906**, and a bottom **908**, the front **902-1**, the back **902-2**, and left and right sides **909**. In the embodiment of FIGS. **9**A-**9**B, the upper half and the lower half of the container are joined together at a seal **929**, which extends around the outer periphery of the container **900**. The bottom of the container **900** is configured in the same way as the top of the container **900**.

[0214] The container **900** includes a structural support frame **940**, a product volume **950**, a dispenser **960**, a top panel **980**-*t* and a bottom panel (not shown). A portion of the top panel **980**-*t* is illustrated as broken away, in order to show the product volume **950**. The product volume **950** is configured to contain one or more fluent products. The dispenser **960** allows the container **900** to dispense these fluent product(s) from the product volume **950** through a flow channel **959** then through the dispenser **960**, to the environment outside of the container **900**. The structural support frame **940** supports the mass of fluent product(s) in the product volume **950**. The top panel **980**-*t* and the bottom panel are relatively flat surfaces, overlaying the product volume **950**, and are suitable for displaying any kind of indicia.

[0215] The structural support frame **940** is formed by a plurality of structural support members. The structural support frame **940** includes front structural support members **943-1** and **943-2**, intermediate structural support members **945-1**, **945-2**, **945-3**, and **945-4**, as well as back structural support members **947-1** and **947-2**. Overall, each of the structural support members in the container **900** is oriented horizontally. And, each of the structural support members in the container **900** has a cross-sectional area that is substantially uniform along its length, although in various embodiments, this cross-sectional area can vary.

[0216] Upper structural support members **943-1**, **945-1**, **945-2**, and **947-1** are disposed in an upper part of the middle **906** and in the top **904**, while lower structural support members **943-2**, **945-4**, **945-3**, and **947-2** are disposed in a lower part of the middle **906** and in the bottom **908**. The upper structural support members **943-1**, **945-1**, **945-2**, and **947-1** are disposed above and adjacent to the lower structural support members **943-2**, **945-4**, **945-3**, and **947-2**, respectively.

[0217] In various embodiments, adjacent upper and lower structural support members can be in contact with each other at one or more relatively smaller locations and/or at one or more relatively larger locations, along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths, so long as there is a gap in the contact for the flow channel **959**, between the structural support members **943-1** and **943-2**. In the embodiment of FIGS. **9**A-**9**B, the upper and lower structural support members are not directly connected to each other. However, in various alternate embodiments, adjacent upper and lower structural support members can be directly connected and/or joined together along part, or parts, or about all, or approximately all, or substantially all, or nearly all, or all of their overall lengths.

[0218] The ends of structural support members **943-1**, **945-2**, **947-1**, and **945-1** are joined together to form a top square that is outward from and surrounding the product volume **950**, and the ends of structural support members **943-2**, **945-3**, **947-2**, and **945-4** are also joined together to form a bottom square that is outward from and surrounding the product volume **950**. In the structural support frame **940**, the ends of the structural support members, which are joined together, are directly connected, all around the periphery of their walls. However, in various alternative embodiments, any of the structural support members of the embodiment of FIGS. **9**A-**9**B can be joined together in any way described herein or known in the art.

[0219] In alternative embodiments of the structural support frame **940**, adjacent structural support members can be combined into a single structural support member, wherein the combined structural support member can effectively substitute for the adjacent structural support members, as their functions and connections are described herein. In other alternative embodiments of the structural support frame **940**, one or more additional structural support members can be added to the structural support members in the structural support frame **940**, wherein the expanded structural support frame can effectively substitute for the structural support frame **940**, as its functions and connections are described herein.

[0220] FIGS. **10**A-**11**B illustrate embodiments of self-supporting flexible containers (that are not stand up containers) having various overall shapes. Any of the embodiments of FIGS. **10**A-**11**B can be configured according to any of the embodiments disclosed herein, including the embodiments of FIGS. **9**A-**9**B. Any of the elements (e.g. structural support frames, structural support members, panels, dispensers, etc.) of the embodiments of FIGS. **10**A-**11**B, can be configured according to any of the embodiments disclosed herein. While each of the embodiments of FIGS. **10**A-**11**B illustrates a container with one dispenser, in various embodiments, each container can include multiple dispensers, according to any embodiment described herein. Part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of each of the panels in the embodiments of FIGS. **10**A-**11**B is suitable to display any kind of indicia. Each of the top and bottom panels in the embodiments of FIGS. **10**A-**11**B is configured to be a nonstructural panel, overlaying product volume(s) disposed within the flexible container, however, in various embodiments, one or more of any kind of decorative or structural element (such as a rib, protruding from an outer surface) can be joined to part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of these panels. For clarity, not all structural details of these flexible containers are shown in FIGS. **10**A-**11**B, however any of the embodiments of FIGS. **10**A-**11**B can be configured to include any structure or feature for flexible containers, disclosed herein.

[0221] FIG. **10**A illustrates a top view of an embodiment of a self-supporting flexible container **1000** (that is not a stand-up flexible container) having a product volume **1050** and an overall shape like a triangle. However, in various embodiments, a self-supporting flexible container can have an overall shape like a polygon having any number of sides. The support frame **1040** is formed by structural support members disposed along the edges of the triangular shape and joined together at their ends. The structural support members define a triangular shaped top panel **1080**-*t*, and a triangular shaped bottom panel (not shown). The top panel **1080**-*t* and the bottom panel are about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **1000** includes a dispenser **1060**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **1000**. In the embodiment of FIG. **10**A, the dispenser **1060** is disposed in the center of the front, however, in various alternate embodiments, the dispenser **1060** can be disposed anywhere else on the top, sides, or bottom, of the container **1000**. FIG. **10**A includes exemplary additional/alternate locations for a dispenser (shown as phantom lines). FIG. **10**B illustrates an end view of the flexible container **1000** of FIG. **10**B, resting on a horizontal support surface **1001**.

[0222] FIG. **11**A illustrates a top view of an embodiment of a self-supporting flexible container **1100** (that is not a stand-up flexible container) having a product volume **1150** and an overall shape like a circle. The support frame **1140** is formed by structural support members disposed around the circumference of the circular shape and joined together at their ends. The structural support members define a circular shaped top panel **1180**-*t*, and a circular shaped bottom panel (not shown). The top panel **1180**-*t* and the bottom panel are about flat, however in various embodiments, part, parts, or about all, or approximately all, or substantially all, or nearly all, or all of any of the side panels can be approximately flat, substantially flat, nearly flat, or completely flat. The container **1100** includes a dispenser **1160**, which is configured to dispense one or more fluent products from one or more product volumes disposed within the container **1100**. In the embodiment of FIG. **11**A, the dispenser **1160** is disposed in the center of the front, however, in various alternate embodiments, the dispenser **1160** can be disposed anywhere else on the top, sides, or bottom, of the container **1100**. FIG. **11**A includes exemplary additional/alternate locations for a dispenser (shown as phantom lines). FIG. **11**B illustrates an end view of the flexible container **1100** of FIG. **10**B, resting on a horizontal support surface **1101**.

[0223] In additional embodiments, any self-supporting container with a structural support frame, as disclosed herein, can be configured to have an overall shape that corresponds with any other known three-dimensional shape. For example, any self-supporting container with a structural support frame, as disclosed herein, can be configured to have an overall shape (when observed from a top view) that corresponds with a rectangle, a polygon (having any number of sides), an oval, an ellipse, a star, or any other shape, or combinations of any of these.

[0224] FIGS. **12**A-**14**C illustrate various exemplary dispensers, which can be used with the flexible containers disclosed herein. FIG. **12**A illustrates an isometric view of push-pull type dispenser **1260**-*a*. FIG. **12**B illustrates an isometric view of dispenser with a flip-top cap **1260**-*b*. FIG. **12**C illustrates an isometric view of dispenser with a screw-on cap **1260**-*c*. FIG. **12**D illustrates an isometric view of rotatable type dispenser **1260**-*d*. FIG. **12**E illustrates an isometric view of nozzle type dispenser with a cap **1260**-*d*. FIG. **13**A illustrates an isometric view of straw dispenser **1360**-*a*. FIG. **13**B illustrates an isometric view of straw dispenser with a lid **1360**-*b*. FIG. **13**C illustrates an isometric view of flip up straw dispenser **1360**-*c*. FIG. **13**D illustrates an isometric view of straw dispenser with bite valve **1360**-*d*. FIG. **14**A illustrates an isometric view of pump FIG. **14**B illustrates an isometric view of pump spray type dispenser **1460**-*b*. FIG. **14**C illustrates an isometric view of trigger spray type dispenser **1460**-*c*.

[0225] To form a flexible container for a fluent product such as those described above, the present disclosure contemplates a method comprising joining two flexible materials together to form a joined material. The method also comprises at least partially forming at least one structural support volume from the joined material and forming at least one expansion port in communication with the at least one structural support volume. The method further comprises joining an additional flexible material to the joined material to at least partially form a product volume for holding the fluent product and also forming a fill port in communication with the product volume.

[0226] In accordance with the method, the product volume and the fill port may be formed in the same step or in separate steps.

[0227] The method advantageously comprises at least partially filling the product volume with a quantity of the fluent product through the fill port. The method also suitably includes expanding the at least one structural support volume by depositing an expansion material into the structural support volume through the expansion port. After at least partially filling the product volume and depositing the expansion material, the method advantageously comprises sealing the fill and expansion ports.

[0228] In connection with sealing the fill port and the expansion port, the method also contemplates removing substantially all of the fill port and the expansion port at the same time as sealing them.

[0229] Preferably, the product volume is at least partially filled with a quantity of the fluent product through the fill port, following which the fill port is sealed and, thereafter, the expansion material is deposited into the at least one structural support volume through the expansion port, following which the expansion port is sealed. However, it will be appreciated that the fill port and the expansion port could both be sealed either at the same time or one at a time in either order after the product volume has been at least partially filled with the fluent product and the expansion material has been deposited into the at least one structural support volume. In addition, it will be appreciated that the order in which the product volume has been at least partially filled with the fluent product and the expansion material has been deposited into the at least one structural support volume could be reversed which may be advantageous for some embodiments.

[0230] Preferably, the fill port and the expansion port are sealed by one or both of heat sealing and ultrasonic welding, and the at least one structural support volume and the product volume are at least partially formed by one of heat sealing and ultrasonic welding.

[0231] In another respect, the step of joining an additional flexible material to the joined material may comprise folding the joined material at least once and joining the joined material to itself to at least partially form the product volume and the fill port. The joined material is suitably folded within a region of the container opposite the fill port and the folded joined material may be joined by a registered cut and seal step to at least partially form the product volume for the fluent product and the fill port communicating with the product volume. In addition to the foregoing, the step of folding the joined material nay be used to create a fold line on the at least one structural support volume.

[0232] Alternatively, the step of joining an additional flexible material to the joined material may instead comprise joining a separate material to the joined material to at least partially form the product volume and the fill port.

[0233] In one embodiment, the two flexible materials are joined together to form the joined material, and the folded joined material is joined to form the product volume by first and second heat sealing steps, respectively. In an alternative embodiment, the two flexible materials are joined together to form the joined material by a first heat sealing step, and the folded joined material is joined to form the product volume by a cut and seal step. Further, the method may advantageously comprise forming a series of the flexible containers wherein each of the flexible containers is at least partially singulated after the heat sealing step or during the cut and seal step to form the product volume.

[0234] In one embodiment, the two flexible materials may comprise an inner flexible material and an outer flexible material wherein neither the inner flexible material nor the outer flexible material are registered. In another embodiment, the two flexible materials may comprise an inner flexible material and an outer flexible material wherein at least the outer flexible material is registered. In still another embodiment, the two flexible materials may comprise an inner flexible material and an outer flexible material wherein both the inner and outer flexible material are registered. In yet another embodiment, the inner flexible material and the outer flexible material may suitably comprise the same material or, alternatively, they may comprise different materials.

[0235] In another respect, the inner flexible material and the outer flexible material may suitably comprise two distinct sheets of material or, alternatively, they may comprise two distinct webs of material.

[0236] In the latter case, the two webs of material may be transported in a machine direction with the expansion port and the fill port being formed for: i) depositing the expansion material through the expansion port in a transverse direction, and ii) at least partially filling the product volume through the fill port in a transverse direction. Alternatively, again with the two webs being transported in the machine direction, the expansion port and the fill port may be formed for: i) depositing the expansion material through the expansion port at an angle of at least 45 degrees to the machine direction, and ii) at least partially filling the product volume through the fill port at an angle of at least 45 degrees to the machine direction. Alternatively, and again with the two webs being transported in a machine direction, the expansion port and the fill port may be formed for: i) depositing the expansion material through the expansion port counter to the machine direction and ii) at least partially filling the product volume through the fill port counter to the machine direction.

[0237] In one embodiment, the flexible container has a top, a bottom, a middle, a front, a back, a left side, and a right side and the fill port and expansion port are formed in at least one of the top, the bottom, the middle, the front, the back, the left side, and the right side for at least partially filling the product volume with a fluent product and depositing an expansion material into the at least one structural support volume, preferably while the container is oriented such that the fill port or expansion port, regardless of where they are located on the flexible container, are facing up. In this manner, depositing a fluent product or an expansion material into the product volume or the at last one structural support volume, respectively, is gravity assisted. Further, the expansion material may comprise any of various materials capable of occupying the at least one structural support volume and making it rigid which includes a wide range of materials including, preferably, liquid nitrogen which can be deposited through the expansion port into the at least one structural support volume following which the expansion port can be sealed to allow the liquid nitrogen to change phase or evaporate to pressurize the at least one structural support volume.

[0238] In accordance with the method, an expansion material fill nozzle may be provided to deposit the expansion material through the expansion port into the at least one structural support volume. The expansion material fill nozzle may be caused to undergo movement in relation to the expansion port: i) in at least one direction to locate the expansion material fill nozzle in at least proximity to the expansion port for depositing the expansion material into the at least one structural support volume, and ii) in at least one direction to move the expansion material fill nozzle out of proximity to the expansion port after depositing the expansion material into the at least one structural support volume. An expansion port nozzle guide may be located within the expansion port before the expansion material fill nozzle is located in at least proximity to the expansion port, in which case the expansion material fill nozzle may be caused to undergo movement into the expansion port nozzle guide while the expansion port nozzle guide is located in the expansion port, following which the expansion material fill nozzle may be removed from the expansion port nozzle guide before or at the same time as the expansion port nozzle guide is removed from the expansion port.

[0239] Alternatively, an expansion port nozzle guide may be located within the expansion port and the expansion material fill nozzle may be caused to remain stationary and deposit the expansion material through the expansion port nozzle guide into the at least one structural support volume from outside the expansion port and, as a further alternative absent the use of an expansion port fill nozzle, the expansion material fill nozzle may be caused to remain stationary and deposit the expansion material into the at least one structural support volume from outside the expansion port.

[0240] In accordance with the method, a blast of gas may be directed at or within the expansion port to open the expansion port and/or the structural support volume. The expansion port may suitably comprise an open space located between two seals. Preferably, the expansion port is about 3 mm to about 50 mm, more preferably, about 4 mm to about 25 mm and, still more preferably, about 5 mm to about 10 mm, in width at the narrowest point, and is about 0.5 cm to about 20 cm, more preferably, about 1 cm to about 15 cm, and about 2 to about 10 cm, in length. The expansion port may be defined as a channel extending away from the product volume.

[0241] In accordance with the method, a fluent product fill nozzle may be provided to deposit the fluent product through the fill port into the product volume, and causing the fluent product fill nozzle to undergo movement in relation to the fill port. The fluent product fill nozzle may be caused to undergo movement in at least one direction in relation to the fill port: i) in at least one direction to locate the fluent product fill nozzle in at least proximity to the fill port for depositing the fluent product into the product volume, and ii) in at least one direction to move the fluent product fill nozzle out of proximity to the fill port after depositing the fluent product into the product volume. A fill port guide nozzle may be located within the fill port before the fluent product fill nozzle is located at least in proximity to the fill port, in which case the fluent product fill nozzle may be caused to undergo movement into the fill port nozzle guide while the fill port nozzle guide is located in the fill port, following which the fluent product fill nozzle may be removed from the fill port nozzle guide before or at the same time as the fill port guide nozzle is removed from the fill port.

[0242] Alternatively, a fill port nozzle guide may be located within the fill port and the fluent product fill nozzle may be caused to remain stationary and deposit the fluent product through the fill port nozzle guide into the product volume from outside the fill port and, as a further alternative absent the use of a fill port nozzle guide the fluent product fill nozzle may be caused to remain stationary and deposit the fluent product into the product volume from outside the fill port.

[0243] In accordance with the method, a blast of gas may be directed at or within the fill port to open the fill port and/or product volume. The fill port may suitably comprise an open space located between two seals, preferably, about 5 mm to about 500 mm, more preferably, about 10 mm to about 200 mm, still more preferably, about 10 mm to about 100 mm, and still more preferably about 25 mm to about 75 mm, in width at the narrowest point, and is about 0.5 cm to about 20 cm, more preferably, about 1 cm to about 15 cm, and about 2 to about 10 cm, in length. The fill port may be defined as a channel extending away from the product volume.

[0244] In another respect, in accordance with the method the product volume may be filled with a quantity of the fluent product comprising between about 1% and about 100%, preferably, between about 50% and about 100%, and more preferably, between about 75% and about 100%, of the total available volume of the product volume.

[0245] In still another respect, the method includes the step of removing at least some air, preferably, most of the air and, more preferably, about all of the air from the product volume before sealing the fill port. In some embodiments this would not be air, but would comprise removing whatever gas the package is being manufactured in (e.g. in a CO-rich environment, or a nitrogen-rich environment).

[0246] In accordance with the method, the flexible container is preferably formed to have a top and a bottom and to include a base structure formed from the joined material by folding over the joined material at the bottom of the flexible container and forming a seal. A gusset may be provided in the base structure by forming a seal therein. Also, a product dispensing port, which may or may not comprise the fill port, may be formed to be in communication with the product volume, and it is sealed, openable for dispensing the fluent product, and closable after dispensing the fluent product.

[0247] With regard to the foregoing, the method also contemplates forming one or more holes in at least one of the two flexible materials joined to comprise the joined material in a portion of the joined material to be folded over at the bottom of the flexible container to be formed into the base structure.

[0248] The method may advantageously include opening the fill port before at least partially filling the product volume with a quantity of the fluent product through the fill port. The fill port may suitably be opened by gripping the flexible container at at least two selected points which are moved closer together. This may comprise mechanical or pneumatic gripping through clamps. Additionally, the fill port may be opened by using a gripper to selectively grip and release the flexible container through a front and a back. This additional gripper may comprise a vacuum for applying a suction to the front and the back of the flexible container to open the fill port for depositing the fluent product. These gripping strategies may be used separately or in combination with each other or other gripping strategies.

[0249] The method may also include opening the expansion port before depositing an expansion material into the at least one structural support volume through the expansion port. The expansion port may also be opened by gripping the flexible container at at least two selected points which are moved closer together. This may comprise mechanical or pneumatic gripping through clamps. Additionally, the expansion port may be opened by using a gripper to selectively grip and release the flexible container through a front and a back. The gripper may comprise a vacuum for applying a suction to the front and the back of the flexible container to open the expansion port for depositing the expansion material. These gripping strategies may be used separately or in combination with each other or other gripping strategies.

[0250] Referring to FIG. **15**, a production line **1500** is illustrated for performing the method of forming a flexible container in accordance with the disclosure. The production line **1500** includes a pair of unwind stands **1502***a*, **1502***b* for unwinding first and second webs **1504***a*, **1504***b*, in a controlled manner. The unwind stands **1502***a*, **1502***b* introduce tension into the respective webs **1504***a*, **1504***b*. Next, the first and second webs each pass through a meter unit **1506**, **1508** which in concert with **1511** (**1511** being a meter unit for one web), equalize the tension in the webs, a sensor system located at position **1509** enables registration and/or alignment of artwork on one or both of the webs **1504***a*, **1504***b*, and a punch created by **1510**. The punch **1510** provides access through an outer layer of a joined material for performing a sealing operation **1534**. From this point, the webs **1504***a*, **1504***b* proceed to a sealing station **1512** comprising a rotary sealer to at least partially form one or more structural support volumes.

[0251] The sealing station **1512** can form complex nonlinear heat seals through two or more layers, e.g., an inner layer and an outer layer, to thereby at least partially form one or more structural support volumes as well as one or more expansion ports for receiving an expansion material, e.g., liquid nitrogen.

[0252] After forming the one or more structural support volumes, the joined webs **1504***a*, **1504***b* pass through a folding station **1514** to fold over the two more layers of the joined webs to form the first fold of a gusset. Next, the joined and folded webs pass through a sealing station **1516** where the now four or more layers, e.g., outer-inner-inner-outer layers, pass through a rotary sealer to seal a first half of the gusset and define the product dispensing port. Following this step, the joined and folded webs pass through a rotary cutting die **1518** to cut and trim around the product dispensing port for the flexible container.

[0253] After cutting and trimming around the product dispensing port, the joined and folded webs pass through a folding station **1520** where folding horns continue gusset formation. Next, the joined and folded webs pass through another folding station **1522** where folding horns/rails complete gusset formation. Following this step, the joined and folded webs pass through another sealing station **1524** where a rotary sealer seals the second half of the gusset.

[0254] After completing these initial steps in the formation and sealing of the gusset, the joined and folded webs pass through a cutting station **1526** where a rotary cutter trims around the expansion port and the fill port. Next, the joined and folded webs pass through a final folding station **1528** to collapse the T-fold to flat in order to finish forming the gusset in the now 6 to 8 layer region. Finally, the joined and folded webs pass through another sealing station **1530** where a further heat seal is formed in the now 6 to 8 layer region to provide structure for the gusset.

[0255] After fully completing the formation of the gusset, the joined and folded web passes through another sealing station **1532** where a perimeter seal is partially formed to at least partially form the product volume and then the joined and folded web passes through still another sealing station **1534** where the perimeter seal is fully formed in the now 8 to 4 layer transition point. Following which the joined and folded web passes through a rotary cutting die **1536** to complete the production of a fully formed singulated flexible container blank from the folded and joined web.

[0256] With a fully formed singulated flexible container blank completed, the container passes through a container blank processing station **1538** where each singulated container can be gripped for further processing. The flexible container is gripped for transport at a gripping station **1540**. Next, the flexible container passes through an opening and filling station **1542** where a fluent product is deposited through the fill port of the flexible container to at least partially fill the product volume. Next, the flexible container passes through a package deflation and sealing station **1544** where excess air is removed from the product volume to bring the fluent product up to a desired fill level and the product fill port is sealed or partially sealed to confine the fluent product within the product volume.

[0257] With a flexible container having the fluent product in the product volume, the flexible container passes through another filling station **1546** where an expansion material, e.g., liquid nitrogen, is deposited through the expansion port into the at least one structural support volume. Next, the flexible container passes through a seal/cut station **1548** where the expansion port is sealed to confine the expansion material within the at least one structural support volume, any unsealed portion of the product fill port is sealed to confine the fluent product within the product volume and cut to remove the fill port and the expansion port and finalize the flexible container. In the case of liquid nitrogen, sealing the expansion port allows the liquid nitrogen to evaporate to pressurize the at least one structural support volume.

[0258] Once the flexible container has gone through this production process, it may be grouped with other flexible containers at **1550**, the grouped flexible containers may be inserted into secondary packaging for shipment, and the secondary packaging may be transported to a unit loader.

[0259] FIGS. **16**A and **16**B illustrates the first and second webs **1504***a*, **1504***b* after leaving the sealing station **1512** to join the webs together while initiating the at least partial formation of one or more structural support volumes as well as one or more expansion ports for receiving an expansion material, e.g., liquid nitrogen. FIGS. **17**A and **17**B illustrate the first and second webs **1504***a*, **1504***b* after leaving the folding station **1514** where the two or more layers of the webs have been folded over to form the first fold of a gusset. FIGS. **18**A and **18**B illustrate the joined and folded webs **1504***a*, **1504***b* after passing through the sealing station **1516** where the now four or more layers, e.g., outer-inner-inner-outer layers, have passed through a rotary sealer to seal a first half of the gusset and the product dispensing port. FIGS. **19**A and **19**B illustrate the joined and folded webs **1504***a*, **1504***b* after pass through a rotary cutting die **1518** to cut and trim the product dispensing port for the flexible container. FIGS. **20**A and **20**B illustrate the joined and folded webs **1504***a*, **1504***b* after passing through a folding station **1520** where folding horns continuing gusset formation. FIGS. **21**A and **21**B illustrate the joined and folded webs **1504***a*, **1504***b* after passing through another folding station **1522** where folding horns/rails complete gusset formation. FIGS. **22**A and **22**B illustrate the joined and folded webs **1504***a*, **1504***b* after passing through another sealing station **1524** where a rotary sealer seals the second half of the gusset. FIG. **23** illustrates the joined and folded web **1504***a*, **1504***b* after passing through another sealing station **1532** where a perimeter seal is partially formed and after passing through still another sealing station **1534** where the perimeter seal is fully formed in the now 8 to 4 layer transition point. FIGS. **24**A, **24**B, and **24**C illustrate the joined and folded web **1504***a*, **1504***b* after passing through a rotary cutting die **1536** to complete the production of a fully formed singulated flexible container from the folded and joined web. FIG. **25** illustrates the fully formed singulated flexible container before passing through a seal/cut station **1548** where the expansion port is sealed to confine the expansion material within the at least one structural support volume and cut to remove the fill port and the expansion port and finalize the flexible container for shipment.

[0260] Part, parts, or all of any of the embodiments disclosed herein can be combined with part, parts, or all of other embodiments known in the art of flexible containers, including those described below.

[0261] Embodiments of the present disclosure can use any and all embodiments of materials, structures, and/or features for flexible containers, as well as any and all methods of making and/or using such flexible containers, as disclosed in the following patent applications: (1) U.S. non-provisional application Ser. No. 13/888,679 filed May 7, 2013, entitled "Flexible Containers" and published as US20130292353 (applicant's case 12464M); (2) U.S. non-provisional application Ser. No. 13/888,721 filed May 7, 2013, entitled "Flexible Containers" and published as US20130292395 (applicant's case 12464M2); (3) U.S. non-provisional application Ser. No. 13/888,963 filed May 7, 2013, entitled "Flexible Containers" published as US20130292415 (applicant's case 12465M); (4) U.S. non-provisional application Ser. No. 13/888,756 May 7, 2013, entitled "Flexible Containers Having a Decoration Panel" published as US20130292287 (applicant's case 12559M); (5) U.S. non-provisional application Ser. No. 13/957,158 filed Aug. 1, 2013, entitled "Methods of Making Flexible Containers" published as US20140033654 (applicant's case 12559M); and (6) U.S. non-provisional application Ser. No. 13/957,187 filed Aug. 1, 2013, entitled "Methods of Making Flexible Containers" published as US20140033655 (applicant's case 12579M2); (7) U.S. non-provisional application Ser. No. 13/889,000 filed May 7, 2013, entitled "Flexible Containers with Multiple Product Volumes" published as US20130292413 (applicant's case 12785M); (8) U.S. non-provisional application Ser. No. 13/889,061 filed May 7, 2013, entitled "Flexible Materials for Flexible Containers" published as US20130337244 (applicant's case 12786M); (9) U.S. non-provisional application Ser. No. 13/889,090 filed May 7, 2013, entitled "Flexible Materials for Flexible Containers" published as US20130294711 (applicant's case 12786M2); (10) U.S. provisional application 61/861,100 filed Aug. 1, 2013, entitled "Disposable Flexible Containers having Surface Elements" (applicant's case 13016P); (11) U.S. provisional application 61/861,106 filed Aug. 1, 2013, entitled "Flexible Containers having Improved Seam and Methods of Making the Same" (applicant's case 13017P); (12) U.S. provisional application 61/861,118 filed Aug. 1, 2013, entitled "Methods of Forming a Flexible Container" (applicant's case 13018P); (13) U.S. provisional application 61/861,129 filed Aug. 1, 2013, entitled "Enhancements to Tactile Interaction with Film Walled Packaging Having Air Filled Structural Support Volumes" (applicant's case 13019P); (14) Chinese patent application CN2013/085045 filed Oct. 11, 2013, entitled "Flexible Containers Having a Squeeze Panel" (applicant's case 13036); (15) Chinese patent application CN2013/085065 filed Oct. 11, 2013, entitled "Stable Flexible Containers" (applicant's case 13037); (16) U.S. provisional application 61/900,450 filed Nov. 6, 2013, entitled "Flexible Containers and Methods of Forming the Same" (applicant's case 13126P); (17) U.S. provisional application 61/900,488 filed Nov. 6, 2013, entitled "Easy to Empty Flexible Containers" (applicant's case 13127P); (18) U.S. provisional application 61/900,501 filed Nov. 6, 2013, entitled "Containers Having a Product Volume and a Stand-Off Structure Coupled Thereto" (applicant's case 13128P); (19) U.S. provisional application 61/900,508 filed Nov. 6, 2013, entitled "Flexible Containers Having Flexible Valves" (applicant's case 13129P); (20) U.S. provisional application 61/900,514 filed Nov. 6, 2013, entitled "Flexible Containers with Vent Systems" (applicant's case 13130P); (21) U.S. provisional application 61/900,765 filed Nov. 6, 2013, entitled "Flexible Containers for use with Short Shelf-Life Products and Methods for Accelerating Distribution of Flexible Containers" (applicant's case 13131P); (22) U.S. provisional application 61/900,794 filed Nov. 6, 2013, entitled "Flexible Containers and Methods of Forming the Same" (applicant's case 13132P); (23) U.S. provisional application 61/900,805 filed Nov. 6, 2013, entitled "Flexible

Containers and Methods of Making the Same" (applicant's case 13133P); (24) U.S. provisional application 61/900,810 filed Nov. 6, 2013, entitled "Flexible Containers and Methods of Making the Same" (applicant's case 13134P); each of which is hereby incorporated by reference.

[0262] Part, parts, or all of any of the embodiments disclosed herein also can be combined with part, parts, or all of other embodiments known in the art of containers for fluent products, so long as those embodiments can be applied to flexible containers, as disclosed herein. For example, in various embodiments, a flexible container can include a vertically oriented transparent strip, disposed on a portion of the container that overlays the product volume, and configured to show the level of the fluent product in the product volume.

[0263] The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm".

[0264] Every document cited herein, including any cross referenced or related patent or patent publication, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any document disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such embodiment. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

[0265] While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

What is claimed is:

1. A method of forming a flexible container, comprising:

joining together a first flexible material and a second flexible material, to form a joined material;

using the joined material, at least partially forming a structural support volume and an expansion port in communication with the structural support volume; and

by joining a third flexible material to the joined material, at least partially forming a product volume and a fill port in communication with the product volume.

2. The method of claim **1**, further comprising:

after the adding, sealing the fill port;

after the sealing, depositing an expansion material into the structural support volume, through the expansion port; and

after the depositing, sealing the expansion port.

3. The method of claim **1**, further comprising depositing an expansion material into the structural support volume, through the expansion port.

4. The method of claim **3**, wherein the depositing occurs while the container being formed is inverted.

5. The method of claim **4**, wherein the forming of the fill port occurs while the container being formed is inverted.

6. The method of claim **5**, wherein the forming of the expansion port occurs while the container being formed is inverted.

7. The method of claim **3**, wherein the depositing includes depositing the expansion material, which comprises one or more phase change materials.

8. The method of claim **7**, wherein the depositing includes depositing the expansion material, which includes liquid nitrogen.

9. The method of claim **1**, wherein the forming of the expansion port includes forming the expansion port from an open space located between two seals of the joined materials.

10. The method of claim **9**, wherein the forming of the expansion port includes forming the expansion port from the open space, which has a narrowest width from about 5 millimeters to about 10 millimeters.

11. The method of claim **1**, wherein the forming of the fill port includes forming the fill port from an open space located between two seals of the joined materials.

12. The method of claim **11**, wherein the forming of the fill port includes forming the fill port from the open space, which has a narrowest width from about 25 millimeters to about 75 millimeters.

13. The method of claim **1**, wherein the forming of the fill port includes forming the fill port, which is also configured to be a product dispensing port.

14. The method of claim **1**, further comprising removing air from the product volume.

15. The method of claim **1**, further comprising:

opening the fill port; and

after the opening, adding a fluent product to the product volume, through the fill port.

16. The method of claim **15**, further comprising opening the fill port by gripping the flexible container.

17. The method of claim **16**, further comprising opening the fill port by gripping the flexible container with one or more vacuum grippers.

18. The method of claim **1**, further comprising:

opening the expansion port; and

after the opening, depositing an expansion material into the structural support volume, through the expansion port.

19. The method of claim **18**, further comprising opening the fill port by gripping the flexible container.

20. The method of claim **19**, further comprising opening the fill port by gripping the flexible container with one or more vacuum grippers.

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