



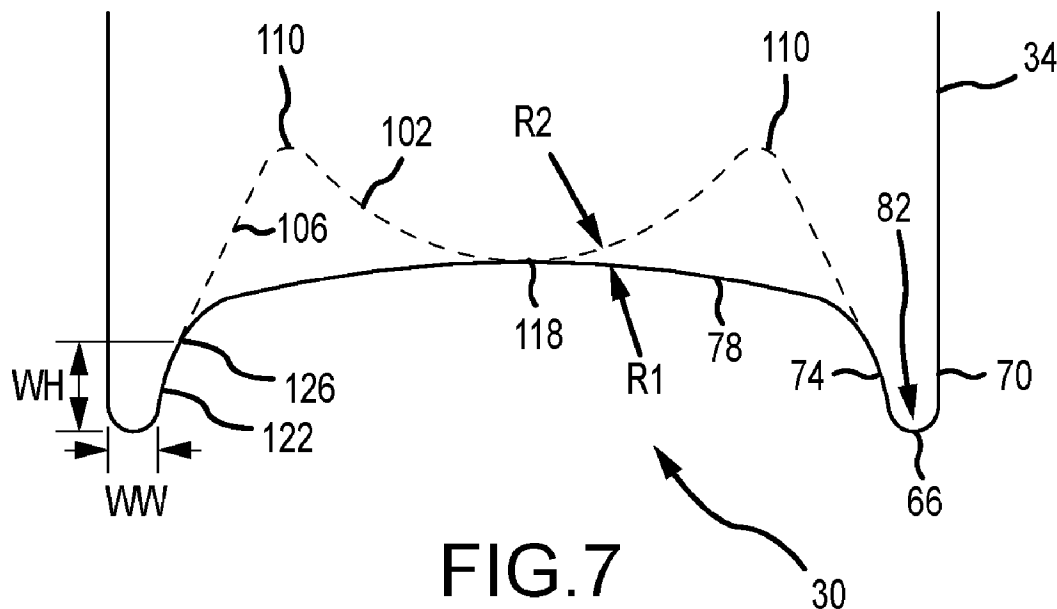
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(54) Titre : CONTENANT BOMBE DOTE D'UN Puits D'AZOTE ET D'UN MECANISME DE FERMETURE
(54) Title: DOMED CONTAINER WITH NITROGEN WELL AND CLOSURE MECHANISM



(57) **Abrégé/Abstract:**

Embodiments of the present invention relate to domed metal containers, and more specifically to pressurized metallic food containers with liquid nitrogen wells and various closure mechanisms. In some embodiments, the metallic food containers are thin-walled aluminum and are pressurized using liquid nitrogen to maintain strength and integrity. The container can have a nitrogen well to receive liquid nitrogen and keep the liquid nitrogen away from the food stuff packaged in the container. In various embodiments, the metallic food container comprises a domed bottom portion shaped and sized to nest with a food stuff packaged in the container. In some embodiments, the container is sealed with a tear away lid, a screw-on lid, or a metallic end closure double seamed to the container.



DOMED CONTAINER WITH NITROGEN WELL AND CLOSURE MECHANISM**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of priority from U.S. Provisional Patent
5 Application Serial No. 62/879,941, filed July 29, 2019, entitled "Domed Container with
Nitrogen Well"; the entire disclosure of which is hereby expressly incorporated by reference
in its entirety.

FIELD OF THE INVENTION

10 Embodiments of the present invention generally relate to domed metal containers,
and more specifically to pressurized metallic food containers with liquid nitrogen wells and
various closure mechanisms.

BACKGROUND OF THE INVENTION

15 Containers, and more specifically food containers, are generally plastic, cardboard,
or metal. The plastic containers are difficult to recycle and, thus, lead to a lot of landfill
waste. Cardboard containers can be weak and breakable food, e.g., chips or crisps, can be
crushed or damaged in weak cardboard containers. Alternatively, cardboard containers are
made with thick sidewalls and/or may have a foil lining and metal bottom portion. The thick
20 cardboard and foil attached thereto can be difficult to recycle and can lead to a lot of landfill
waste. Containers with thick cardboard and foil sides interconnected to a metal bottom are
expensive and time consuming to manufacture because they involve many steps and
different materials. These cardboard and metal containers and are also susceptible to water
damage and failure. For example, food containers should be impermeable to prevent
25 spoilage due to moisture and other contaminants. Cardboard is not impermeable and, thus,
a metal lining must be used. However, if the metal lining is not properly sealed to a metal
bottom and a metal or plastic lid, then leakage can occur, permitting moisture and other
contaminants into the container.

Often times chips are sold in bags, but the chips can be crushed or damaged in bags.
30 Additionally, the bags are over pressurized and underfilled in order to protect the chips from
breaking. Additionally, bags are difficult to recycle and lead to landfill waste. Stackable
chips are often sold in cylindrical containers that suffer from many of the disadvantages
described above, in addition to flat bottoms that create pressure points for curved chips and

increase chip breakage. Further, bags and soft cylindrical containers can make shipping more difficult if the contents are fragile, such as is the case with chips. Thus, there is an unmet need to provide a rigid, cost-effective metal container that can be used to store frangible foodstuffs and dry food with reduced food breakage that is also recyclable and, therefore, environmentally sustainable.

SUMMARY OF THE INVENTION

These and other needs are addressed by the various embodiments and configurations of embodiments of the present invention. This invention relates to a novel thin-walled metallic food container and methods for providing a metallic food container with a unique domed-shaped bottom portion, a nitrogen well proximate the domed-shaped bottom, various closure mechanisms, and pressurizing the container after dry food has been placed in the thin-walled metal container. In one embodiment, the lower dome portion of the container has a hyperbolic paraboloid shape, which is characterized by two distinct arcs or radii of curvature oriented at substantially right angles with respect to each other and in opposite directions, i.e., one curves upwardly and the other curves downwardly. In another embodiment, the lower dome portion has a symmetrical shape with only one radius of curvature. The novel container is easily recyclable, can hold a large number of stackable chips or other food product, has a thin contour wall, has various closure mechanisms, and is sturdy such that the chips will not break in transit or after the consumer purchases the container of food. Note that the terms “chips” and “crisps” are used interchangeably herein.

Metal containers can be used for food storage, but without internal pressurization thick walls must be used. Thin-walled metal food containers need increased internal pressure to maintain strength and prevent food breakage, but pressurizing the container after the food, especially dry food products, has been put into the container can be problematic. Accordingly, a novel method is provided herein for pressurizing a container after the container has been filled with dry food. In some embodiments, liquid nitrogen is introduced into the container after the container has been filled with dry food and then the container is sealed such that the liquid nitrogen turns to gas and pressurizes the container.

Features of the present invention may be employed in a wide range of food containers, including pressurized food containers with tear away lids or reusable lids. Although the invention generally relates to metallic food containers, the invention and

features described herein could easily be implemented on a variety of plastic containers, for example plastic sandwich containers commonly found in convenient stores.

Embodiments of the present invention differ from prior food containers because prior containers for holding stackable chips do not have any antibreakage features, nitrogen
5 wells, or utilize pressurized metal containers. Prior art containers consist of flat metal ends seamed directly to cardboard and foil container side walls.

Thus, it is one aspect of various embodiments of the present invention to provide a metallic food container that reduces the point load on the stackable saddle chips and decreases the amount of chip breakage that occurs. In some embodiments, the metallic food
10 container has a bottom portion shaped similarly to the stackable chips such that the domed bottom portion of the container can cradle and contact the chip in multiple locations. In various embodiments, the metallic food container has a unique, domed bottom portion with a first radius of curvature (R_1) along a first centerline of the bottom, for example along the major axis of the chip and from chip low point to low point, and a second radius of curvature
15 (R_2) along a second centerline of the bottom, for example along the minor axis of the chip and from chip high point to high point (depending on the orientation of the chip, i.e., whether the radius of curvature along the major axis is curving upward or downward). In some embodiments, the first centerline of the bottom is substantially perpendicular to the second centerline of the bottom. One advantage of some embodiments is that the curve of the
20 domed bottom portion aligns with and fits the hyperbolic-paraboloid-shaped or ellipsoid-shaped stackable crisps.

In some embodiments, the dome on the bottom portion of the container is symmetrical, meaning there is a consistent radius of curvature defining the entire dome. Thus, in some embodiments the domed portion has an ellipsoidal shape. For example, in
25 some embodiments the domed portion has a spherical shape, in other embodiments the domed portion has a spheroidal shape, and in still other embodiments the domed portion has a tri-axial ellipsoidal shape. If the container holds spheroid-shaped, tri-axial-ellipsoid-shaped, or hyperbolic-paraboloid-shaped crisps and the bottom has a spherical-shaped dome, then the radius of curvature of the dome will match one radius of curvature of the
30 crisp, e.g., the major or minor axis radius of curvature. If the container holds spheroid-shaped, tri-axial-ellipsoid-shaped, or hyperbolic-paraboloid-shaped crisps and the bottom has a spheroid-shaped or a tri-axial-ellipsoid-shaped dome, then the dome will have two radii of curvature that match the two radii of curvature of the crisps.

Having a dome-shaped bottom portion, rather than a flat bottom, requires that the container filler position the chips in the proper orientation regarding right side up or upside down to reduce crisp breakage because the correct chip curve should be placed on the matching container bottom curve. Further, if the dome-shaped bottom portion has a symmetrical shape with only one radius of curvature, then the filler can position the crisps in any direction relative to the 360° of rotation of the crisps as long as the correct side of the crisps is facing downward. For example, if the crisps are oval shaped, the minor or major axis could be in any direction (360°) if the container is circular and the domed bottom portion is symmetrical as long as the proper crisp curve is facing downward. However, this embodiment could lead to problems because the filler will not know exactly where the crisps are positioned relative to the dome and will not know the preferred location to inject the liquid nitrogen such that the liquid nitrogen avoids contacting the crisps. This is only a problem if the container has liquid nitrogen injected after the crisps are in the container and prior to closure, the container is circular shaped, and the crisps are not circular (e.g., the crisps are oval shaped). As the filling process is likely automated, some containers may have the crisps oriented in one direction while other containers have the crisps oriented in another direction (i.e., rotated around a longitudinal axis of the container), which means that the liquid nitrogen could be injected at different locations relative to the crisps. Having a domed bottom portion with two different radii of curvature is advantageous because during filling the filler should position the chips in the proper direction relative to the curves of the domed bottom for the chips to sit on the dome properly. When this happens, and in this embodiment, the filler will know how the crisps are oriented relative to the container and know where the preferred liquid nitrogen injection location is, meaning the liquid nitrogen can be injected at the preferred location every time.

In one aspect of the present invention, the container may have indicia or other forms of marking on the exterior surface, which identifies the orientation of the container and internal geometry. It is another aspect of the present invention that the container can be properly oriented prior to filling to assure that the crisp or other food product is positioned in the proper orientation within the container. Accordingly, the indicia or other marking can be used by the system or machinery to properly align the container relative to the food product put into the container and properly align the container for injection of the liquid nitrogen. For example, the following patents and patent applications relate to orienting the container and are incorporated by reference herein: U.S. Patent No. 9,259,913 to Ellefson;

U.S. Patent No. 9,340,368 to Ellefson et al.; U.S. Patent No. 6,524,048 to Tsukada et al.; U.S. Patent No. 4,016,968 to Stelter; and U.S. Patent Publication No. 2017/0197241 to Ellefson.

It is one aspect of the present invention to provide a food container that is made of an impermeable metal material. In various embodiments, the metallic food container has thick metal walls that do not require internal pressurization to gain strength. For example, the metal walls may be at least about 0.005" to about 0.010" thick such that internal pressurization is not required for strength. In one embodiment, the metal walls are at least about 0.006" thick such that internal pressurization is not required for strength. In alternative embodiments, the metallic food container has thin metal walls that require internal pressurization for strength. In some embodiments, the walls are between about 0.003" and 0.005" thick. In a preferred embodiment of the thin-walled container, the walls are about 0.004" thick. In some embodiments, the walls of the thin-walled container have a maximum thickness of about 0.005".

In some embodiments, the metallic food container has an aluminum wall (which can be thin) and an integral bottom portion without any seam connecting this bottom portion to a lower end of the aluminum sidewall. Alternately, the bottom portion may be a separate piece that is seamed to the lower end of the sidewall by double seaming or other methods well known by those skilled in the art. Further, in one embodiment the lightweight container has thin sidewalls and is pressurized to gain strength. To prevent the thin aluminum walls from being damaged, which could cause the chips or other food products to break, the internal pressure of the container must be higher than the atmospheric pressure. In some embodiments, this is achieved by using a container with a nitrogen well proximate the domed bottom portion. Liquid nitrogen (which is in liquid form due to being stored and dispensed at a high pressure and/or low temperature) is inserted into the nitrogen well and then the container is sealed. The liquid nitrogen changes into a gas because the container is at a lower pressure and/or higher temperature than the stored liquid nitrogen, thus the nitrogen decreases in pressure and/or increases in temperature and the gaseous nitrogen pressurizes the container. In order for liquid nitrogen dosing to effectively pressurize a container, some of the liquid nitrogen must remain in the liquid state at least until the package is sealed. After the container is sealed, any additional liquid nitrogen converted to gas will cause an increase in package pressure and improve rigidity. If the nitrogen evaporates before the container can be sealed, then there is little to no increase in the internal

package pressure, which can result in paneling or pulling a vacuum and container damage during shipping.

Additionally, embodiments of the present invention include food containers with standard internal coatings or chemical treatments. For example, epoxy coatings or BPANI
5 coatings can be used. Alternatively, the container could be uncoated but chemically treated to resist discoloration. For example, the container could have a chemical treatment such as zirconium or anodizing.

In some embodiments, the container has a flat bottom and an insert with the preferred dome shape and/or nitrogen well is inserted into the bottom of the container before the
10 container is filled with crisps or other food items. The insert could have one radius of curvature, such as a typical symmetrical dome shape. Alternatively, the insert could have a specific hyperbolic paraboloid shaped to match the crisps in the container or other shaped food stuff. The insert can be a plastic material, a metallic material, a composite material, cardboard, or other material.

Another advantage of pressurizing the container is that contamination and/or
15 spoilage is easily detected and recognized. Thus, if the container is opened or punctured, then the internal nitrogen and other gas escapes from the container and the container is depressurized (i.e., the internal pressure of the container will be equal to the atmospheric pressure). Once the container is depressurized, the thin aluminum walls will be weaker and
20 the container will feel “soft.” A consumer or retailer will be able to feel the difference between a pressurized (firm) container and depressurized (soft) container, which will signal to the consumer whether the container has been opened, punctured, or otherwise tampered. Moreover, the pressurized container creates an audible cue when the container is opened. Consumers like the audible cue because then they know the package has not been tampered
25 with and they know the food is fresh or not contaminated. In some embodiments, Valcorin (i.e., dimethyl decarbonate) is added to the container to sterilize the headspace of the container.

It is one aspect of embodiments of the present invention to provide a container that prevents the liquid nitrogen from contacting the chips or other food in the container. When
30 liquid nitrogen contacts the crisps or other food, the nitrogen is absorbed and the surface area of the nitrogen dramatically increases, resulting in almost immediate vaporization. Then the nitrogen gas escapes before the container can be closed or sealed and the lightweight container will not have sufficient pressure to gain strength. In prior art stacking

chip containers, the bottom of the container was flat. If nitrogen dosing was desired in a container with a flat bottom, then nitrogen dosing onto a flat surface would result in contact between the crisps and liquid nitrogen, which causes the nitrogen to flash-off and quickly evaporate out of the container before a lid, cap, or other end closure can be put onto the container.

The nitrogen well is a feature that does not allow the chips to enter the area where the liquid nitrogen resides due to simple geometry incompatibilities. Additionally, the nitrogen well is the lowest point of the container such that the liquid nitrogen will fall down into and reside in the nitrogen well due to gravity. Therefore, the chips will not touch the liquid nitrogen once the liquid nitrogen is in the well.

The novel nitrogen well shape has additional advantages, including preventing the liquid nitrogen from contacting the chips, which allows the container to be nitrogen dosed either before or after the chips are placed in the container and before application of the end closure or lid. The novel nitrogen well keeps the liquid nitrogen separate from the chips. In some embodiments, the well has an area for the nitrogen that is positioned below and away from the chips, which prevents contact with the chips or other foodstuff. Starting at the container sidewall and moving down the container toward the bottom, there may be a series of reduced radii that are recessed from the subsequent dome. This series of radii make up the nitrogen well. The nitrogen well is shaped and positioned such that chips or other food stuff are unable to fall into the recessed well area. The container's near-vertical sidewall terminates in a sharp radius, which leads to a larger radius that matches the radius of the chips placed in the container. Moreover, a nitrogen well with a small radius of curvature, and thus small width, at the bottom prevents the nitrogen from spreading out and evaporating quickly due to an increase in surface area. In some embodiments, the end closure or lid of the container has a nitrogen well into which liquid nitrogen can be injected to increase the internal pressure of the container once the container is sealed.

It is another aspect of various embodiments of the present invention to provide a metallic food container that is easily recyclable. Accordingly, in some embodiments, the container is comprised of a recyclable metal material.

In another aspect of the present invention, a metallic food container is provided that is manufactured with conventional manufacturing equipment. It is one aspect of embodiments of the present invention to provide a metallic food container with a domed bottom portion that is formed using traditional draw and iron techniques. In some

embodiments the domed bottom portion also includes a nitrogen well surrounding the domed portion. More specifically, a method for forming a metallic food container is provided, wherein the typical draw and iron steps are used to form a blank (i.e., a circular shaped flat piece of metal) into the container body (i.e., sidewalls and bottom portion). A
5 punch can be used to shape the bottom portion into the final desired dome shape and/or nitrogen well.

Another aspect of embodiments of the present invention is to provide a method for filling a food container with food and pressurizing the food container to a predetermined rigidity. In some embodiments this method includes the following steps: a) providing a
10 metallic food container with a domed bottom portion and a nitrogen well surrounding the domed portion positioned below the domed portion; b) filling the container with stackable chips or other food; c) injecting a predetermined amount of liquid nitrogen into the nitrogen well; and d) sealing the container using a lid or end closure. Steps (b) and (c) can be switched, i.e., in the reverse order, in some embodiments.

15 It is preferred to fill the container with the crisps before injecting the nitrogen because filling the container with crisps after the nitrogen must be done quickly such that the nitrogen does not evaporate prior to closure and the crisps must be oriented in the correct position. In some embodiments, the container must be sealed within about 15 seconds after the nitrogen is injected into the container. In various embodiments, the container must be
20 sealed within about 5 seconds after the nitrogen is injected into the container. In one embodiment, the container is sealed within 1 second of receiving the liquid nitrogen. If the liquid nitrogen is injected into the container after the container is filled with chips or other food, then the only food that can be put into the container is stackable food or food that permit a line of sight to the bottom of the container, i.e., a line of sight to the nitrogen well.
25 Thus, loose foods like peanuts cannot be put into the container and then liquid nitrogen injected in the container because the liquid nitrogen would contact the peanuts and evaporate. If the liquid nitrogen is injected into the container before the container is filled with food, then a line of sight to the well is not necessary after the food is in the container and foods like peanuts can be put into the container. Additionally, loose foods like peanuts
30 do not need to be oriented in a specific direction, unlike stackable chips, and the container could be filled more quickly with loose foods, thus permitting the liquid nitrogen to be injected prior to the container being filled with food and the container sealed before the liquid nitrogen vaporizes and evaporates. The amount of liquid nitrogen injected depends

on how much liquid nitrogen is needed in the container when the container is sealed and how long between the time the nitrogen is injected into the container to when the container is sealed.

Additionally, it is preferred that there is no water, and minimal water vapor, in the container when the liquid nitrogen is injected. In some embodiments, the liquid nitrogen is injected into the container using a targeted spray directed away from the food and into the nitrogen well. Preferably, the liquid nitrogen is sprayed into the portion of the well between the minor axis of an oval chip and the sidewall because there is more space between the chip and the sidewall here, which reduces the chances and/or amount of nitrogen contacting the chips. In various embodiments, the liquid nitrogen is injected down into the well directly using a long needle-shaped tube. In other embodiments, the liquid nitrogen is sprayed onto the container sidewall and drips down the sidewall into the nitrogen well. In alternative embodiments, the liquid nitrogen may be dosed on top of the chip stack or other food in the container and as long as some of the liquid nitrogen waterfalls down off of the chip stack and into the nitrogen well, which occurs due to gravity, then the container can be sealed and have an increased internal pressure. Although, it is preferred that the liquid nitrogen not contact the food. However, if contact occurs, then most of the liquid nitrogen will “dance” off of the food, like water in a skillet. Therefore, most of the liquid nitrogen does not soak into the food it contacts. Additionally, contact of the liquid nitrogen with the food is unlikely to affect the taste of the food.

Some embodiments may include a straw-like portion extending from the container sidewall and extending the entire length or a portion of the length of the sidewall and into the well such that the liquid nitrogen is directed into the straw-like portion and down into the well without contacting the food. The straw-like portion directs the liquid nitrogen into the well. Alternatively, a removable straw can be placed in the container before it is filled with food, for example if loose foods like peanuts are packaged, then the container can be filled with food and the nitrogen doser can shoot the nitrogen into the container via the removable straw. Finally, the removable straw can be removed before the container is sealed or it can remain in the container and removed by the consumer when he/she opens the container.

If the chips are placed into the container before the liquid nitrogen, then care must be taken to ensure that crumbs do not end up in the nitrogen well because the liquid nitrogen will contact the crumbs and can immediately flash off or evaporate before the container can

be sealed, which results in a minimal increase in internal package pressure. In alternative embodiments, the liquid nitrogen is injected into the nitrogen well before the container is filled with stackable chips or other food. The nitrogen well can be filled using standard equipment and then the container is filled with chips and sealed. For example, standard
5 liquid nitrogen dosing equipment can be purchased from Vacuum Barrier Corporation or Chart.

The amount of liquid nitrogen needed to properly pressurize the container varies depending on how and when the liquid nitrogen is injected, the amount of increased pressure desired in the container, and the size of the container. The goal is for the sealed container
10 to have a positive pressure relative to the ambient external air. It is preferred that the container have a pressure of at least about 10 psi (at about 70°F) higher than the ambient external atmosphere at the location where the container is filled and sealed. The container can have a pressure greater than 10 psi above ambient pressure at 70°F, but 10 psi above ambient pressure is the minimum required for consistency of the containers and the
15 minimum needed to provide strength for the thin-walled container. Additionally, the larger the container, the more liquid nitrogen required based on the ideal gas law. Additionally, if the liquid nitrogen contacts the crisps, then more liquid nitrogen will be required since some nitrogen will evaporate upon contact. Further, the longer the container is open, i.e., if the container is nitrogen dosed first and then filled with food, the more liquid nitrogen is
20 required.

For example, if a container has 250 mL of gas space in the container, the container has 1 atmosphere (14.7 psia = 0 psig) of gas prior to adding any liquid nitrogen, and it is desired that the container have 2 atmospheres (29.4 psia = 14.7 psig) of gas after sealing, then 0.313 grams of liquid nitrogen should be added to the container and the container
25 should be sealed almost immediately thereafter.

The exact amount of nitrogen put into the container may not be known. Rather, the variables controlled are the length of time the valve connected to the nitrogen doser is open and the size of the nozzle used for the nitrogen dosing. The nozzle size can vary depending on the amount of liquid nitrogen needed and the speed of the filling system. For example,
30 if the container filling system operates at high speeds, then a larger nozzle will be needed to shoot out the same amount of nitrogen in a shorter amount of time.

In one trial, a 0.105" nozzle was used to inject liquid nitrogen for 100 milliseconds (i.e., the nozzle was open for 100 milliseconds), which yielded a sealed container with 30% headspace at about 40 psi above atmospheric pressure.

5 The liquid nitrogen is injected into the container at about 0-5 Kelvin (or about -273° C to about -268° C). At this temperature at atmospheric pressure, the nitrogen is in its liquid phase. However, the cold liquid nitrogen is not stable under atmospheric conditions, i.e., a warmer temperature, and therefore it evaporates rapidly, but not immediately.

10 In some embodiments, a metallic food container is provided comprising: a cylindrical sidewall with an upper end and a lower end; an opening proximate the upper end; a bottom portion interconnected to the lower end of the cylindrical sidewall, wherein the bottom portion comprises: a dome-shaped portion; and a well positioned proximate to a lower portion of the dome-shaped portion to receive a liquid.

15 In additional and alternative embodiments, the metallic food container further comprises a neck interconnected to the upper end of the cylindrical sidewall and extending around the upper end of the cylindrical sidewall, wherein the neck extends upwardly from the cylindrical sidewall; a peripheral curl interconnected to an upper end of the neck; a tear away lid secured to a crown of the peripheral curl; threads on an exterior surface of the neck which are adapted to receive a threaded end closure which is selectively removable; and/or an end closure double-seamed to the neck of the container, the end closure having a pull tab
20 for selectively removing at least a portion of the end closure. In additional and alternative embodiments, the bottom portion is integrally interconnected to the lower end of the cylindrical sidewall such that the bottom portion is one piece with the cylindrical sidewall, and/or the well is concentric with the dome-shaped portion.

25 In some embodiments, a pressurized metallic food container is provided comprising: a cylindrical, substantially vertical sidewall with an upper end and a lower end; a neck interconnected to the upper end of the sidewall and extending upwardly and inwardly from the sidewall; an opening proximate the neck; a bottom portion integrally interconnected to the lower end of the cylindrical sidewall, wherein the bottom portion comprises: a substantially linear outer panel wall extending downwardly from the sidewall; a U-shaped
30 curved wall having a first radius of curvature and interconnected to a bottom portion of the outer panel wall; an inner panel wall extending upwardly from an interior portion of the U-shaped curved wall; a dome-shaped portion with a second radius of curvature, the domed portion interconnected to an uppermost portion of the inner panel wall at a third radius of

curvature, wherein the outer panel wall, U-shaped curved wall, and inner panel wall form a well positioned around and concentric with the dome-shaped portion.

In additional and alternative embodiments, the inner panel wall is substantially linear; the first radius of curvature is smaller than the second radius of curvature; the well
5 has a constant height and width around the circumference of the container; and/or the domed portion has a hyperbolic paraboloid shape.

In some embodiments, a pressurized metallic food container is provided comprising: a cylindrical, substantially vertical sidewall with an upper end and a lower end; a neck interconnected to the upper end of the sidewall and extending upwardly and inwardly from
10 the sidewall; an opening proximate the neck; and a bottom portion integrally interconnected to the lower end of the cylindrical sidewall, wherein the bottom portion comprises a dome-shaped portion having a mirror image shape to a food stuff and liquid nitrogen.

In some embodiments, a method of manufacturing a metallic food container is provided comprising: providing a metallic blank in a shape of a circular disc; punching the
15 metallic blank to form a continuous sidewall with an upper end and a lower end and an opening proximate the upper end; shaping a bottom portion interconnected to the lower end of the sidewall, wherein the bottom portion comprises a dome-shaped portion and a well positioned proximate to a lower portion of the dome-shaped portion to receive a liquid, and wherein the domed-shaped portion has a specific profile to match a profile of a food stuff.

In additional and alternative embodiments, the method further comprises applying
20 indicia to an exterior portion of the sidewall, wherein the indicia is provided for proper orientation of the metallic food container. In some embodiments, the method further comprises providing a lid; and securing the lid to the upper end of the continuous sidewall, after the container is filled with food stuff, to form a two-piece metallic food container.

In some embodiments, a method of filling a metallic food container in a pressurized state is provided comprising: providing the metallic food container comprising: a cylindrical
25 sidewall with an upper end and a lower end; an opening proximate the upper end; a bottom portion interconnected to the lower end of the cylindrical sidewall, wherein the bottom portion comprises: a domed-shaped portion with a geometric profile designed to nest with a food stuff; and a well positioned on a lower peripheral portion of the domed-shaped portion
30 to receive a predetermined amount of liquid nitrogen; filling the metallic food container with food; injecting a predetermined amount of liquid nitrogen into the well of the container; sealing the container with an end closure; and pressurizing the container to a pressure above

atmospheric pressure, wherein the liquid nitrogen becomes a gas as a result of a decrease in pressure or an increase in temperature.

In additional and alternative embodiments, the pressure above atmospheric pressure is about 10 psi. In various embodiments, the bottom portion is integrally interconnected to the cylindrical sidewall; the dome-shaped portion has a hyperbolic paraboloid shape; and/or the metallic food container further comprises indicia on an exterior portion of the sidewall, and wherein the method further comprises using the indicia to properly orient the metallic food container prior to filling the metallic food container with food stuff. In some embodiments, the method further comprises interconnecting the bottom to the cylindrical sidewall.

In some embodiments, a metallic food container is provided comprising: a cylindrical sidewall with an upper end and a lower end; an opening proximate the upper end; a bottom portion interconnected to the lower end of the cylindrical sidewall, wherein the bottom portion comprises: a dome-shaped portion; and a well extending downward from the dome-shaped portion and extending around a circumference of the container, the well configured to receive a liquid.

In various embodiments, the well is directly interconnected to the cylindrical sidewall such that cylindrical sidewall is substantially vertical and terminates in the well formed by a radius of curvature, and the well comprises an inner well wall extending inward toward a center of the container from the well radius of curvature, wherein the well inner wall interconnects to the dome-shaped portion. In one embodiment, the metallic food container is a thin-walled metallic food container and the cylindrical sidewall has a thickness between about 0.003 inches and about 0.005 inches. In some embodiments, the metallic food container further comprises: a peripheral curl interconnected to the upper end of the sidewall; and a tear away lid secured to a crown of the peripheral curl. In one embodiment, the metallic food container further comprises: a neck extending from the upper end of the cylindrical sidewall and extending inwardly from the cylindrical sidewall; a peripheral curl interconnected to the neck; and a tear away lid secured to a crown of the peripheral curl. In additional or alternative embodiments, the metallic food container further comprises: a threaded portion positioned above the upper end of the sidewall, the threaded portion comprising a plurality of threads on an exterior surface of the threaded portion, wherein the threads are adapted to receive a threaded lid that is selectively removable; and a peripheral curl interconnected to an upper end of the threaded portion. In one embodiment, the metallic

food container further comprises: a neck extending from the upper end of the cylindrical sidewall and extending inwardly from the cylindrical sidewall; and an end closure double-seamed to the neck of the container, the end closure having a pull tab for selectively removing at least a portion of the end closure. In one embodiment, the metallic food container further comprises: a neck extending from the upper end of the cylindrical sidewall and extending outwardly from the cylindrical sidewall; a first peripheral curl interconnected to the neck; and an upper portion comprising: a second peripheral curl on an upper end; a threaded portion positioned below the second peripheral curl, the threaded portion comprising a plurality of threads on an exterior surface of the threaded portion, wherein the threads are adapted to receive a threaded lid that is selectively removable; a countersink interconnected to a bottom end of the threaded portion; and a third peripheral curl interconnected to an upper outer end of the countersink; wherein the third peripheral curl of the upper portion is double seamed to the first peripheral curl. In some embodiments, the bottom portion is integrally interconnected to the lower end of the cylindrical sidewall such that the bottom portion is one piece with the cylindrical sidewall. In various embodiments, the dome-shaped portion has a hyperbolic paraboloid shape having a first curve with a first radius of curvature and a second curve with a second radius of curvature positioned substantially perpendicular to the first curve.

In various embodiments of the present invention, a pressurized metallic food container is provided comprising: a cylindrical, substantially vertical sidewall with an upper end and a lower end; a neck interconnected to the upper end of the sidewall and extending upwardly from the sidewall; an opening proximate the neck; and a bottom portion integrally interconnected to the lower end of the cylindrical sidewall, wherein the bottom portion comprises: a substantially linear outer panel wall extending downwardly from the sidewall; a U-shaped curved wall having a first radius of curvature and interconnected to a bottom portion of the outer panel wall; an inner panel wall extending upwardly from an interior portion of the U-shaped curved wall; and a dome-shaped portion with a first curve having a second radius of curvature, the domed portion interconnected to an uppermost portion of the inner panel wall at a third radius of curvature, wherein the outer panel wall, U-shaped curved wall, and inner panel wall form a well positioned around and concentric with the dome-shaped portion, and wherein the well is configured to receive a predetermined amount of liquid nitrogen.

In some embodiments, the inner panel wall is substantially linear, and the well has a constant height and a constant width around a circumference of the container. In various embodiments, the first radius of curvature is smaller than the second radius of curvature. In one embodiment, the domed portion has a hyperbolic paraboloid shape having a second
5 curve with a fourth radius of curvature positioned substantially perpendicular to the first curve of the domed portion. In various embodiments, the metallic food container is a thin-walled metallic food container and the cylindrical, substantially vertical sidewall has a thickness between about 0.003 inches and about 0.005 inches.

In one embodiment of the invention, a method of manufacturing a metallic food
10 container comprising: providing a metallic blank in a shape of a circular disc; punching the metallic blank to form a continuous sidewall with an upper end and a lower end and an opening proximate the upper end; and shaping a bottom portion interconnected to the lower end of the sidewall, wherein the bottom portion comprises a dome-shaped portion and a well positioned proximate to a lower portion of the dome-shaped portion to receive a liquid, and
15 wherein the domed-shaped portion has a specific profile to match a profile of a food stuff.

In some embodiments, the method further comprises applying indicia to an exterior portion of the sidewall, wherein the indicia is provided for proper orientation of the metallic food container. In various embodiments, the method further comprises providing a lid; and securing the lid to the upper end of the continuous sidewall after the container is filled with
20 food stuff to form a two-piece metallic food container.

In one embodiment of the present invention, a method of filling a metallic food container to create a pressurized vessel is provided, the method comprising: providing the metallic food container comprising: a cylindrical sidewall with an upper end and a lower end; an opening proximate the upper end; a bottom portion interconnected to the lower end
25 of the cylindrical sidewall, wherein the bottom portion comprises: a dome-shaped portion with a geometric profile designed to nest with a food stuff; and a well positioned on a lower peripheral portion of the dome-shaped portion to receive a predetermined amount of liquid nitrogen; filling the metallic food container with the food stuff; injecting a predetermined amount of liquid nitrogen into the well of the container; and sealing the container with an
30 end closure to pressurize the container above atmospheric pressure, wherein the liquid nitrogen becomes a gas as a result of a decrease in pressure or an increase in temperature.

In some embodiments, the pressure above atmospheric pressure is about 10 psi. In various embodiments, the liquid nitrogen is injected down into the well directly using a long

needle-shaped tube. In one embodiment, the method further comprises forming a hyperbolic paraboloid shape in the dome-shaped portion. In some embodiments, the end closure is a metallic end closure double seamed to the upper end of the cylindrical sidewall, a paper or plastic tear away lid interconnected to the upper end of the cylindrical sidewall, or a screw-on lid interconnected to the upper end of the cylindrical sidewall. In one embodiment, the method further comprises sealing the container with the end closure within about 15 seconds after the predetermined amount of liquid nitrogen is injected into the well of the container.

In one embodiment, a method of filling a thin-walled metallic food container to create a pressurized vessel is provided, the method comprising: providing the thin-walled metallic food container comprising: a cylindrical sidewall with an upper end and a lower end, wherein the cylindrical sidewall has a thickness between about 0.003 inches and about 0.005 inches; an opening proximate the upper end; a bottom portion interconnected to the lower end of the cylindrical sidewall; filling the metallic food container with a dry food; injecting a predetermined amount of liquid nitrogen through the opening and into the bottom portion of the container; and sealing the container with an end closure to pressurize the container above atmospheric pressure, wherein the liquid nitrogen becomes a gas as a result of a decrease in pressure and/or an increase in temperature, and wherein the container has an internal pressure that is at least about 10 psi above an ambient pressure.

In some embodiments, the method further comprises forming a dome-shaped portion with a geometric profile designed to nest with the dry food in the bottom portion of the thin-walled metallic food container. In some embodiments, the method further comprises forming a well positioned on a lower peripheral portion of the dome-shaped portion, the well configured to receive the predetermined amount of liquid nitrogen. In various embodiments, the thin-walled metallic food container further comprises a well positioned on a peripheral portion of the bottom portion, the well configured to receive the predetermined amount of liquid nitrogen. In one embodiment, the end closure is a tear away lid secured to a top portion of the thin-walled metallic food container. In some embodiments, the method further comprises providing the thin-walled metallic food container comprising a threaded portion proximate the upper end of the cylindrical side wall, wherein the end closure is a screw-on lid that is screwed onto the threaded portion of the thin-walled metallic food container. In some embodiments, the method further comprises: providing a separate upper portion comprising threads and a peripheral curl; interconnecting the peripheral curl of the upper portion to the upper end of the cylindrical sidewall; and

wherein the end closure is a screw-on lid that is screwed onto the threads of the upper portion. In various embodiments, the predetermined amount of liquid nitrogen is determined based on an amount of time between injecting the liquid nitrogen and sealing the container, a size of the thin-walled metallic food container, and a desired final internal pressure.

The phrases "at least one," "one or more," and "and/or," as used herein, are open-ended expressions that are both conjunctive and disjunctive in operation. For example, each of the expressions "at least one of A, B and C," "at least one of A, B, or C," "one or more of A, B, and C," "one or more of A, B, or C," and "A, B, and/or C" means A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B, and C together.

Unless otherwise indicated, all numbers expressing quantities, dimensions, conditions, and so forth used in the specification and claims are to be understood as being modified in all instances by the term "about".

The term "a" or "an" entity, as used herein, refers to one or more of that entity. As such, the terms "a" (or "an"), "one or more," and "at least one" can be used interchangeably herein.

The use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Accordingly, the terms "including," "comprising," or "having" and variations thereof can be used interchangeably herein.

It shall be understood that the term "means" as used herein shall be given its broadest possible interpretation in accordance with 35 U.S.C. § 112(f). Accordingly, a claim incorporating the term "means" shall cover all structures, materials, or acts set forth herein, and all of the equivalents thereof. Further, the structures, materials, or acts and the equivalents thereof shall include all those described in the summary of the invention, brief description of the drawings, detailed description, abstract, and claims themselves.

These and other advantages will be apparent from the disclosure of the invention(s) contained herein. The above-described embodiments, objectives, and configurations are neither complete nor exhaustive. The Summary of the Invention is neither intended nor should it be construed as being representative of the full extent and scope of the present invention. Moreover, references made herein to "the present invention" or aspects thereof should be understood to mean certain embodiments of the present invention and should not necessarily be construed as limiting all embodiments to a particular description. The present

invention is set forth in various levels of detail in the Summary of the Invention as well as in the attached drawings and the Detailed Description and no limitation as to the scope of the present invention is intended by either the inclusion or non-inclusion of elements, components, etc. in this Summary of the Invention. Additional aspects of the present invention will become more readily apparent from the Detailed Description, particularly when taken together with the drawings.

DETAILED DESCRIPTION

Although the following text sets forth a detailed description of numerous different embodiments, it should be understood that the legal scope of the description is defined by the words of the claims set forth at the end of this disclosure. The detailed description is to be construed as exemplary only and does not describe every possible embodiment since describing every possible embodiment would be impractical, if not impossible. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims. To the extent that any term recited in the claims at the end of this patent is referred to in this patent in a manner consistent with a single meaning, that is done for sake of clarity only so as to not confuse the reader, and it is not intended that such claim term be limited, by implication or otherwise, to that single meaning.

Figs. 2, 5, 11, 16, 19, 25, 30, 36 show some embodiments of the present invention, but these embodiments do not show the nitrogen well. It is noted that the invention comprises these embodiments with or without the nitrogen well, but preferably with the nitrogen well added to these figures. Figs. 2, 5, 11, 16, 19, 25, 30, 36 show containers with the desired dome-shaped bottom and the preferred radius of curvature for the domed bottom. The shape of the dome matches or corresponds to the saddle shape of stacking chips placed in the container. This dome radius results in a higher number of contact points between the chips and the dome, which decreases chip breakage during filling and shipping. Prior art stacking chip containers have a flat bottom portion seamed to a cardboard or foil tube. The flat bottom results in two primary points of contact between the chips and the bottom, which increases breakage because pressure is incurred on the chips in two primary points. Additionally, Figs. 2, 5, 11, 16, 19, 25, 30, 36 show various container end closures or lids, all of which can be used with containers having nitrogen wells. The terms “end closure,” “lid,” and “cap” can be used interchangeably herein.

Fig. 1, is a front elevation view of a container 10 according to one embodiment of the present invention. The container 10 has a top portion or top end 22 with a curl 18 surrounding an opening. The top end 22 is opposite a closed bottom end 26 having a bottom portion 30. The container 10 has a body 14 and a sidewall 34 extending from the bottom portion 30 to the curl 18. The container 10 has a height H between about 3.0 inches and 13.0 inches in some embodiments. In preferred embodiments, the height H is about 3.438 inches, 7.50 inches, 9.1875 inches, or 11.50 inches.

Fig. 2 is a cross-section of the container 10 taken along line 2-2 of Fig. 1. The container 10 has a curl outer diameter COD and an inner diameter ID. In some embodiments, the curl outer diameter COD is between about 2.00 inches and about 4.00 inches. In preferred embodiments, the curl outer diameter COD is about 3.040 inches. In some embodiments, the inner diameter ID is between about 2.10 inches and about 3.90 inches. In preferred embodiments, the inner diameter ID is about 2.8705 inches. An enlarged view of the curl 18 is shown in Fig. 4. An enlarged view of the bottom portion 30 is shown in Fig. 5.

Fig. 3 is a cross-section of the container 10 taken at the same place on Fig. 1 as Fig. 2. Fig. 3 is the same container 10 as Fig. 2 except that it also includes a nitrogen well at the bottom 26. An enlarged view of the curl 18 is shown in Fig. 4. An enlarged view of the bottom portion 30 is shown in Figs. 6 and 7. Although the height H of Fig. 3 appears taller than Fig. 2, it is within the scope of this embodiment that the heights of the containers 10 of Figs. 2 and 3 are the same. Thus, if the overall heights H are the same, then the interior portion 11 of the container 10 into which chips or other food can be stored would be smaller for Fig. 3. If the customer prefers the interior storage 11 of the container to remain the same, then the addition of the nitrogen well 82 will add to the overall exterior height H of the container 10, as currently shown in Fig. 3.

Fig. 4 is an enlarged view of the curl 18 on the top end 22 of the container 10 of Figs. 1-3. The curl 18 has a circular or otherwise rounded shape. The curl 18 can have an oval shape in some embodiments. In various embodiments, the radius of curvature of the curl 18 is between about 0.020 inches and about 0.060 inches. In a preferred embodiment, the radius of curvature of the curl 18 is about 0.040 inches.

The container 10 of Figs. 1-4 can be sealed or closed using any known method in the art. For example, a paper or plastic pull top can be used, similar to the tear away lid 238 disclosed and discussed in connection with Figs. 10-15. Specifically, the tear away lid can

be interconnected to a crown of the curl 18. Alternatively, a pull top, cap, other pull or tear away lid, or other closure mechanism can be used to seal the container 10.

Note that the bottom portions 30 or bottom ends 26 disclosed and discussed in connection with Figs. 5-9 apply to all embodiments described herein and repetitive discussions will not be provided.

Fig. 5 is an enlarged view of the bottom end 26 of Fig. 2, i.e., a bottom end 26 without a nitrogen well. The bottom end 26 includes a curved portion 46 below the sidewall 34. The curved portion 46 extends to a straight portion 50, which is interconnected to the domed portion 54. In some embodiments, the curved portion 46 has a radius of curvature between about 0.010 inches and about 0.20 inches. In a preferred embodiment, the curved portion 46 has a radius of curvature of about 0.100 inches. In some embodiments, the straight portion 50 has a length L1 between about 0.010 inches and about 0.10 inches. In a preferred embodiment, the straight portion 50 has a length L1 of about 0.050 inches. In some embodiments, the domed portion 54 has a radius of curvature between about 6.0 inches and about 10.0 inches. In a preferred embodiment, the domed portion 54 has a radius of curvature of about 8.1 inches. The radius of curvature of the domed portion 54 can change depending on the chips or other food to be packaged in the container 10. In some embodiments, the domed portion 54 has a height DH between about 0.010 inches and about 0.200 inches. In a preferred embodiment, the domed portion 54 has a height DH of about 0.100 inches. This height would be much higher if a nitrogen well was included.

Fig. 6 is an enlarged cross-sectional elevation view of the bottom end 26 of the container 10 of Fig. 3. The container 10 has two saddled potato chips 94 positioned on the domed portion 78 and a nitrogen well 82 positioned below the domed portion 78. A small amount of liquid nitrogen 2 is shown in the nitrogen well 82. The nitrogen well 82 allows for nitrogen dosing of the container 10 while the nitrogen 2 is in the liquid phase and prevents the liquid nitrogen 2 from contacting the chips 94. Using liquid nitrogen 2 in the well 82 allows a sufficient amount of time to close the container 10 before the liquid nitrogen 2 changes to a gaseous phase and escapes the container 10. The nitrogen well 82 adds to the novelty and desirability of the domed-shaped bottom 30 by adding a location for nitrogen 2 to sit and not be touched by the chips 94. The nitrogen 2 increases the internal pressure of the container 10, which permits the container 10 to be a thin-walled aluminum design. Using the thin-walled aluminum design without the increased internal pressure would create a weak container that could be bent or crushed, which would break or crush the chips or

other food contained therein. Prior art chip containers were thicker (typically thick cardboard with a foil liner) and, thus, did not require increased internal pressure or nitrogen dosing to maintain the strength and shape of the container and prevent chip breakage. However, if thin aluminum is used for the side wall, then increased internal pressure is necessary and nitrogen dosing is a reliable and FDA-approved way to increase the internal pressure of a food container.

The sidewall 34 extends downward to the nitrogen well 82, which is formed by an outer well wall 70 (also called a “well outer sidewall”) interconnected to a curved portion 66 (also called a “well bottom”), which is interconnected to an inner well wall 74 (also called a “well inner sidewall”). In some embodiments, the lower end of the container sidewall 34 may not directly connect with the well outer sidewall 70. Thus, there may be a bump or curve or other extension or indentation portioned between the lower end of the container sidewall 34 and the well outer sidewall 70.

The inner well wall 74 is interconnected to the domed portion 78. The domed portion 78 of Figs. 6 and 7 can be similar to the domed portion 54 of Fig. 5 or can be similar to the domed portion 254 of Fig. 16. In some embodiments, the domed portion 78 has a radius of curvature R1 between about 4.0 inches and about 10.0 inches. In a preferred embodiment, the domed portion 78 has a radius of curvature R1 of about 8.1 inches. The radius of curvature R1 of the domed portion 78 can change depending on the chips or other food to be packaged in the container 10. As shown in Fig. 6, which includes chips 94 positioned on the domed portion 78, the domed portion 78 is sized and shaped to fit the curvature and size of the chips 94 such that the chips 94 are substantially supported by the domed portion 78. Thus, the chips 94 contact the domed portion 78 in multiple points, rather than two points as was done in the prior art.

The bottom end 26 of the container 10 of Figs. 3 and 6 may have a symmetrical domed portion 78, meaning the cross-sectional elevation view would look the same no matter where the cut in the container 10 is made as long as the cut goes through the center of the container. Alternatively, the bottom 30 could have two different domed portions 78, each having a different radius of curvature, and preferably positioned substantially perpendicular to one another. For example, the bottom end 26 may have a hyperbolic paraboloid where the two different domed portions 78 have radii of curvature oriented in opposite directions: one up and one down. In other embodiments, the two radii of curvature of the two domed portions 78 could be oriented in the same direction: both down.

Fig. 7 is also an enlarged view of the bottom end 26 of the container 10 shown in cross-section. Fig. 7 may be the same container 10 as shown in Figs. 3 and 6 or it can be a different container. For example, the bottom portion 26 shown in Fig. 7 has a hyperbolic paraboloid shape. Fig. 7 is a cross-section taken along the major axis of the container 10 and shows the first domed portion 78 and the first radius of curvature R1 in solid lines. The first radius of curvature R1 extends from low point to low point (i.e., from the innermost point 126 of the nitrogen well 82 on one side to the innermost point 126 of the nitrogen well 82 on the other side). The first domed portion 78 and its first radius of curvature R1 are oriented downwardly in the present embodiment to match the downwardly oriented radius of curvature of the crisps when the crisps are positioned with major axis curvature facing the container bottom 26. Again, the sidewall 34 extends downward to the nitrogen well 82, which is formed by an outer well wall 70 interconnected to a curved portion 66, which is interconnected to an inner well wall 74. The inner well wall 74 is interconnected to a first domed portion 78. The well 82 has a well height WH and a well width WW. In some embodiments, the well height WH is between about 0.10 inches and about 0.40 inches. In a preferred embodiment, the well height WH is about 0.25 inches. In some embodiments, the well width WW is between about 0.05 inches and about 0.25 inches. In a preferred embodiment, the well width WW is about 0.125 inches. In some embodiments, the well height WH is double the well width WW. In some embodiments, the nitrogen well 82 is concentric and the same height WH and width WW around the entire circumference of the container 10. In other embodiments, the nitrogen well 82 varies in height WH or width WW around the container circumference. In some embodiments, the radius of curvature of the curved portion 66 is between about 0.01 inches and about 0.50 inches. In a preferred embodiment, the radius of curvature of the curved portion 66 is about 0.04 inches.

Shown in dashed lines is a cross-sectional view of the bottom end 26 taken along a line that is perpendicular to the cut line 3-3. More specifically, the cross section shown in dashed lines is taken along the minor axis of the container 10 and is substantially perpendicular to the cross section shown in solid lines (i.e., the cross section showing R1). Thus, in this embodiment, the bottom 30 has two different domed portions 78, 102, each having a different curvature, as shown by the different cross-sectional views: a first downwardly-oriented curved domed portion 78 and a second upwardly-oriented curved domed portion 102. Here, the bottom 30 has a hyperbolic paraboloid shape.

The second (also called minor axis herein) domed portion 102 is the same as and matches the first (also called major axis herein) domed portion 78 along the concentric ring 122, which is also the well inner wall 74. At point 126, the second domed portion 102 diverges from the first domed portion 78. The second domed portion 102 extends upwardly forming a conical portion 106 that angles inwardly to the center of the container 10 to match the hyperbolic paraboloid shape of a crisps. The conical portion 106 meets the second radius of curvature R2 along the minor axis at the high points 110. The second radius of curvature R2 is oriented upwardly and extends from high point 110 to high point 110 to match the upwardly oriented radius of curvature of the crisps when the crisps are positioned with the major axis curvature facing the container bottom 26. At center point 118 the first radius of curvature R1 meets the second radius of curvature R2. Thus, point 118 is the lowest point of the second radius of curvature R2 and is the highest point of the first radius of curvature R1.

Fig. 8 is a top plan view of the container 10 with a crisp 94 positioned on the bottom 30 of the container 10. Here, the crisp 94 is shown with an oval shape (in two dimensions), but the crisp 94 may have a circular shape or any other shape in other embodiments. The minor axis 146 of the crisp 94 is the shorter of the two axes and is shown vertically in Fig. 8. The major axis 150 of the crisp 94 is the longer of the two axes and is shown horizontally in Fig. 8. If the crisp 94 has a hyperbolic paraboloid shape, then the radius of curvature of the major axis 150 is oriented downwardly or convex (e.g., an upside down U) and the radius of curvature of the minor axis 146 is oriented upwardly or concave (e.g., a U). At the intersection of the minor 146 and major 150 axes of a hyperbolic paraboloid shaped chip 94 is the saddle point 154, also called the minmax point.

The dashed line shows the inner edge of the nitrogen well 82 according to some embodiments. In this embodiment, the nitrogen well is concentric with the container sidewall 34. However, in other embodiments, the nitrogen well 82 may not be concentric with the container wall and instead may be an oval shape similar to the oval shaped crisp 94. In some embodiments, the method of filling the container includes placing the crisps 94 inside the container 10 and then charging the liquid nitrogen and directing the liquid nitrogen flow into the area between the sidewall 34 and the crisps 94, i.e., into the nitrogen well 82, preferably in the portion of the well 82 between the sidewall 34 and the minor axis 146 of the oval crisp 94. This is because there is more space between the sidewall 34 and the minor axis 146 of the crisp 94 than there is between the sidewall 34 and the major axis 150 of the

crisp. In some embodiments, the method of filling the container 10 includes charging the liquid nitrogen into the container 10, e.g., into the nitrogen well 82, before the food or crisps are placed into the container 10. Because the food is not yet in the container 10, the liquid nitrogen can be directed in any portion of the well 82. The well 82 prevents the crisps 94 from contacting the liquid nitrogen already in the container 10.

Note that the container 10 shape and proportions and chip 94 shape and proportions can vary in various embodiments. For example, in some embodiments, the container 10 has an oval shape and/or a larger nitrogen well. Additionally, the chips 94 may be circular or larger or smaller than shown. The chips 94 can also have different proportions between the major 150 and minor 146 axes. In some embodiments, there is more space between the chips 94 and the container sidewall 34, as shown in Fig. 9. In some embodiments, the container 10 is circular shaped when viewed from a top plan view. In other embodiments, the container 10 is oval shaped, when viewed from a top plan view, to match the crisp 94 shape.

Fig. 9 is a top plan view of the container 10 with one or more stackable crisps 94 and showing the different dome curvature lines if the domed portion has a hyperbolic paraboloid shape. Here the domed bottom portion has two different radii of curvature. The container 10 has a first centerline 166, which aligns with the major axis of the crisp 94, and a second centerline 170, which aligns with the minor axis of the crisp 94. The center point 174 of the container 10 is located where the first centerline 166 intersects the second centerline 170. The dashed circle is the innermost point/edge 126 of the nitrogen well 82, i.e., the point 126 where the second domed portion (102 in Fig. 8) diverges from the first domed portion (78 in Fig. 8). The high points 110 from Fig. 8 are proximate the edge of the crisp 94 and positioned on the minor axis of the crisp 94 and the second centerline 170 of the container 10. Topographical lines of the conical portion 106 show the shape of the dome extending upwardly.

In the embodiment shown, it is preferred to inject the liquid nitrogen between the minor axis of the crisp 94 (i.e., near the second centerline 170 of the container 10) and the sidewall 34. It is not preferred to inject the liquid nitrogen between the major axis of the crisp 94 (i.e., near the first centerline 166 of the container 10) and the sidewall 34.

Figs. 10-17 show another embodiment of the container 210. This embodiment can have a nitrogen well (Fig. 12) or no nitrogen well (Fig. 11). The only difference between this embodiment and the embodiment of Figs. 1-4 is that the top end 222 of this container

210 has a different shape than the top end 22 of Figs. 1-4. Specifically, the container 210 has an inwardly oriented neck portion proximate the top end 222 of the container 210. Note that the bottom portions 30 or bottom ends 26 disclosed and discussed in connection with Figs. 5-9 apply to this embodiment and repetitive discussions will not be provided.

Fig. 10 is a front elevation view of a container 210 according to an embodiment of the present invention. The container 210 has a top portion or top end 222 with a curl 218 surrounding an opening. The top end 222 is opposite a closed bottom end 226 having a bottom portion 230. The container 210 has a body 214 and a sidewall 234 extending from the bottom portion 230 to curl 218. The container 210 has a height H between about 3.0 inches and 13.0 inches in some embodiments. In preferred embodiments, the height H is about 3.438 inches, 7.50 inches, 9.1875 inches, or 11.50 inches. The container 210 has an outer diameter OD. In some embodiments, the outer diameter OD is between about 2.00 inches and about 4.00 inches. In preferred embodiments, the container outer diameter OD is about 2.8825 inches.

Fig. 11 is a cross-sectional elevation view of the container 210 taken along line 11-11 of Fig. 10. The container 210 has a top inner diameter TID. In some embodiments, the top inner diameter TID is between about 2.00 inches and about 3.90 inches. In preferred embodiments, the top inner diameter TID is about 2.7125 inches. An enlarged view of the curl 218 is shown in Fig. 15. An enlarged view of the bottom portion 230 is shown in Fig. 16.

Fig. 12 is a cross-sectional elevation view of the container 210 taken at the same place on Fig. 10 as Fig. 11. Fig. 12 is the same container 210 as Fig. 11 except that it also includes a nitrogen well 282 at the bottom 226. An enlarged view of the curl 218 is shown in Fig. 15. An enlarged view of the bottom portion 230 is shown in Fig. 17. Although the height H of Fig. 12 appears taller than Fig. 11, it is within the scope of this embodiment that the heights of the containers 210 of Figs. 11 and 12 are the same. Thus, if the overall heights H are the same, then the interior portion 211 of the container 210 into which chips or other food can be stored would be smaller for Fig. 12. If the customer prefers the interior storage 211 of the container to remain the same, then the addition of the nitrogen well 282 will add to the overall exterior height H of the container 210, as currently shown in Fig. 12.

Fig. 13 is a perspective view of the container 210 showing the body 214 and a tear away lid 238 on the top end 222. Fig. 14 is a top plan view showing the tear away lid 238 on the container 210. The tear away lid 238 does not extend all the way to the perimeter of

the curl 218; thus, a portion of the curl 218 is visible in the top plan view. The tear away lid 238 has a circular shape to match the container's shape but could have any other shape necessary to match the container. The tear away lid 238 is secured to a crown or top surface of the curl 218 of the container 210 using an adhesive or other known securing means. The tear away lid 238 has a tab portion 240 extending from the main body of the tear away lid 238. The tab portion is provided for the user to hold and pull the tear away lid 238 off of the container 210. The tab portion 240 can be larger or smaller and/or have a different shape in other embodiments, as desired by the user. The user pulls on the tab portion 240 and peels the tear away lid 238 off of the container 210 to open the container 210 and access its contents.

Fig. 15 is an enlarged view of the curl 218 on the top end 222 of the container 210 of Figs. 10-14. The curl 218 has a circular or otherwise rounded shape. The curl 218 can have an oval shape in some embodiments. In various embodiments, the radius of curvature of the curl 218 is between about 0.020 inches and about 0.060 inches. In a preferred embodiment, the radius of curvature of the curl 218 is about 0.040 inches.

Fig. 16 is an enlarged view of the bottom end 226 of Fig. 11, i.e., a bottom end 226 without a nitrogen well. The bottom end 226 includes a curved portion 246 below the sidewall 234. The curved portion 246 extends to a straight portion 250, which is interconnected to the domed portion 254. In some embodiments, the curved portion 246 has a radius of curvature between about 0.010 inches and about 0.20 inches. In a preferred embodiment, the curved portion 246 has a radius of curvature of about 0.100 inches. In some embodiments, the straight portion 250 has a length L1 between about 0.010 inches and about 0.20 inches. In a preferred embodiment, the straight portion 250 has a length L1 of about 0.050 inches. In some embodiments, the domed portion 254 has a radius of curvature between about 3.0 inches and about 10.0 inches. In a preferred embodiment, the domed portion 254 has a radius of curvature between about 3.50 inches and about 5.50 inches or between about 7.00 inches and about 9.00 inches. In a preferred embodiment, the domed portion 254 has a radius of curvature of about 4.05 inches or about 8.12 inches. The radius of curvature of the domed portion 254 can change depending on the chips or other food to be packaged in the container 210. In some embodiments, the domed portion 254 has a height between about 0.050 inches and about 0.400 inches. In a preferred embodiment, the domed portion 254 has a height of about 0.20 inches.

Fig. 17 is an enlarged view of a cross-sectional elevation view of the bottom end 226 of the container 210 of Fig. 12. The sidewall 234 extends downward to the nitrogen well 282, which is formed by an outer well wall 270 (also called a “well outer sidewall”) interconnected to a curved portion 266 (also called a “well bottom”), which is interconnected to an inner well wall 274 (also called a “well inner sidewall”). The inner well wall 274 is interconnected to the domed portion 278. In some embodiments, the domed portion 278 has a radius of curvature R1 between about 6.0 inches and about 10.0 inches. In a preferred embodiment, the domed portion 278 has a radius of curvature R1 of about 8.1 inches. The radius of curvature R1 of the domed portion 278 can change depending on the chips or other food to be packaged in the container 210. The domed portion 278 is sized and shaped to fit the curvature and size of the chips or other food product such that the chips are substantially supported by the domed portion 278. Thus, the chips contact the domed portion 278 is multiple points, rather than two points as was done in the prior art.

The bottom end 226 of the container 210 of Figs. 12 and 17 may have a symmetrical domed portion 278, meaning the cross-sectional elevation view would look the same no matter where the cut in the container 210 is made as long as the cut goes through the center of the container. Alternatively, the domed portion 278 could have two different radii of curvature, preferably positioned substantially perpendicular to one another. For example, the bottom end 226 may have a hyperbolic paraboloid shape where the two different radii of curvature are also oriented in opposite directions: one up and one down. In other embodiments, the two radii of curvature could be oriented in the same direction: both down.

Figs. 18-22 show another embodiment of the container 310. This embodiment can have a nitrogen well (Fig. 20) or no nitrogen well (Fig. 19). The only difference between this embodiment and the embodiments of Figs. 1-4 and 10-15 is that the top end 322 of this container 310 has a different shape than the top ends 22, 222 of Figs. 1-4 and 10-15. Specifically, the container 310 has an inwardly oriented neck portion proximate the top end 322 of the container 310 and a peripheral curl 318 double seamed to an end closure 338, which can be metallic end closure. Note that the bottom portions 30, 230 or bottom ends 26, 226 disclosed and discussed in connection with Figs. 5-9 and 16-17 apply to this embodiment and repetitive discussions will not be provided.

Fig. 18 is a perspective view of a container 310 according to an embodiment of the present invention. The container 310 has a top portion or top end 322 with a curl 318 (see Fig. 22) surrounding an opening. The curl 318 is double seamed to an end closure 338. The

top end 322 is opposite a closed bottom end 326 having a bottom portion 330. The container 310 has a body 314 and a sidewall 334 extending from the bottom portion 330 to top end 322.

Fig. 19 is a cross-sectional elevation view of the container 310 of Fig. 18. The container 310 has a height H between about 3.0 inches and 13.0 inches in some embodiments. In preferred embodiments, the height H is about 3.438 inches, 7.50 inches, 9.1875 inches, or 11.50 inches. The container 310 has an outer diameter OD and a top inner diameter TID. In some embodiments, the outer diameter OD is between about 2.00 inches and about 4.00 inches. In preferred embodiments, the container outer diameter OD is about 2.8845 inches. In some embodiments, the top inner diameter TID is between about 2.00 inches and about 3.90 inches. In preferred embodiments, the top inner diameter TID is about 2.7105 inches. An enlarged view of the curl 318 seamed to the end closure 338 is shown in Fig. 22. An enlarged view of the bottom portion 330 is shown in Fig. 16.

Fig. 20 is a cross-sectional elevation view of the container 310 of Fig. 18 taken at the same location as Fig. 19. Fig. 20 is the same container 310 as Fig. 19 except that it also includes a nitrogen well 382 at the bottom 326. An enlarged view of the curl 318 seamed to an end closure 338 is shown in Fig. 22. An enlarged view of the bottom portion 330 is shown in Fig. 17. Although the height H of Fig. 20 appears taller than Fig. 19, it is within the scope of this embodiment that the heights of the containers 310 of Figs. 19 and 20 are the same. Thus, if the overall heights are the same, then the interior portion of the container 310 into which chips or other food can be stored would be smaller for Fig. 20. If the customer prefers the interior storage of the container to remain the same, then the addition of the nitrogen well 382 will add to the overall exterior height of the container 310, as currently shown in Fig. 20.

Fig. 21 is a top plan view showing the end closure 338 on the container 310. Two perpendicular center lines are shown. The end closure 338 has a tear away center panel 360 with a pull tab 364. The pull tab 364 is interconnected to the center panel via a rivet or other interconnection means 368. The pull tab 364 can be various shapes and sizes, other than the shape and size shown in Fig. 21. The pull tab 364 is positioned proximate the score line 362 such that the nose of the tab 364 can fracture the score line 362 to open the container. The center panel 360 is defined by a score line 362 extending around the perimeter of the center panel 360. When the user lifts the tail of the pull tab 364, the score line 362 fractures and the entire center panel 360 is peeled back and removed. The end closure 338 may have

a safety fold or other mechanism proximate the score line 360 such that a sharp edge does not remain after the user removes the center panel 360. The center panel 360 has a circular shape to match the shape of the container 310 but could have any other shape necessary to match the container shape.

5 Fig. 22 is an enlarged view of the top end 322 of the container 310 of Figs. 18-21. Specifically, the end closure 338 is shown double seamed onto the container 310. The container 310 has an inwardly oriented neck portion 342 positioned above and interconnected to the sidewall 334 and a peripheral curl 318 interconnected to the upper portion of the neck 342. The container curl 318 can have a circular or otherwise rounded
10 shape before it is double seamed to the end closure 338. The curl 356 of the end closure 338 is wrapped around the container curl 318 and the two curls 318, 356 are pressed together to securely seal the end closure 338 onto the container 310.

As shown in Fig. 22, the end closure 338 has a substantially flat and/or horizontally oriented center panel 360 with a score 362. The center panel 360 is interconnected to a
15 countersink inner panel wall 390 at a radius of curvature. The countersink inner panel wall 390 can be linear or curved when viewed in cross-section. The countersink inner panel wall 390, is interconnected to a countersink 358 having a radius of curvature. The countersink 358 is interconnected to a substantially linear countersink outer panel wall 388, which is interconnected to a chuck wall 386 having a break or cured portion. The chuck wall 386 can
20 be curved or linear when viewed in cross-section. The upper end of the chuck wall 386 is interconnected to the peripheral curl 356.

Figs. 23-27 show another embodiment of the container 410. This embodiment can have a nitrogen well (Fig. 26) or no nitrogen well (Fig. 25). The only difference between this embodiment and the embodiments of Figs. 1-4, 10-15, and 18-22 is that the top end 422
25 of this container 410 has a different shape than the top ends 22, 222, 322 of Figs. 1-4, 10-15, and 18-22. Specifically, the container 410 has a threaded portion 402 proximate the top end 422 of the container 410 and a screw-on lid (also called a “cap” herein) 438 is screwed onto the threaded portion 402. Note that the bottom portions 30, 230, 330 or bottom ends 26, 226, 326 disclosed and discussed in connection with Figs. 5-9 and 16-17 apply to this
30 embodiment and repetitive discussions will not be provided.

Fig. 23 is a perspective view of a container 410 with a screw-on lid 438 according to an embodiment of the present invention. Fig. 24 is a front elevation view of the container 410 without the screw-on lid. The container 410 has a top portion or top end 422 opposite

a closed bottom end 426 having a bottom portion 430 and a body 414 therebetween. The top end 422 has a curl 418 surrounding an opening. Below the curl 418 is a threaded portion 402 having threads 404 and a substantially flat portion 406 between the threads 404. The threaded portion 402, which includes the flat portion 406, generally is positioned substantially vertically. The container 410 has a neck portion 442 positioned between the threaded portion 402 and a sidewall 434. The neck portion 442 tapers inwardly from the sidewall 434 to the threaded portion 402. The threads 404 can be embossed into the substantially flat portion 406 or otherwise stamped or pressed into the substantially flat portion 406 to form the threaded portion 402. Alternatively, the threads 404 can be manufactured into the substantially flat portion 406 in any way known or used in the art. The sidewall 434 extends from the bottom portion 430 to the neck 442. The container 410 has a height H between about 3.0 inches and 13.0 inches in some embodiments. In preferred embodiments, the height H is about 3.438 inches, 7.50 inches, 9.1875 inches, or 11.50 inches. The container 410 has an outer diameter OD. In some embodiments, the outer diameter OD is between about 2.00 inches and about 4.00 inches. In preferred embodiments, the container outer diameter OD is about 2.8845 inches.

The screw-on lid 438 has a substantially flat upper surface 436 with a side portion 444 extending downwardly from and substantially perpendicular to the upper surface 436. The upper surface 436 is oriented in a substantially horizontal plane and the side portion 444 is oriented substantially vertically. The side portion 444 can include grooves 440 to aid a user in gripping the screw-on lid 438. Various embodiments can have more or fewer grooves 440 and the grooves 440 can have varying sizes. However, some embodiments do not include the grooves 440. The inner surface of the side portion 444 can have lugs that receive the threads 404 of the container.

Fig. 25 is a cross-sectional elevation view of the container 410 of Figs. 23-24 taken along line 25-25 of Fig. 24 and shown with the lid 438. The container 410 has a top inner diameter TID. In some embodiments, the top inner diameter TID is between about 2.00 inches and about 3.90 inches. In preferred embodiments, the top inner diameter TID is about 2.6705 inches. An enlarged view of the top end 422 is shown in Fig. 27. An enlarged view of the bottom portion 430 is shown in Fig. 16.

Fig. 26 is a cross-sectional elevation view of the container 410 of Figs. 23-24 and is taken at the same location as Fig. 25 and shown with the lid 438. Fig. 25 is the same container 410 as Fig. 25 except that it also includes a nitrogen well 482 at the bottom 426.

An enlarged view of the top end 422 is shown in Fig. 27. An enlarged view of the bottom portion 430 is shown in Fig. 17. Although the height H of Fig. 26 appears taller than Fig. 25, it is within the scope of this embodiment that the heights of the containers 410 of Figs. 25 and 26 are the same. Thus, if the overall heights H are the same, then the interior portion 411 of the container 410 into which chips or other food can be stored would be smaller for Fig. 26. If the customer prefers the interior storage 411 of the container to remain the same, then the addition of the nitrogen well 482 will add to the overall exterior height H of the container 410, as currently shown in Fig. 26.

Fig. 27 is an enlarged view of the top end 422 of the container 410 of Figs. 23-26. The container 410 has an inwardly oriented neck portion 442 positioned above and interconnected to the sidewall 434 and a threaded portion 402 interconnected to the upper portion of the neck 442. The threaded portion 402 has a substantially flat portion 406 and threads 404 extending therefrom. A peripheral curl 418 is interconnected to the upper portion of the threaded portion 402. The peripheral curl 418 can have a circular, oval, or otherwise rounded shape. The screw-on lid 438 is screwed onto the threaded portion 402 of the container 410. More specifically, an inner surface of the side portion 444 engages the threads 404 of the container 410 to securely seal the container 410. A groove 440 in the side portion 444 can also be seen in Fig. 27. The upper portion 436 of the screw-on lid 438 is positioned on the peripheral curl 418 of the container 410. Thus, the diameter of the substantially flat upper portion 436 of the screw-on lid must be the same as the curl outer diameter or slightly larger than the curl outer diameter.

Figs. 28-32 show another embodiment of the container 510. This embodiment can have a nitrogen well (Fig. 31) or no nitrogen well (Fig. 30). The only difference between this embodiment and the embodiments of Figs. 1-4, 10-15, 18-22, and 23-27 is that the top end 522 of this container 510 has a different shape than the top ends 22, 222, 322, 422 of Figs. 1-4, 10-15, 18-22, and 23-27. Specifically, the container 510 has a threaded portion 502 proximate the top end 522 of the container 510 and a screw-on lid (which is similar to or the same as the lid 438 of Fig. 23) is screwed onto the threaded portion 502. Note that the bottom portions 30, 230, 330 or bottom ends 26, 226, 326 disclosed and discussed in connection with Figs. 5-9 and 16-17 apply to this embodiment and repetitive discussions will not be provided.

Fig. 28 is a perspective view of a container 510 with a threaded portion 502 to receive a screw-on lid according to an embodiment of the present invention. Fig. 29 is a front

elevation view of the container 510 shown without the lid. The container 510 has a top portion or top end 522 opposite a closed bottom end 526 having a bottom portion 530 and a body 514 therebetween. This container 510 is a two-piece container comprising a main portion 500 and an upper portion 501 interconnected to one another. The main portion 500 comprises the bottom portion 530, the sidewall 534, a flared out neck portion 572 positioned above the sidewall 534, and a peripheral curl 518 positioned above the flared out neck portion 572 and double seamed to a peripheral curl 556 of the upper portion 501. The upper portion 501 comprises a curl 516 at the top end 522 and surrounding an opening. One reason why the container 510 may be manufactured comprising two-pieces 500, 501 is that then the threading tools do not have to be on the container body manufacturing line. Rather, the upper portion 501 is manufactured on a separate line with threading tools than the line that make the main portion 500. It may be less expensive to manufacture the threaded container 510 out of two pieces 500, 501 and double seam, or otherwise interconnect, the two pieces 500, 501 together. Thus, the embodiment shown in Figs. 23-27 can be manufactured out of two pieces, similar to the present invention.

Below the curl 516 is a threaded portion 502 having threads 504 and a substantially flat portion 506 between the threads 504. The threaded portion 502, which includes the flat portion 506, generally is positioned substantially vertically. The threads 504 can be embossed into the substantially flat portion 506 or otherwise stamped or pressed into the substantially flat portion 506. Alternatively, the threads 504 can be manufactured into the substantially flat portion 506 in any way known or used in the art. The upper portion 501 has a countersink 558 positioned between the threaded portion 502 and the peripheral curl 556. The neck portion 572 extends outwardly from the sidewall 534 such that it extends beyond (in the radial direction) the threaded portion 502, i.e., the outer diameter of the peripheral curl 556 of the main portion 500 is larger than the outer diameter of the threaded portion 502. The container 510 has a height H between about 3.0 inches and 13.0 inches in some embodiments. In preferred embodiments, the height H is about 3.438 inches, 7.50 inches, 9.1875 inches, or 11.50 inches. The container 510 has an outer diameter OD. In some embodiments, the outer diameter OD is between about 2.00 inches and about 4.00 inches. In preferred embodiments, the container outer diameter OD is about 2.8845 inches.

The container 510 can use the same screw-on lid as shown in Figs. 23 and 25-27 and such description will not be repeated here. Alternatively, a different screw-on lid could be used with the present embodiment.

Fig. 30 is a cross-sectional elevation view of the container 510 taken along line 30-30 of Fig. 29. An enlarged view of the top end 522 is shown in Fig. 32. An enlarged view of the bottom portion 530 is shown in Fig. 16.

Fig. 31 is a cross-sectional elevation view of the container 510 taken at the same place on Fig. 29 as Fig. 30. Fig. 31 is the same container 510 as Fig. 30 except that it also includes a nitrogen well 582 at the bottom 526. An enlarged view of the top end 522 is shown in Fig. 32. An enlarged view of the bottom portion 530 is shown in Fig. 17. Although the height H of Fig. 31 appears taller than Fig. 30, it is within the scope of this embodiment that the heights of the containers 510 of Figs. 30 and 31 are the same. Thus, if the overall heights H are the same, then the interior portion 511 of the container 510 into which chips or other food can be stored would be smaller for Fig. 31. If the customer prefers the interior storage 511 of the container to remain the same, then the addition of the nitrogen well 582 will add to the overall exterior height H of the container 510, as currently shown in Fig. 31.

Fig. 32 is an enlarged view of the top end 522 of the container 510 of Figs. 28-31. The container 510 is a two-piece container comprising a main portion 500 and an upper portion 501 interconnected to one another. The main portion 500 comprises the bottom portion 530, the sidewall 534, a flared out neck portion 572 positioned above the sidewall 534, and a peripheral curl 518 positioned above the flared out neck portion 572 and double seamed to a peripheral curl 556 of the upper portion 501. The flared-out neck portion 572 is formed by two opposing curved portions. The upper portion 501 comprises a curl 516 at the top end 522 and surrounding an opening. The curl 516 curls inward rather than outward, but the curl 516 could be oriented outwardly as shown in Figs. 24 and 27. Below the curl 516 is a threaded portion 502 having threads 504 and a substantially flat portion 506 between the threads 504. The threaded portion 502, including the flat portion 506, generally is positioned substantially vertically. Interconnected to the lower end of the substantially flat portion 502 is a countersink inner panel wall 590, which is interconnected to the countersink 558 having a radius of curvature, which is interconnected to a substantially linear countersink outer panel wall 588. The countersink inner panel wall 590 has two curved portions with a break portion or a juncture therebetween. The upper curved portion of the countersink inner panel wall 590 is oriented outwardly and the lower curved portion is oriented inwardly in the embodiment shown. In alternative embodiments, the countersink inner panel wall 590 could be linear or only have one curved portion. The peripheral curl 556 is interconnected to the upper end of the countersink outer panel wall 588. The

peripheral curl 556 of the upper portion 501 is interconnected to (preferably via double seaming) the peripheral curl 518 of the main portion 500.

5 In some embodiments, when a screw-on lid is interconnected to the container, the outer diameter of the screw-on lid is the same as or less than the outer diameter of the double seamed peripheral curl 556 of the upper portion 501. Accordingly, the flared out neck portion 572 may be included, and thus sized and shaped, such that the outer diameter of the lid is the same as the outer diameter of the curl 556.

10 Figs. 33-39 show another embodiment of the container 610. This embodiment can have a nitrogen well (Fig. 37) or no nitrogen well (Fig. 36). The only difference between this embodiment and the embodiments of Figs. 1-4, 10-15, 18-22, 23-27, and 28-32 is that the top end 622 of this container 610 has a different shape than the top ends 22, 222, 322, 422, 522 of Figs. 1-4, 10-15, 18-22, 23-27, and 28-32. Specifically, the container 610 has a threaded portion 602 proximate the top end 622 of the container 610 and a groove 676 below a ridge 680, which is below the threaded portion 602. The container 610 also utilizes a
15 screw-on lid (also called a “cap” herein) 638 that is screwed onto the threaded portion 602 and that has a tamper band 696 positioned at the bottom of the screw-on lid 638. Note that the bottom portions 30, 230, 330 or bottom ends 26, 226, 326 disclosed and discussed in connection with Figs. 5-9 and 16-17 apply to this embodiment and repetitive discussions will not be provided.

20 Fig. 33 is a perspective view of a container 610 with a screw-on lid 638 according to an embodiment of the present invention. Fig. 34 is a front elevation view of the container 610 with the screw-on lid 638. Fig. 35 is a front elevation view of the container 610 shown without the screw-on lid. The container 610 has a top portion or top end 622 opposite a closed bottom end 626 having a bottom portion 630 and a body 614 therebetween. The top
25 end 622 has a curl 618 surrounding an opening. Below the curl 618 is a threaded portion 602 having threads 604 and a substantially flat portion 606 between the threads 604. The threaded portion 602, which includes the flat portion 606, generally is positioned substantially vertically. The threads 604 can be embossed into the substantially flat portion 606 or otherwise stamped or pressed into the substantially flat portion 606. Alternatively,
30 the threads 604 can be manufactured into the substantially flat portion 606 in any way known or used in the art.

The container 610 has a ridge 680 positioned below the threaded portion 602, a groove 676 below the ridge 680, and then a neck 642 below the groove 676. The neck

portion 642 is positioned between the threaded portion 602 and the sidewall 634, and more specifically between the groove 676 and the sidewall 634. The neck portion 642 tapers inwardly from the sidewall 634 to the groove 676. The sidewall 634 extends from the bottom portion 630 to the neck 642. The container 610 has a height H between about 3.0 inches and 13.0 inches in some embodiments. In preferred embodiments, the height H is about 3.438 inches, 7.50 inches, 9.1875 inches, or 11.50 inches. The container 610 has an outer diameter OD. In some embodiments, the outer diameter OD is between about 2.00 inches and about 4.00 inches. In preferred embodiments, the container outer diameter OD is about 2.8845 inches.

The screw-on lid 638 has a substantially flat upper portion 636 with a side portion 644 extending downwardly from and substantially perpendicular to the upper portion 636. The upper portion 636 is oriented in a substantially horizontal plane and the side portion 644 is oriented substantially vertically. The side portion 644 includes threads 698 to receive the threads 604 of the container 610 and to aid a user in gripping the screw-on lid 638. The threads 698 can be embossed into the side portion 644 or otherwise stamped or pressed into the side portion 644. Alternatively, the threads 604 can be manufactured into the side portion 644 in any way known or used in the art. The threads 604, 698 of both the container 610 and lid 638 can be various shapes and sizes, but the threads 604, 698 of both the container 610 and lid 638 must be shaped similar to one another to engage one another and function properly. The threads 698 of the lid 638 must be larger and/or longer than the threads 604 of the container 610 to permit the lid 638 to be unscrewed from the container 610. Moreover, the lid 638 may need to be flexible or bendable to permit the user to unscrew the lid 638 from the container 610 because of the shape and size of the threads 602, 698 on each. If the lid 638 bends or flexes as the user unscrews the lid 638 from the container 610, then the tamper band 696 may more easily detach from the lid 638. Alternatively, the lid 638 can have lugs on an inner surface of the side portion 644 that receive the threads 604 of the container.

The lid 638 also includes a tamper band 696 (also called a “tamper ring”) positioned below the side portion 644. Additionally, the lid 638 can include a neck portion 700 between the side portion 644 and the tamper band 696. In the embodiment shown, the neck portion 700 curves inward from the tamper band 696 to the side portion 644. The neck portion 700 is sized and shaped to accommodate the ridge 680 of the container 610. The tamper band 696 is separable from the lid 638 after the container 610 is opened for the first time. Thus,

the tamper band 696 can be connected to the lid 638 via thin bridges or slits or perforations can be cut in between the lid 638 and the tamper band 696 after it is formed such that the tamper band 696 is frangible and separable from the lid 638. Thus, the thin bridges, slits, or perforations form an area of weakness such that the tamper ring 696 is easily separable from the lid 638 by a user. The tamper band 696 indicates to a consumer whether the container 610 has been opened previously.

Fig. 36 is a cross-sectional elevation view of the container 610 with a lid 638 taken along line 36-36 of Fig. 34. The container 610 has a top inner diameter TID. In some embodiments, the top inner diameter TID is between about 2.00 inches and about 3.90 inches. In preferred embodiments, the top inner diameter TID is about 2.6705 inches. An enlarged view of the top end 622 is shown in Fig. 39. An enlarged view of the bottom portion 630 is shown in Fig. 16.

Fig. 37 is a cross-sectional elevation view of the container 610 with a lid 638 taken at the same place on Fig. 34 as Fig. 36. Fig. 37 is the same container 610 as Fig. 36 except that it also includes a nitrogen well 682 at the bottom 626. An enlarged view of the top end 622 is shown in Fig. 39. An enlarged view of the bottom portion 630 is shown in Fig. 17. Although the height H of Fig. 37 appears taller than Fig. 36, it is within the scope of this embodiment that the heights of the containers 610 of Figs. 36 and 37 are the same. Thus, if the overall heights H are the same, then the interior portion 611 of the container 610 into which chips or other food can be stored would be smaller for Fig. 37. If the customer prefers the interior storage 611 of the container to remain the same, then the addition of the nitrogen well 682 will add to the overall exterior height H of the container 610, as currently shown in Fig. 37.

Fig. 38 is a top plan view of the container 610 with the lid 638. The upper portion 636 is substantially flat. In this view, the lid's threads 698 and neck portion 700 are visible.

Fig. 39 is an enlarged view of the top end 622 of the container 610 of Figs. 33-38. The container 610 has an inwardly oriented neck portion 642 positioned above and interconnected to the sidewall 634, a groove 676 interconnected to the upper portion of the neck 642, a ridge 680 interconnected to and positioned above the groove 676, and a threaded portion 602 interconnected to and positioned above the ridge 680. The threaded portion 602 has a substantially flat portion 606 and threads 604 extending therefrom. A peripheral curl 618 is interconnected to the upper portion of the threaded portion 602. The peripheral curl 618 can have a circular, oval, or otherwise rounded shape.

The screw-on lid 638 is screwed onto the threaded portion 602 of the container 610. More specifically, the threads 698 on the lid's side portion 644 engage the threads 604 of the container 610 to securely seal the container 610. The upper portion 636 of the screw-on lid 638 is positioned on the peripheral curl 618 of the container 610. Thus, the diameter of the substantially flat upper portion 636 of the screw-on lid must be the same as the curl 618 outer diameter or slightly larger than the curl outer diameter. The tamper band 696 has a protrusion 697 that fits into the groove 676 of the container 610. The neck portion 700 of the lid 638 receives and ridge 680 of the container. The container's groove 676 and ridge 680 work in combination with the lid's neck portion 700 and perforations, bridges, or slits between the tamper band 696 and lid 638 to permit detachment of the tamper band 696 from the lid 638. Additionally, the container ridge 680 holds the tamper band 696 onto the container 610 even after the lid 638 has been removed from the container 610.

Note that the tamper band 696 of the present embodiment can be included in any other embodiment herein that includes a screw-on lid. For example, the tamper band 696 can be added to the lid 438 of Figs. 23-27. In some embodiments, the portion of the container 410 proximate the neck 442 may need to include a groove and ridge similar to the groove 676 and ridge 680 of the container 610 of Figs. 33-39 to accommodate and work with the tamper band 696. Further, the tamper band 696 can be added to the lid of Figs. 28-32. In some embodiments, the portion of the container 510 proximate the countersink 558 and countersink inner wall 590 may need to include a groove and ridge similar to the groove 676 and ridge 680 of the container 610 of Figs. 33-39 to accommodate and work with the tamper band 696.

While various embodiments of the present invention have been described in detail, it is apparent that modifications and alterations of those embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and alterations are within the scope and spirit of the present invention, as set forth in the following claims. Further, the invention(s) described herein is capable of other embodiments and of being practiced or of being carried out in various ways. It is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

CLAIMS

What is claimed is:

1. A metallic food container comprising:
a cylindrical sidewall with an upper end and a lower end;
5 an opening proximate the upper end;
a bottom portion interconnected to the lower end of the cylindrical sidewall, wherein
the bottom portion comprises:
a dome-shaped portion; and
a well extending downward from the dome-shaped portion and extending
10 around a circumference of the container, the well configured to receive a liquid.
2. The metallic food container of claim 1, wherein the well is directly
interconnected to the cylindrical sidewall such that cylindrical sidewall is substantially
vertical and terminates in the well formed by a radius of curvature.
3. The metallic food container of claim 2, wherein the well comprises an inner
15 well wall extending inward toward a center of the container from the well radius of
curvature, wherein the well inner wall interconnects to the dome-shaped portion.
4. The metallic food container of claim 1, wherein the metallic food container
is a thin-walled metallic food container and the cylindrical sidewall has a thickness between
about 0.003 inches and about 0.005 inches.
- 20 5. The metallic food container of claim 1, further comprising:
a peripheral curl interconnected to the upper end of the sidewall; and
a tear away lid secured to a crown of the peripheral curl.
6. The metallic food container of claim 1, further comprising:
a neck extending from the upper end of the cylindrical sidewall and extending
25 inwardly from the cylindrical sidewall;
a peripheral curl interconnected to the neck; and
a tear away lid secured to a crown of the peripheral curl.
7. The metallic food container of claim 1, further comprising:
a threaded portion positioned above the upper end of the sidewall, the threaded
30 portion comprising a plurality of threads on an exterior surface of the threaded portion,
wherein the threads are adapted to receive a threaded lid that is selectively removable; and
a peripheral curl interconnected to an upper end of the threaded portion.

8. The metallic food container of claim 1, further comprising:

a neck extending from the upper end of the cylindrical sidewall and extending inwardly from the cylindrical sidewall; and

5 an end closure double-seamed to the neck of the container, the end closure having a pull tab for selectively removing at least a portion of the end closure.

9. The metallic food container of claim 1, further comprising:

a neck extending from the upper end of the cylindrical sidewall and extending outwardly from the cylindrical sidewall;

a first peripheral curl interconnected to the neck; and

10 an upper portion comprising:

a second peripheral curl on an upper end;

a threaded portion positioned below the second peripheral curl, the threaded portion comprising a plurality of threads on an exterior surface of the threaded portion, wherein the threads are adapted to receive a threaded lid that is selectively removable;

15 a countersink interconnected to a bottom end of the threaded portion; and

a third peripheral curl interconnected to an upper outer end of the countersink;

wherein the third peripheral curl of the upper portion is double seamed to the first peripheral curl.

20 10. The metallic food container of claim 1, wherein the bottom portion is integrally interconnected to the lower end of the cylindrical sidewall such that the bottom portion is one piece with the cylindrical sidewall.

11. The metallic food container of claim 1, wherein the dome-shaped portion has a hyperbolic paraboloid shape having a first curve with a first radius of curvature and a
25 second curve with a second radius of curvature positioned substantially perpendicular to the first curve.

12. A pressurized metallic food container comprising:
a cylindrical, substantially vertical sidewall with an upper end and a lower end;
a neck interconnected to the upper end of the sidewall and extending upwardly from
the sidewall;

5 an opening proximate the neck; and

a bottom portion integrally interconnected to the lower end of the cylindrical
sidewall, wherein the bottom portion comprises:

a substantially linear outer panel wall extending downwardly from the
sidewall;

10 a U-shaped curved wall having a first radius of curvature and interconnected
to a bottom portion of the outer panel wall;

an inner panel wall extending upwardly from an interior portion of the U-
shaped curved wall; and

a dome-shaped portion with a first curve having a second radius of curvature,
15 the domed portion interconnected to an uppermost portion of the inner panel wall at a third
radius of curvature,

wherein the outer panel wall, U-shaped curved wall, and inner panel wall
form a well positioned around and concentric with the dome-shaped portion, and

20 wherein the well is configured to receive a predetermined amount of liquid
nitrogen.

13. The metallic food container of claim 12, wherein the inner panel wall is
substantially linear, and wherein the well has a constant height and a constant width around
a circumference of the container.

25 14. The metallic food container of claim 12, wherein the first radius of curvature
is smaller than the second radius of curvature.

15. The metallic food container of claim 12, wherein the domed portion has a
hyperbolic paraboloid shape having a second curve with a fourth radius of curvature
positioned substantially perpendicular to the first curve of the domed portion.

30 16. The metallic food container of claim 12, wherein the metallic food container
is a thin-walled metallic food container and the cylindrical, substantially vertical sidewall
has a thickness between about 0.003 inches and about 0.005 inches.

17. A method of manufacturing a metallic food container comprising:
providing a metallic blank in a shape of a circular disc;
punching the metallic blank to form a continuous sidewall with an upper end and a
lower end and an opening proximate the upper end; and

5 shaping a bottom portion interconnected to the lower end of the sidewall, wherein
the bottom portion comprises a dome-shaped portion and a well positioned proximate to a
lower portion of the dome-shaped portion to receive a liquid, and wherein the domed-shaped
portion has a specific profile to match a profile of a food stuff.

18. The method of claim 17, further comprising applying indicia to an exterior
10 portion of the sidewall, wherein the indicia is provided for proper orientation of the metallic
food container.

19. The method of claim 17, further comprising:
providing a lid; and
securing the lid to the upper end of the continuous sidewall after the container is
15 filled with food stuff to form a two-piece metallic food container.

20. A method of filling a metallic food container to create a pressurized vessel,
the method comprising:

providing the metallic food container comprising:
a cylindrical sidewall with an upper end and a lower end;
20 an opening proximate the upper end;
a bottom portion interconnected to the lower end of the cylindrical sidewall,
wherein the bottom portion comprises:

a dome-shaped portion with a geometric profile designed to nest with
a food stuff; and

25 a well positioned on a lower peripheral portion of the dome-shaped
portion to receive a predetermined amount of liquid nitrogen;

filling the metallic food container with the food stuff;
injecting a predetermined amount of liquid nitrogen into the well of the container;
and

30 sealing the container with an end closure to pressurize the container above
atmospheric pressure, wherein the liquid nitrogen becomes a gas as a result of a decrease in
pressure or an increase in temperature.

21. The method of claim 20, wherein the pressure above atmospheric pressure is about 10 psi.

22. The method of claim 20, wherein the liquid nitrogen is injected down into the well directly using a long needle-shaped tube.

5 23. The method of claim 20, further comprising forming a hyperbolic paraboloid shape in the dome-shaped portion.

24. The method of claim 20, wherein the end closure is a metallic end closure double seamed to the upper end of the cylindrical sidewall, a paper or plastic tear away lid interconnected to the upper end of the cylindrical sidewall, or a screw-on lid interconnected
10 to the upper end of the cylindrical sidewall.

25. The method of claim 20, further comprising sealing the container with the end closure within about 15 seconds after the predetermined amount of liquid nitrogen is injected into the well of the container.

26. A method of filling a thin-walled metallic food container to create a
15 pressurized vessel, the method comprising:

providing the thin-walled metallic food container comprising:

a cylindrical sidewall with an upper end and a lower end, wherein the cylindrical sidewall has a thickness between about 0.003 inches and about 0.005 inches;

an opening proximate the upper end;

20 a bottom portion interconnected to the lower end of the cylindrical sidewall:
filling the metallic food container with a dry food;

injecting a predetermined amount of liquid nitrogen through the opening and into the bottom portion of the container; and

25 sealing the container with an end closure to pressurize the container above atmospheric pressure, wherein the liquid nitrogen becomes a gas as a result of a decrease in pressure and/or an increase in temperature, and wherein the container has an internal pressure that is at least about 10 psi above an ambient pressure.

27. The method of claim 26, further comprising forming a dome-shaped portion with a geometric profile designed to nest with the dry food in the bottom portion of the thin-
30 walled metallic food container.

28. The method of claim 26, further comprising forming a well positioned on a lower peripheral portion of the dome-shaped portion, the well configured to receive the predetermined amount of liquid nitrogen.

29. The method of claim 26, wherein the thin-walled metallic food container
5 further comprises a well positioned on a peripheral portion of the bottom portion, the well configured to receive the predetermined amount of liquid nitrogen.

30. The method of claim 26, wherein the end closure is a tear away lid secured to a top portion of the thin-walled metallic food container.

31. The method of claim 26, further comprising providing the thin-walled
10 metallic food container comprising a threaded portion proximate the upper end of the cylindrical side wall, wherein the end closure is a screw-on lid that is screwed onto the threaded portion of the thin-walled metallic food container.

32. The method of claim 26, further comprising:
providing a separate upper portion comprising threads and a peripheral curl;
15 interconnecting the peripheral curl of the upper portion to the upper end of the cylindrical sidewall; and
wherein the end closure is a screw-on lid that is screwed onto the threads of the upper portion.

33. The method of claim 26, wherein the predetermined amount of liquid
20 nitrogen is determined based on an amount of time between injecting the liquid nitrogen and sealing the container, a size of the thin-walled metallic food container, and a desired final internal pressure.



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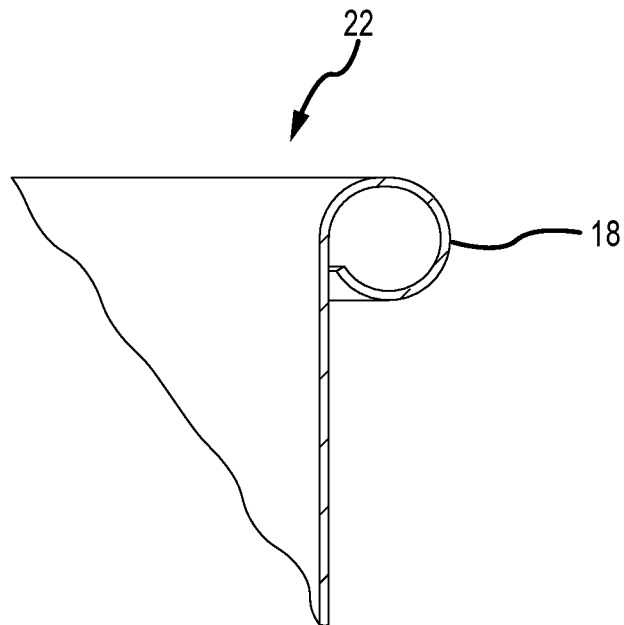


FIG. 4

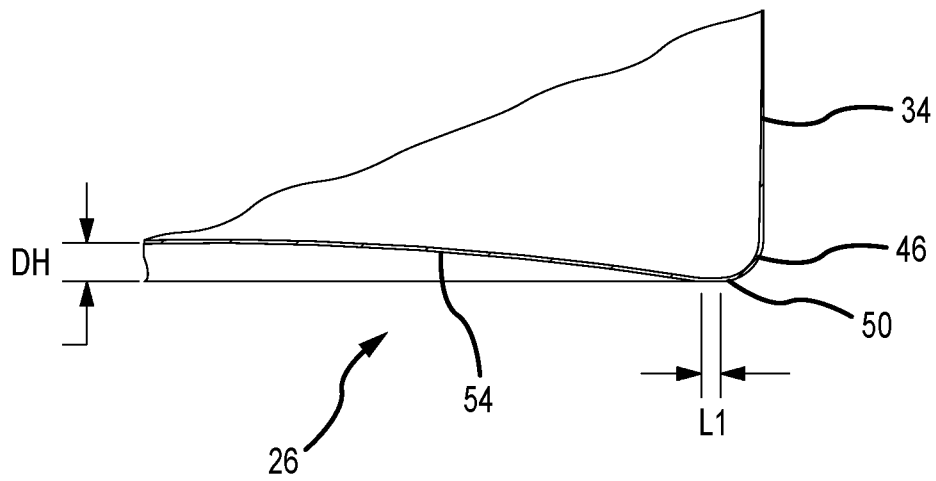


FIG. 5

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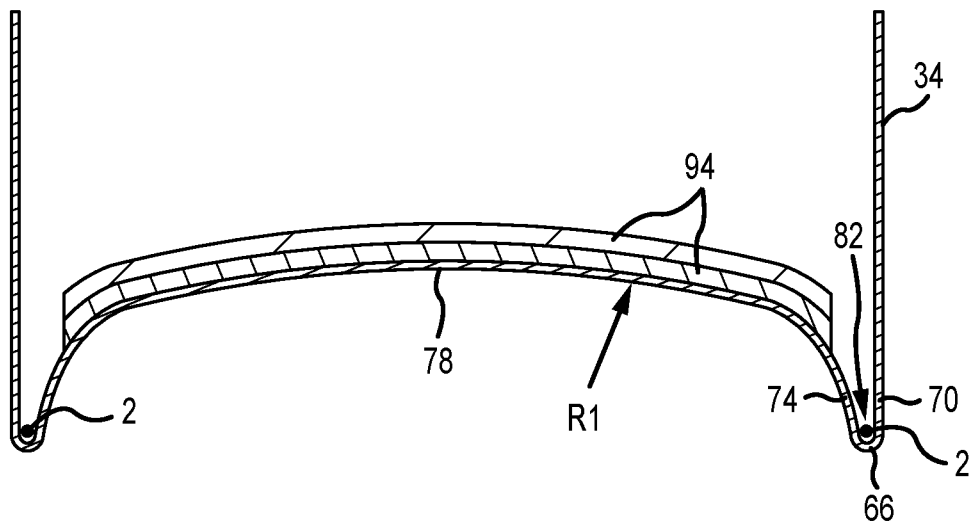


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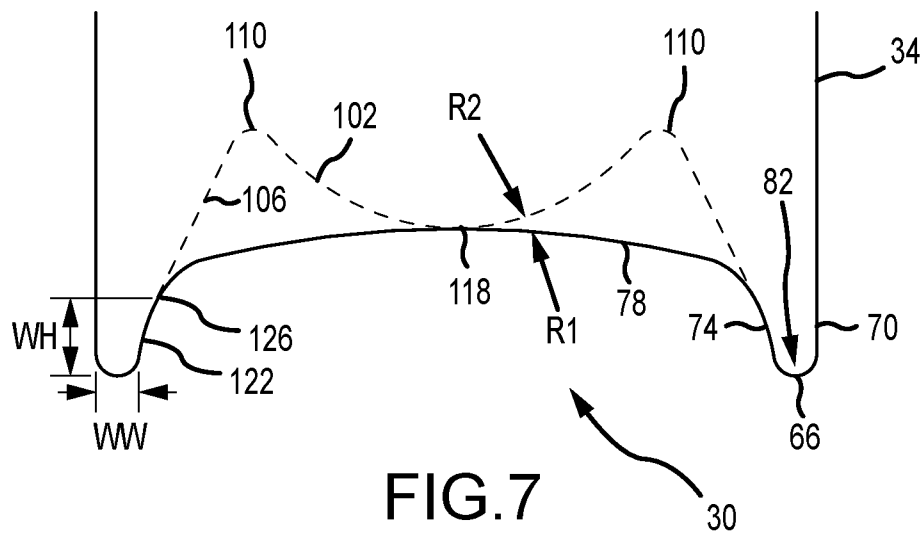


FIG. 7

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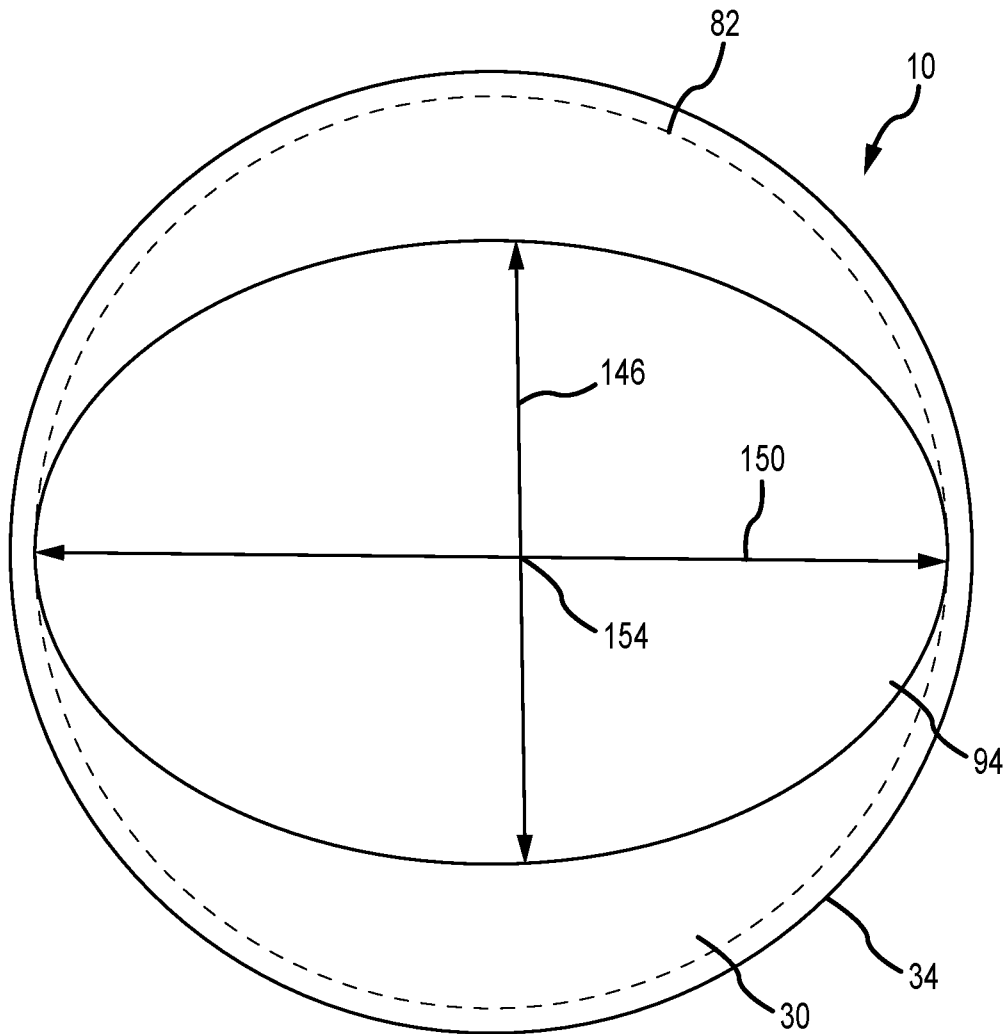


FIG. 8

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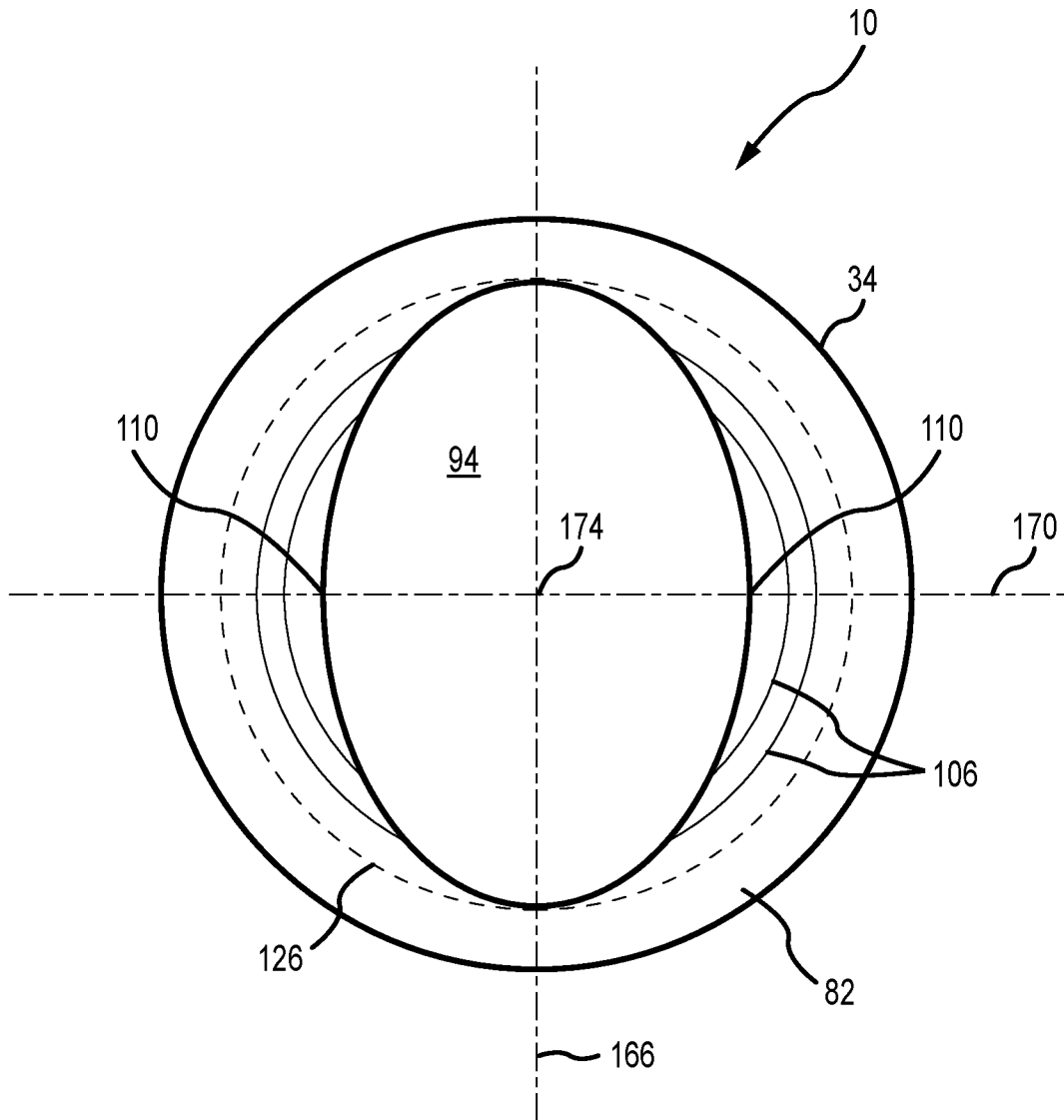
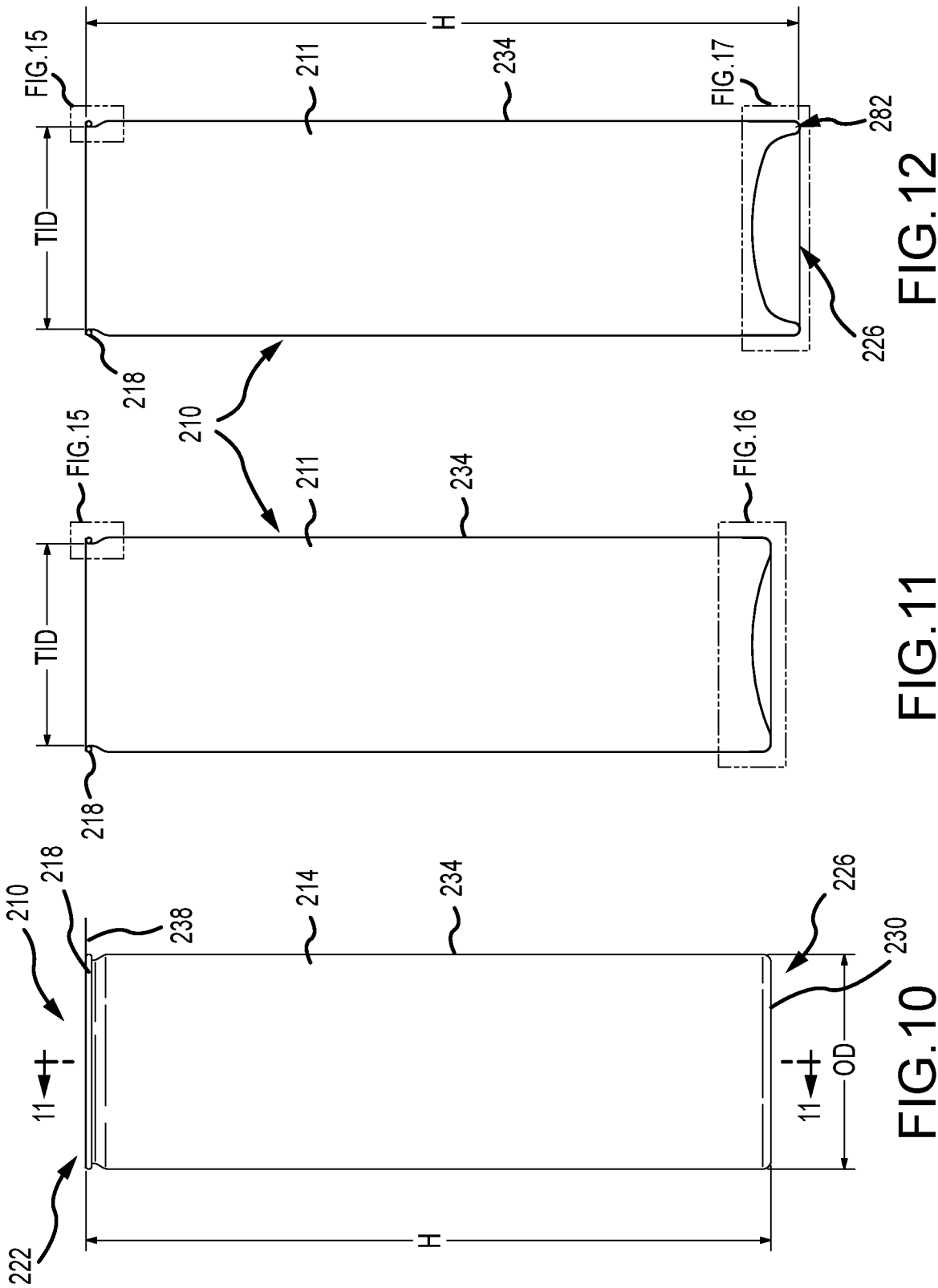
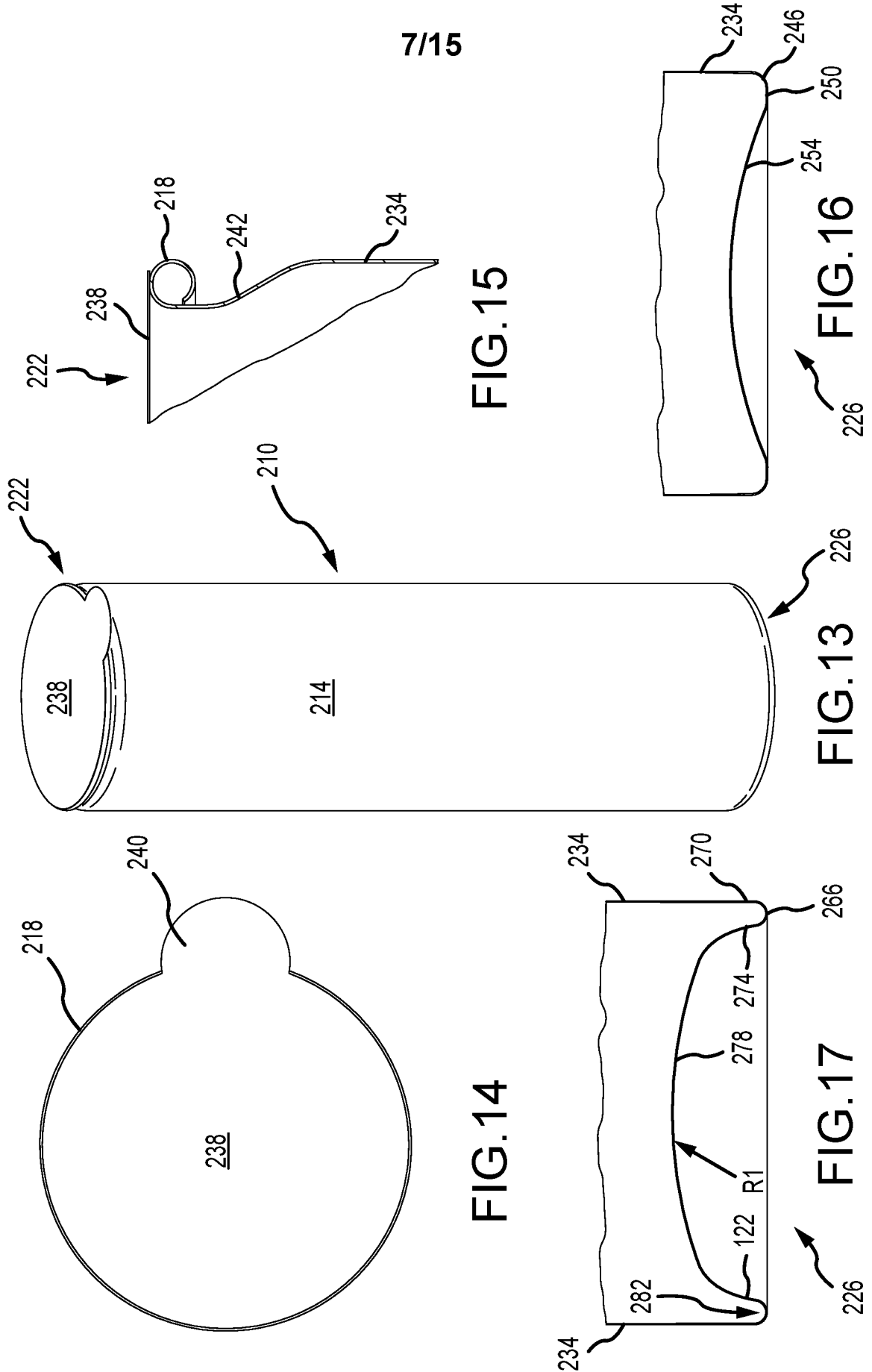
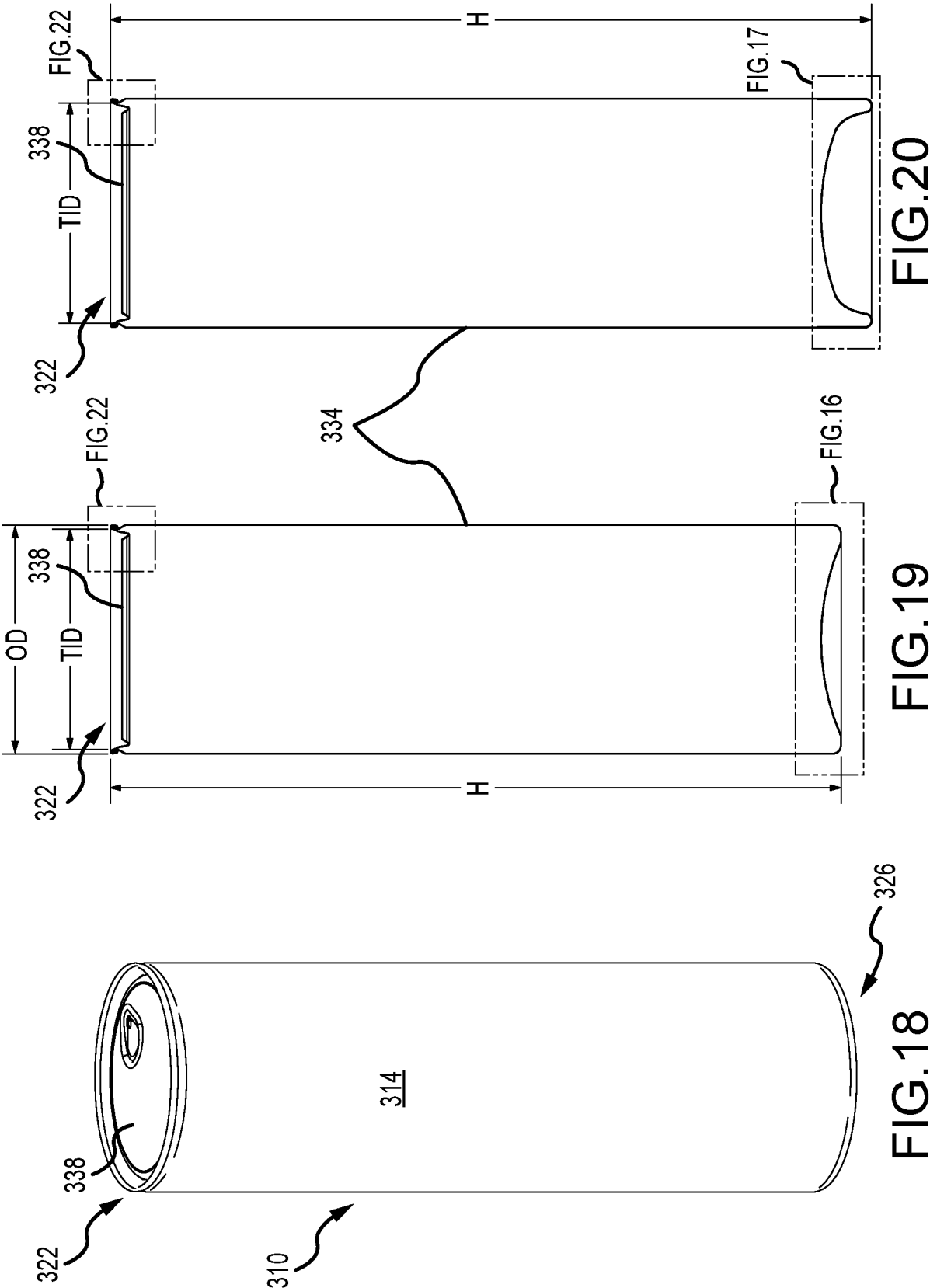


FIG. 9







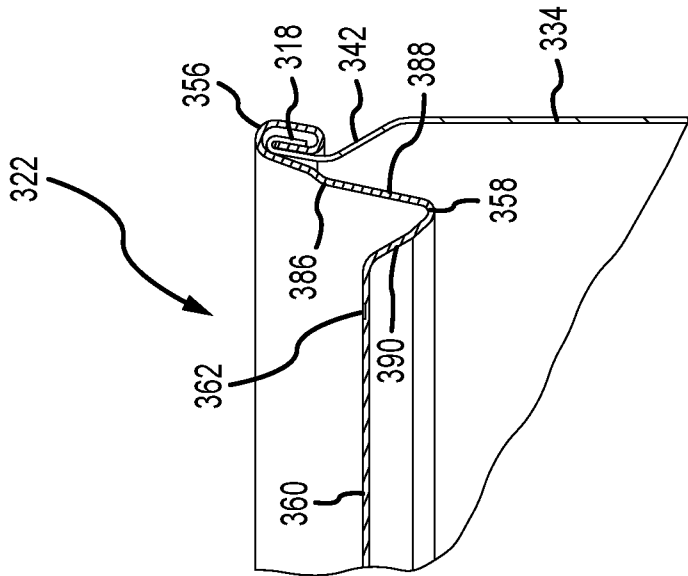


FIG. 22

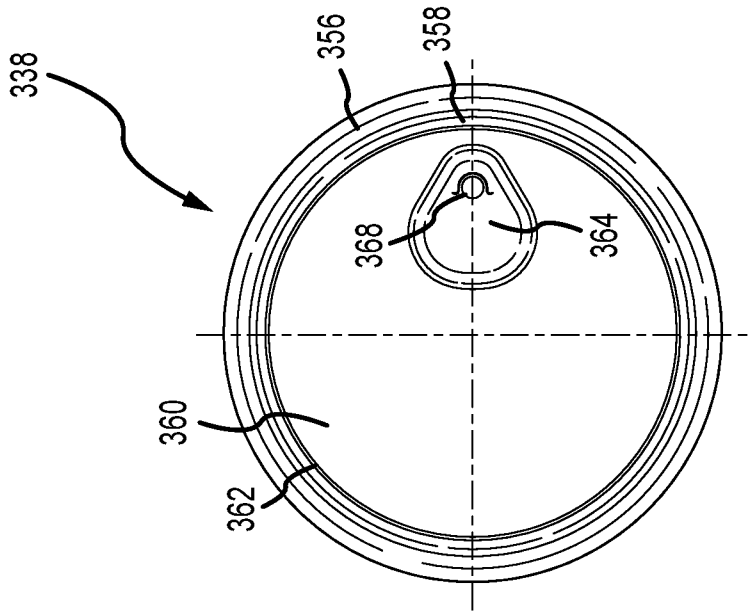
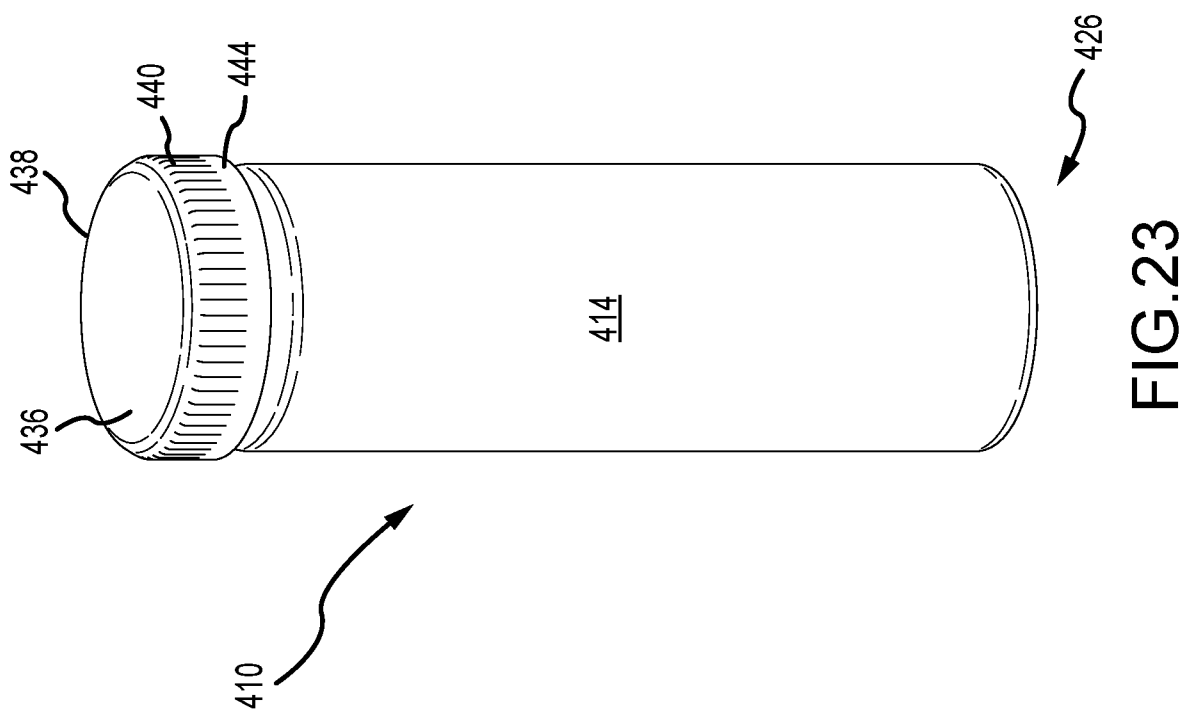
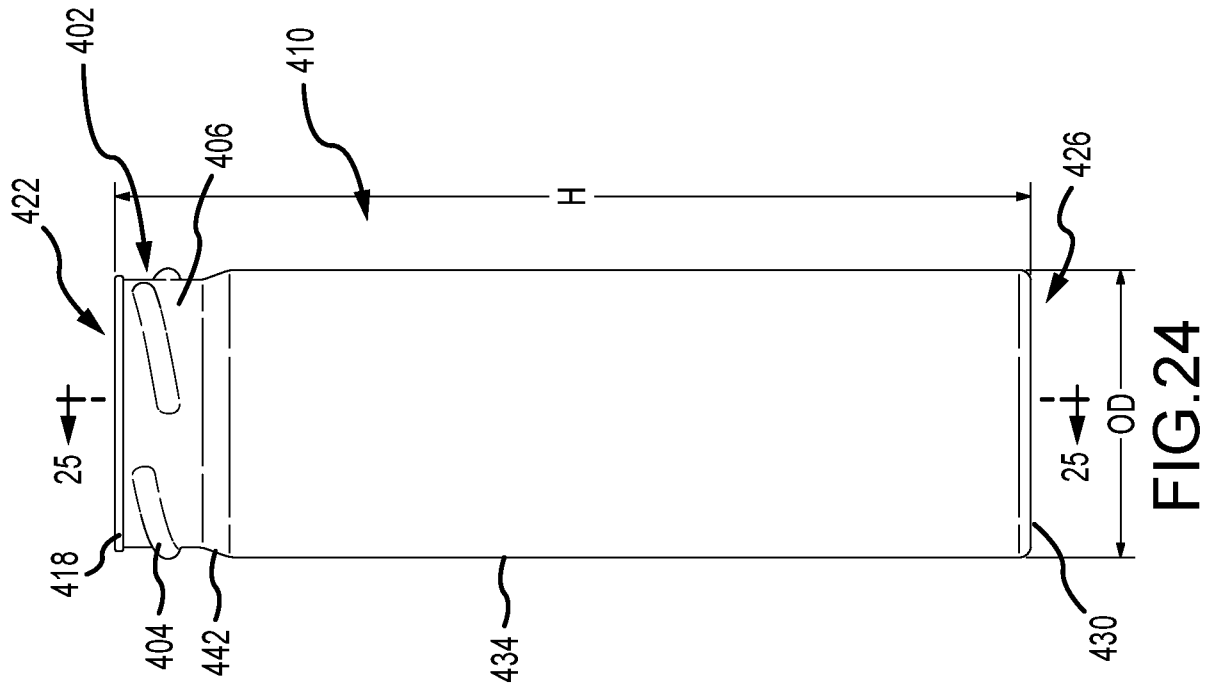


FIG. 21

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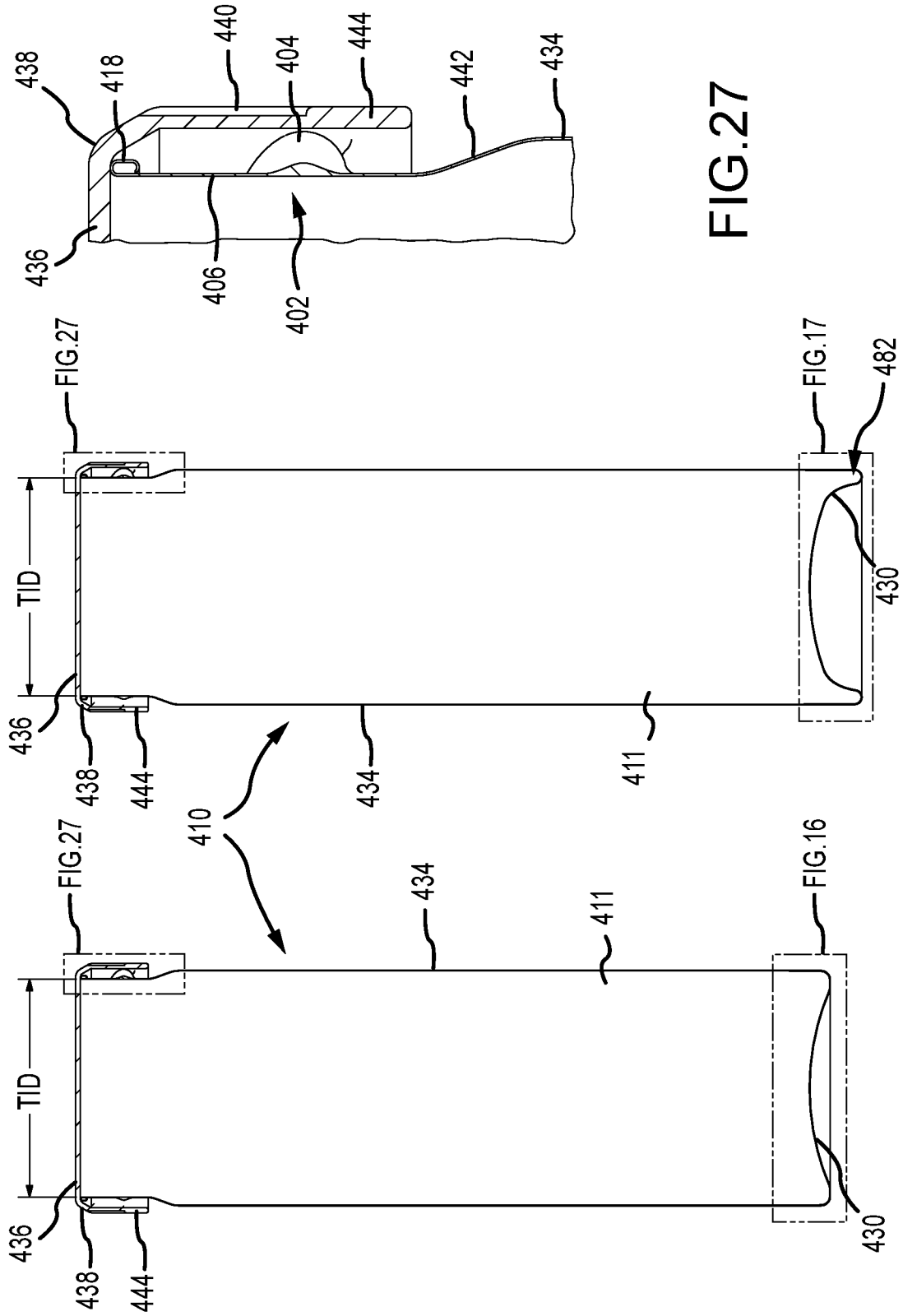
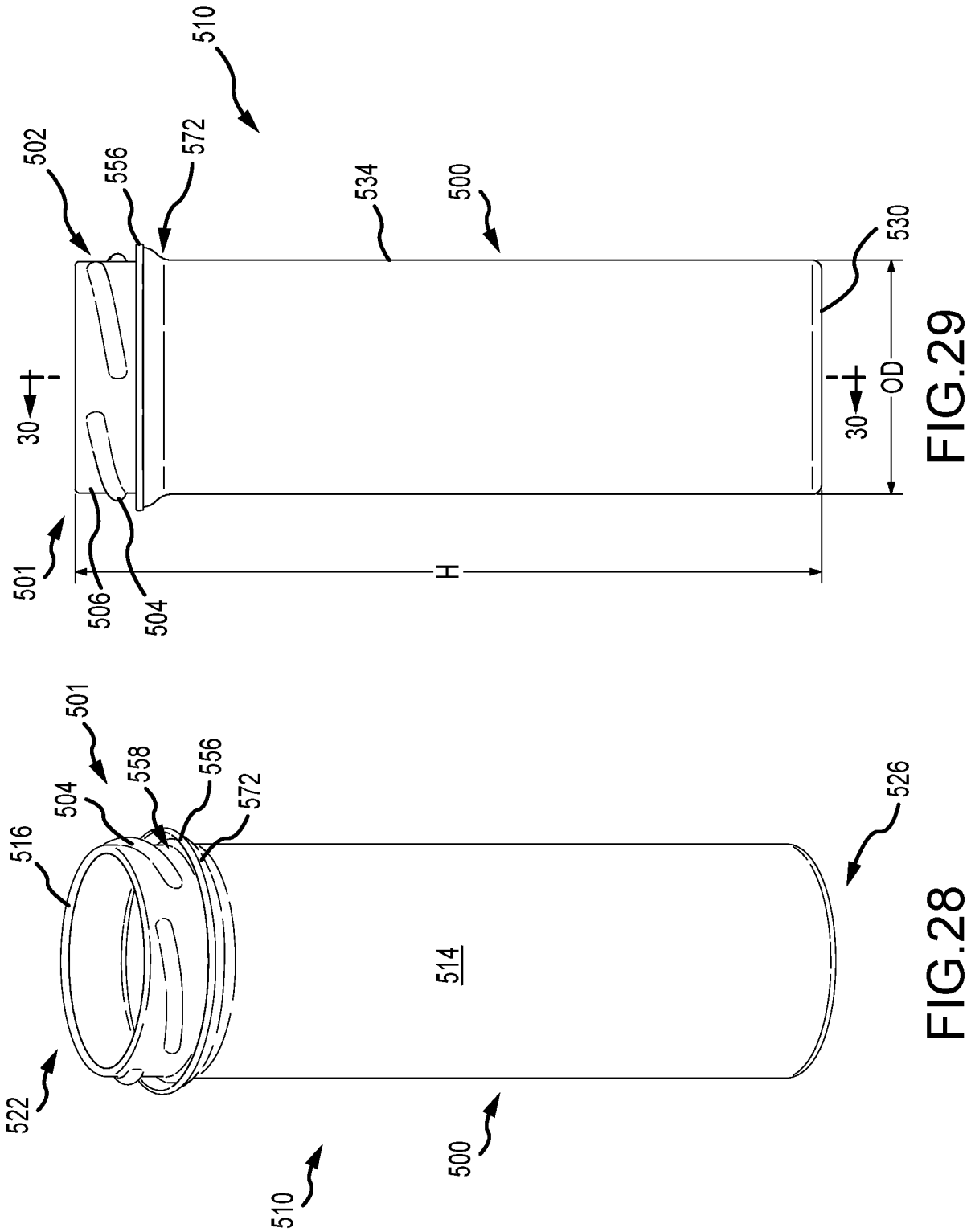


FIG.27

FIG.26

FIG.25



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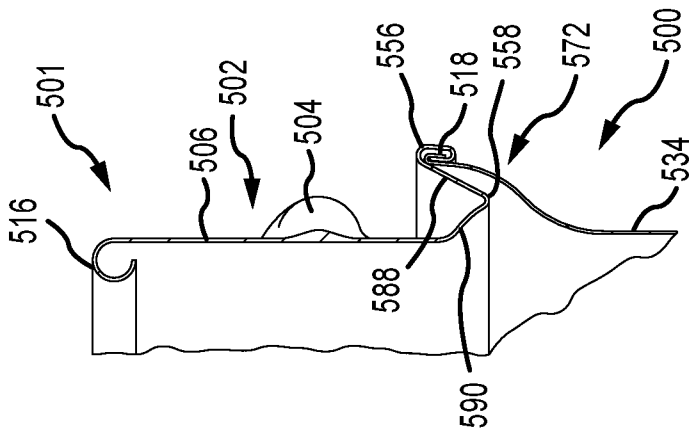
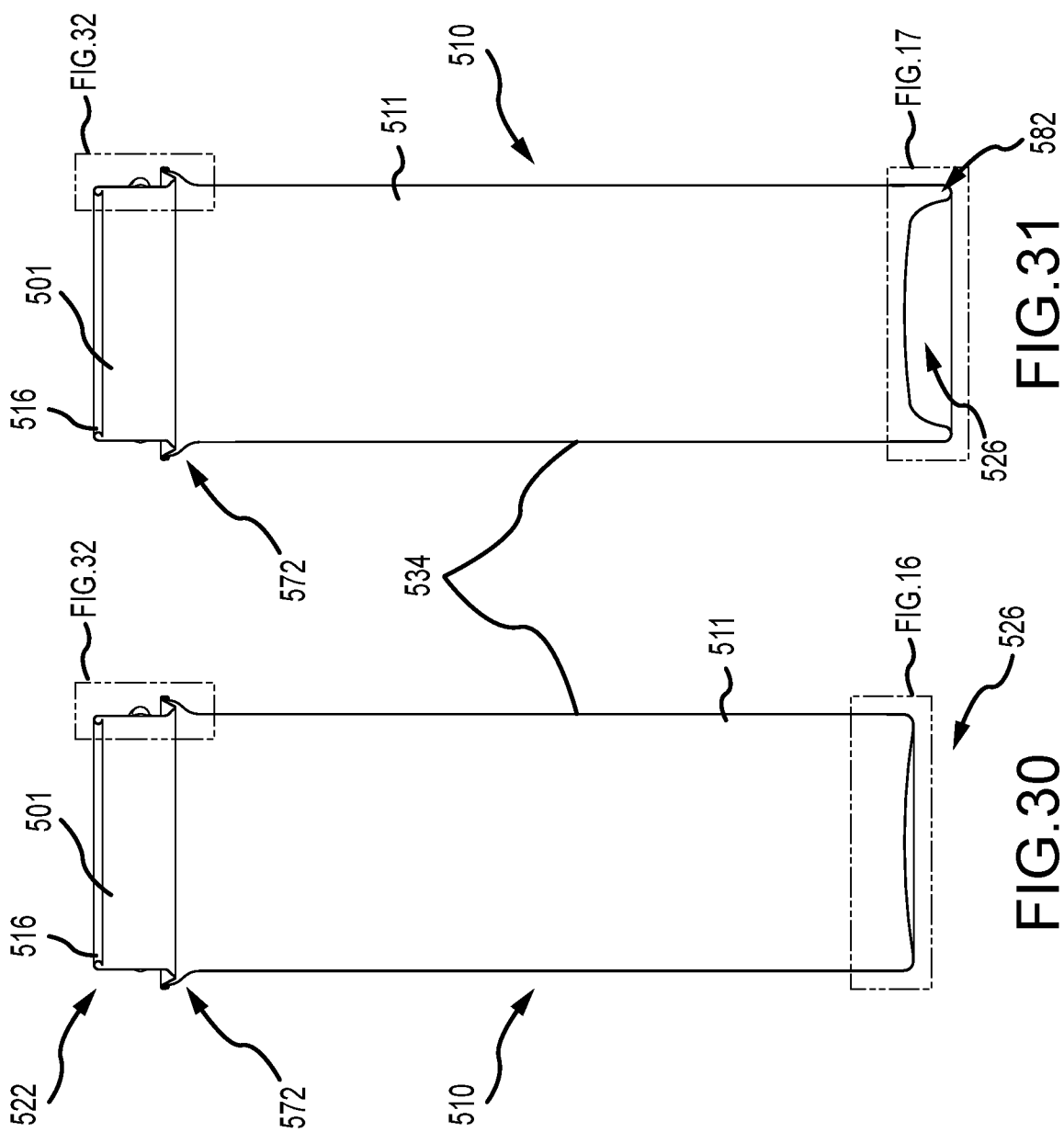
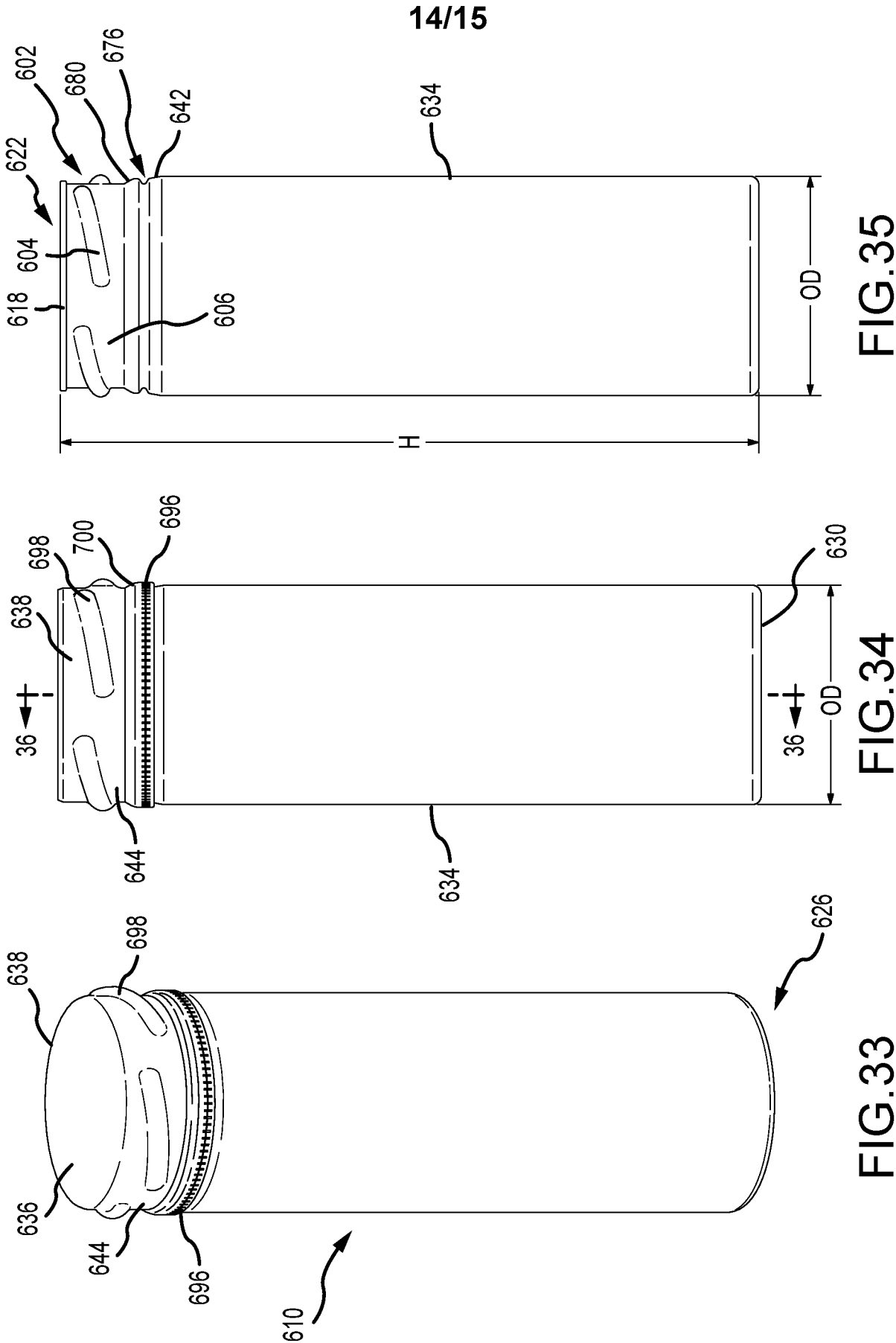


FIG.32



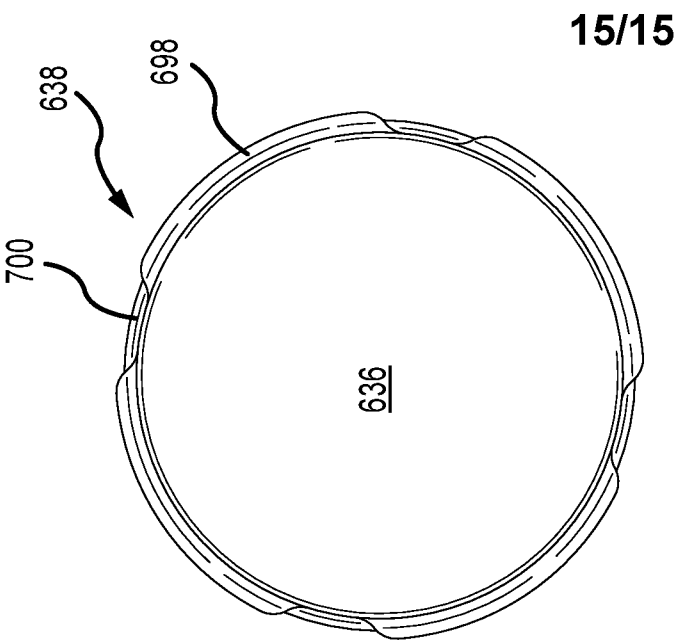


FIG. 38

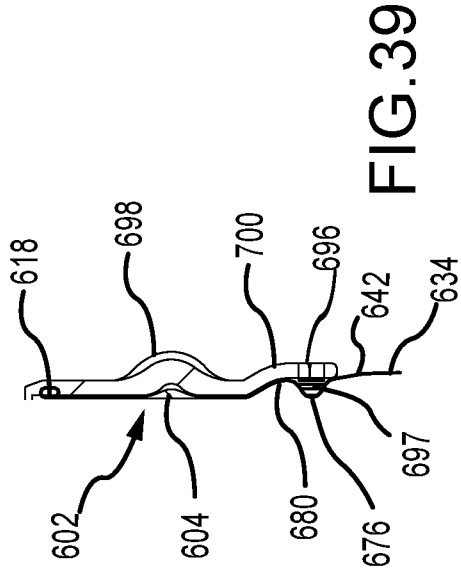


FIG. 39

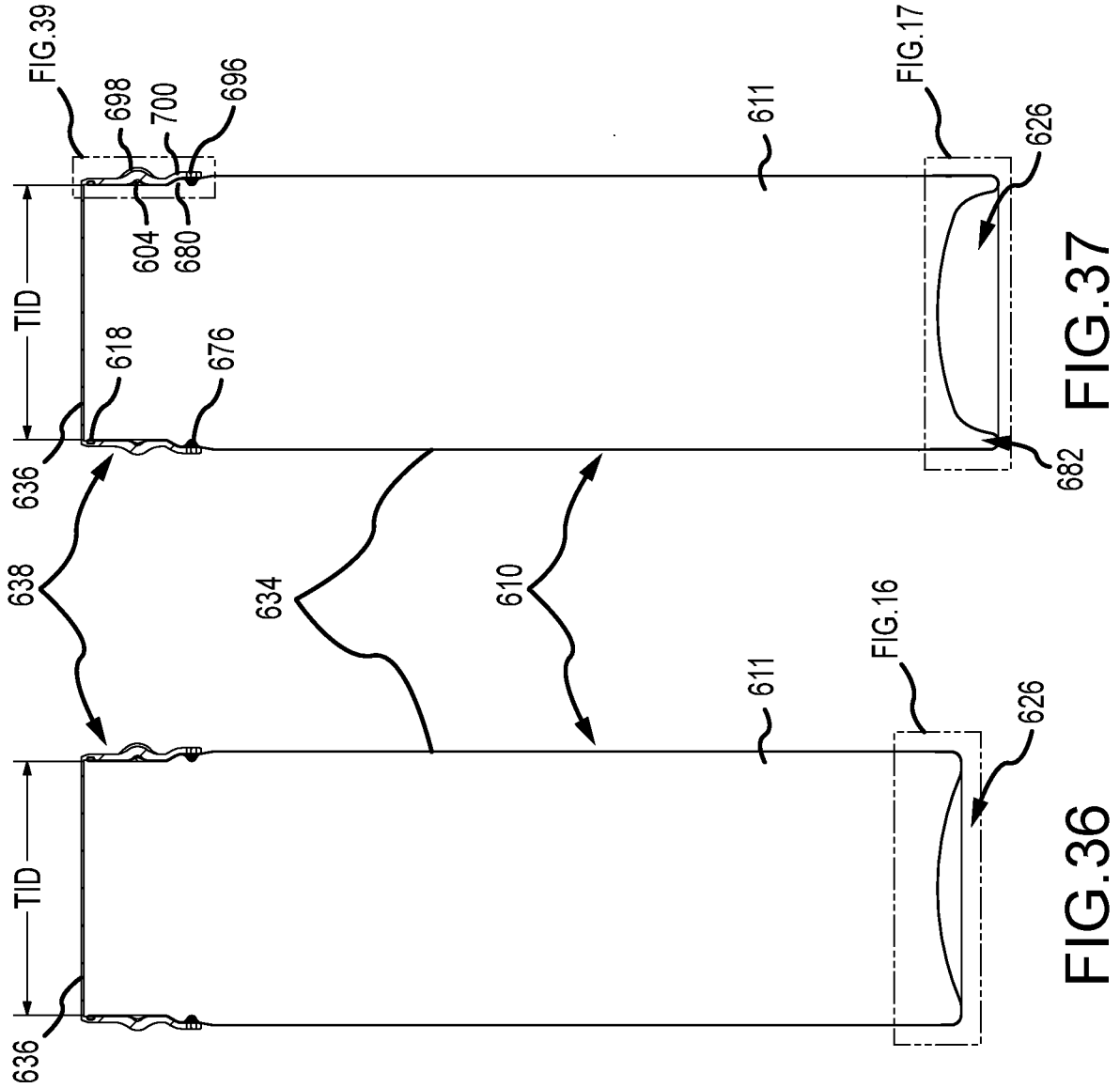


FIG. 36

FIG. 37

FIG. 16

FIG. 17

FIG. 39

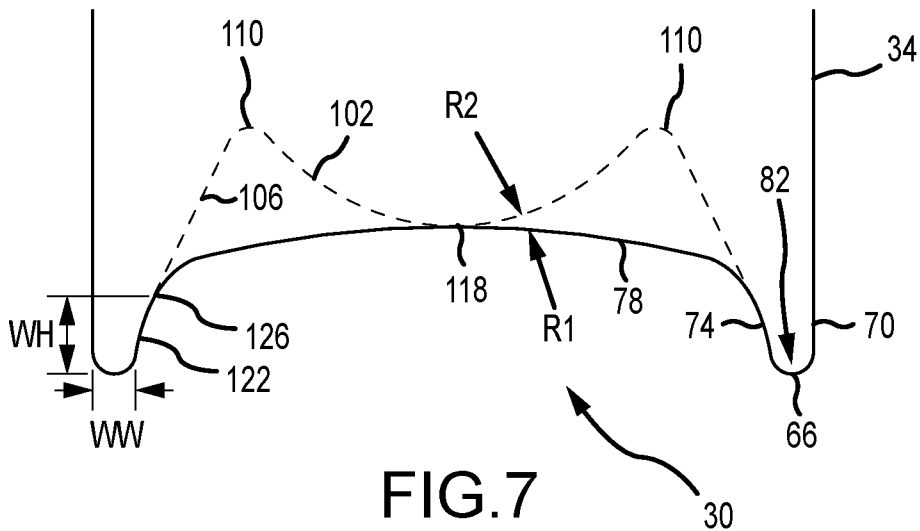


FIG.7