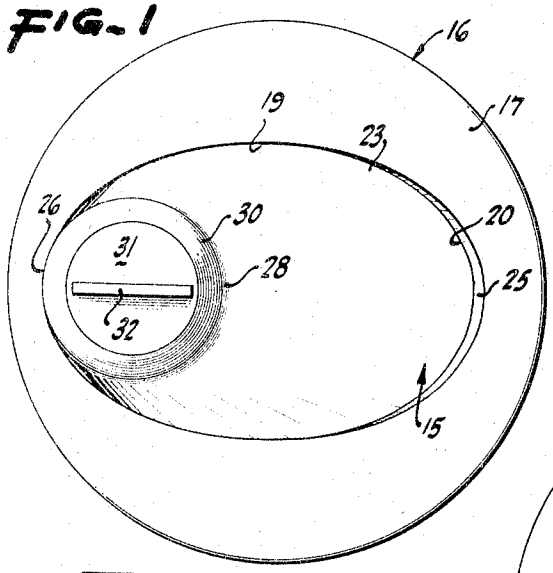
June 6, 1967 P. P. STEVENS, JR 3,323,694

INVERTIBLE CLOSURE FOR A CONTAINER

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FIG. 1



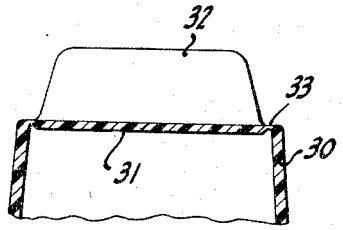


FIG. 6

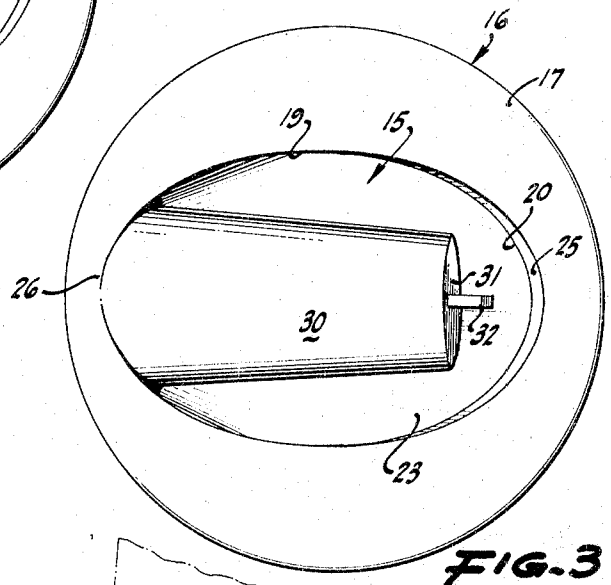


FIG. 3

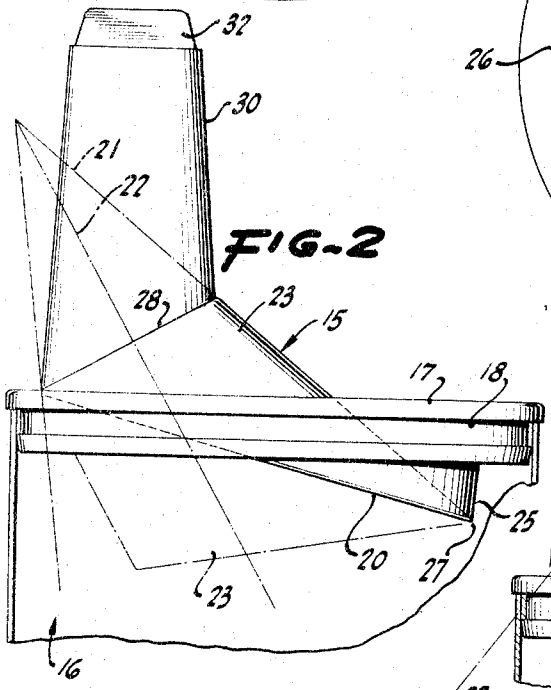


FIG. 2

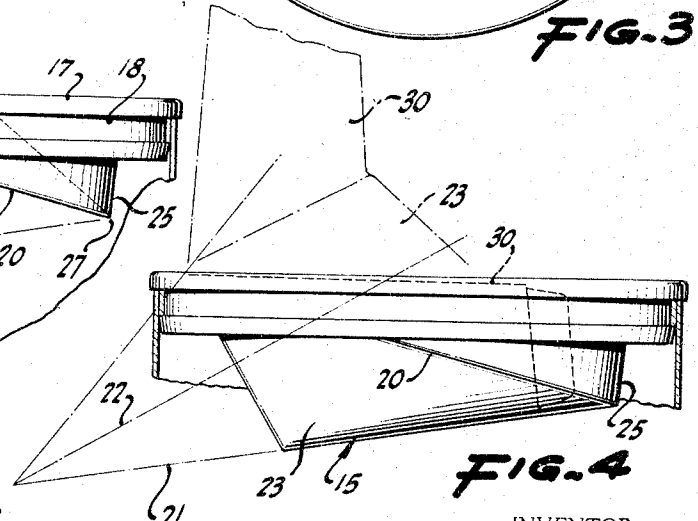


FIG. 4

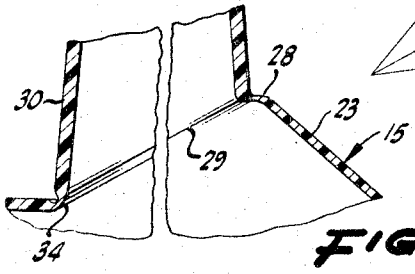


FIG. 5

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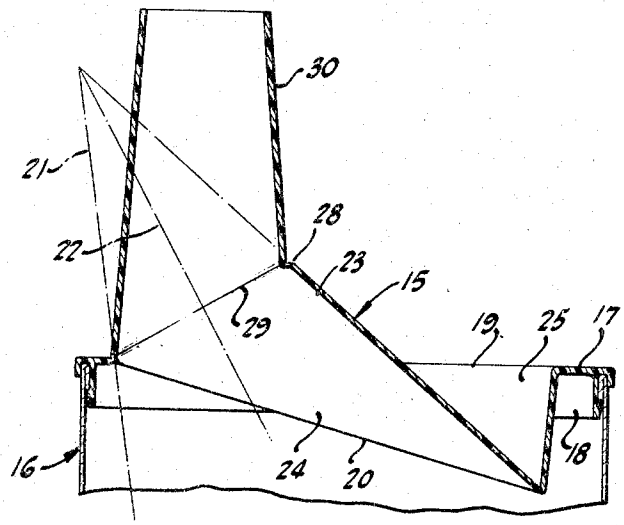


FIG. 7

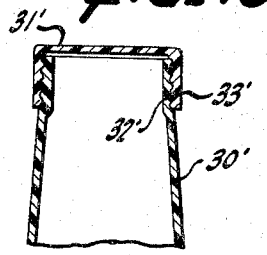


FIG. 10

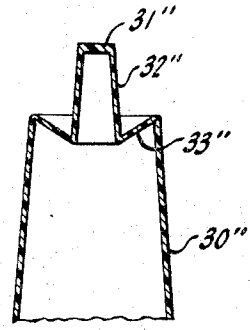


FIG. 11

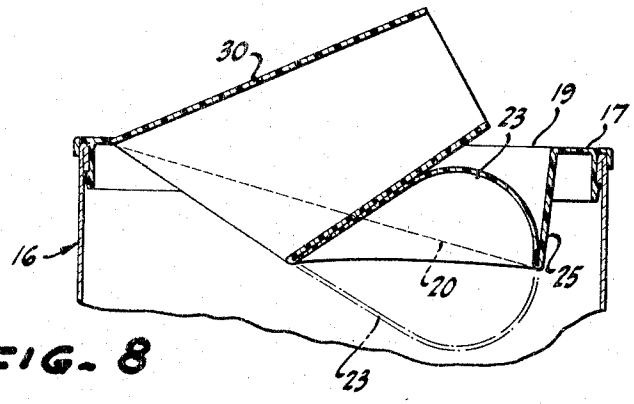


FIG. 8

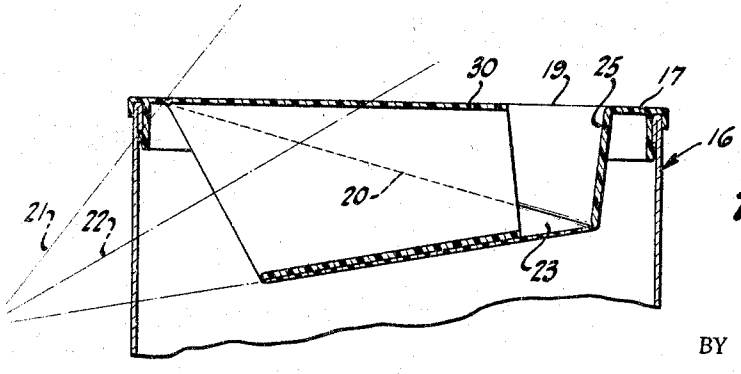


FIG. 9

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United States Patent Office 3,323,694 Patented June 6, 1967

3,323,694

INVERTIBLE CLOSURE FOR A CONTAINER

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Filed Feb. 18, 1966, Ser. No. 528,578
12 Claims. (Cl. 222—498)

This invention relates to a container closure and, more particularly, to a container closure structure selectively invertible between open and closed positions and through which the contents of the container can be dispensed. An exemplary instance of a container with which the dispensing closure structure is useful is one intended for a liquid product such as lubricating oil for automobile engines and the like.

It is usual to store and transport containers in relatively large cases or cartons each of which receives therein a plurality of individual containers stacked one upon another and arranged in side-by-side rows. In order to maximize use of the space available within such shipping cartons, it is advantageous to have the container walls free from outwardly extending protuberances. It is also advantageous in many instances to equip containers with dispensing closures through which the container contents can be discharged provided that any such dispensing closure does not materially increase the size of the storage and shipping space required for the containers.

The present invention is concerned with a dispensing closure structure for containers, which closure structure is selectively movable between an open position in which it projects outwardly from the container to facilitate the discharge of material therethrough and a closed position in which substantially no portion of the closure structure projects outwardly beyond the dimensional limits of the container to interfere with the usual handling and packaging thereof. Dispensing closure structures of this general type (i.e. relatively movable between open and closed positions) are not broadly new. Accordingly, an object, among others, of the present invention is to provide an improved dispensing closure structure which is quickly and easily moved between its open and closed positions, such positions defining a type of reverse symmetry and being essentially mirror images of each other as respects at least certain components of the structure, by inversion thereof through a geometric center plane, and which positively maintains itself in each such position.

Embodiments of the invention are illustrated in the accompanying drawings, in which:

FIGURE 1 is a top plan view of a container equipped with a dispensing closure structure made in accordance with the present invention, and in which such closure structure is shown in the open position thereof;

FIGURE 2 is a broken side view, essentially in elevation but with certain components being illustrated in section, of the dispensing closure structure shown in FIGURE 1;

FIGURE 3 is a top plan view of the container shown in FIGURE 1, but with the dispensing closure structure illustrated in the closed position thereof;

FIGURE 4 is a broken side view, essentially in elevation but with certain components being illustrated in section, of the container shown in FIGURE 3 with the dispensing closure structure in its closed position;

FIGURE 5 is an enlarged, broken vertical sectional view illustrating one of the hinge elements of the dispensing closure structure;

FIGURE 6 is an enlarged, broken vertical sectional view showing a frangible seal or cap for the dispensing closure structure to confine the contents of the container therewithin;

FIGURES 7, 8 and 9 are broken vertical sectional views respectively illustrating the dispensing closure structure in its open position, in an intermediate position, and in its closed position;

FIGURE 10 is a broken vertical sectional view similar to that of FIGURE 6 but showing a modified cap for the dispensing closure structure in place of the frangible cap illustrated in FIGURE 6; and

FIGURE 11 is a broken vertical sectional view of a further modified cap.

The dispensing closure structure is generally designated in the drawings with the numeral **15** and is shown in functional association with a container **16** which, by way of example, may be a cylindrical metal can adapted to receive therein a variety of products—dry or liquid—such as, in the case of a liquid, lubricating oil for automobile engines. The container may be formed of metal or any other material suitable for the product intended to be received therewithin.

The container **16** is provided with a top wall, lid or cover **17** which may or may not be formed of the same material as the rest of the container, and it can be secured to the side walls thereof by any conventional means. In the particular structure illustrated, the cover **17** is fabricated from a synthetic resin plastic material, and it is provided with a depending fastener wall **18** adapted to telescope into and sealingly engage the upper end portion of the container side wall. Such fastener side wall **18** forms no part of the present invention, and, with respect thereto, any suitable arrangement may be employed to secure the cover **17** to the side walls of the container, such as the container closure arrangement disclosed in copending application Ser. No. 415,648 filed Dec. 3, 1964 and now U.S. Patent No. 3,297,193.

As is most evident in FIGURES 1 and 3, the top wall **17** of the container is for the most part substantially planar, and is provided with an enlarged opening **19** therein of ovate configuration. That is to say, the opening **19** has the shape defined by the intersection of a plane cutting a right cone at an acute angle to the vertical axis thereof. More particularly, and referring to FIGURES 2, 4 and 7, the opening **19** is seen to be substantially a projection of the plane defined by the lower edge **20** of the closure structure **15**, which edge is essentially a closed curve defining a plane cutting through a projected cone **21** at a non-normal angle to the vertical axis **22** thereof.

The cone **21** conforms to and is determined by (or determines) a diaphragm **23** which is flexible and forms a part of the dispensing closure structure **15**. The diaphragm **23** terminates in and defines the edge **20** which, as indicated hereinbefore, is a closed curve establishing the perimetric boundary of an opening **24** through which the diaphragm **23** can be inverted between the open position thereof shown in FIGURE 2 and its closed position illustrated in FIGURE 4—which open and closed positions of the diaphragm are essentially mirror images of each other.

The diaphragm **23** is hingedly connected along the edge **20** thereof to the cover **17** of the container **16** through an intervening wall structure **25** which, as is evident in the drawings, has a varying height. More particularly, the plane defined by the edge **20** is angularly disposed with respect to the plane of the cover **17** so that the wall structure **25** interconnecting these planes must vary in height from an exceedingly small dimension at the intersection of the plane defined by the edge **20** with the top wall **17** (which intersection is indicated generally with the numeral **26** in FIGURES 1 and 3) to a relatively large dimension at the location of the intersection of the plane defined by the edge **20** with the

base of the cone **21** (which intersection is denoted in FIGURES 2 and 7 with the numeral **27**).

The diaphragm **23** has an edge **28** forming a closed curve that defines a plane substantially normal to the vertical axis **22** of the cone. The edge **28** establishes the perimetric boundary of a dispensing orifice **29** (FIGURES 5 and 7) through which the contents of the container **16** can be discharged when the closure structure **15**, and diaphragm **23** thereof, is in the open position illustrated in FIGURES 1, 2 and 7. In the particular embodiment of the invention being considered, a funnel or spout **30** is hingedly connected with the diaphragm **23** along the edge **28** thereof, and such spout is useful in confining and directing the contents of the container **16** to a particular location as such contents are discharge therefrom. For example, the spout **30** may be inserted into the rigid filler tube or conduit forming the lubricant-supply entrance iuto the crankcase of an automobile engine.

The spout **30** as shown is provided at the outer discharge end thereof with a tear-out closure cap **31** equipped centrally with a pull tab **32** and connected with the spout through a thin frangible membrane **33**. In the form shown, the cap **31** is integral with the spout **30**, and can be separated therefrom by application of a force to the pull tab **32** sufficient to fracture the thin frangible membrane **33**. When once the cap **31** is removed from the spout **30** such removal is permanent; and, therefore, the container is not designed for reuse although reuse thereof is certainly possible.

A removable cap is shown in FIGURE 10 and is denoted in its entirety with the numeral **31'**. The modified spout with which the removable cap **31'** is used is denoted **30'**, and at its upper end the spout is provided with external threads **32'**. The cap **31'** has a depending wall equipped with internal threads **33'** adapted to matingly engage the threaded upper end of the spout **30'**. Thus, the cap **31'** is selectively removable from and replaceable onto the spout **30'**, and any container with which this closure structure is employed is especially suited for repeated usage.

A further modified closure cap of the tear-out type is illustrated in FIGURE 11. This modified cap is denoted in its entirety with the numeral **31''**, and the spout on which it is used is denoted in its entirety with the numeral **30''**. The closure cap **31''** is elongated, as shown at **32''**, and is connected with the spout **30''** through a thin frangible membrane **33''**. In removing the closure cap **31''** from the spout **30''**, the elongated intermediate portion **32''** may be grasped and pinched inwardly and sufficient force then applied to the cap to rupture the membrane **33''** along the juncture thereof with the spout **30''**.

In the structure illustrated, the diaphragm **23**, spout **30** and wall structure **25** are integrally formed, and may be fabricated from any suitable material which has the properties of flexibility and shape-maintaining rigidity, and, as stated, plastic materials are advantageously employed such as, for example, polyethylene and polypropylene. With materials of this type, the fabrication technique may be an injection molding operation in which event the diaphragm **23**, wall structure **25** and spout **30** are molded in the open position of the assemblage shown in FIGURES 1, 2 and 7. Further, the cover **17** of the container (and the cap **31**) may be formed integrally with the wall structure **25**, diaphragm **23** and spout **30**; and in the embodiment of the invention illustrated, this entire structural assemblage is so formed integrally in a single injection molding operation. In view of the unitary character of such assemblage, the container **16** after first being filled with its contents may then be provided with a closure-equipped cover **17**, although in some cases the container may be first provided with a cover **17**, filled through the bottom, and then equipped with a bottom closure.

The spout **30**, wall structure **25** and cover **17** are sufficiently thick to be relatively rigid or stiff, and, for example, may have a thickness of about 0.030 to 0.40 of

an inch. The diaphragm **23** is made sufficiently thin to be flexible in order that it can be inverted through the opening **24** between its open and closed positions respectively shown in FIGURES 2 and 4. A wall thickness providing such flexibility may be, for example, in the range of 0.020 to 0.030 of an inch. The mergence of the diaphragm **23** with the spout **30** along the edge **28** defines a hinge area, as does the mergence of the diaphragm **23** with the wall structure **25** along the edge **20**. A suitable hinge is provided by reducing the thickness of the material along such lines of mergence, and a typical wall thickness thereat may be about 0.005 to 0.015 of an inch. This relationship is shown most clearly in FIGURE 5 wherein an enlargement of the mergence of the diaphragm **23** with the spout **30** is shown. For purposes of identification, the hinge defined by such reduced wall thickness is denoted with the numeral **34**.

The filled container **16** will be received for use with the closure structure **15** in the closed position thereof illustrated in FIGURES 3 and 4; and when it is desired to dispense all or a portion of the contents of the container the spout **30** is pulled upwardly whereupon the diaphragm **23** is inverted through the opening **24** in being moved from the closed position shown in FIGURE 4 into the open position illustrated in FIGURE 2. The requisite lifting force may be imparted to the spout **30** directly or through the tab **32** of the cap **31**. In any event, after the spout **30** is in its elevated position the cap **31** is torn free of the spout by fracturing the thin membrane **33**. As indicated hereinbefore, the spout **30** is a relatively stiff component and may be inserted into the rigid, vertically oriented filler tube of an automobile engine and will then support the inverted container unattended until its contents are drained therefrom.

The modified cap **31'** and associated spout **30'** illustrated in FIGURE 10 are more suitable than the cap **31** and spout **30** in the case where only a portion of the container contents are to be discharged at any one time—in which event the cap **31'** permits the spout to be reclosed. The closure structure **15** can be returned to its closed position by applying a downward force to the spout **30** (or **30'**) to displace the spout and diaphragm **23** from the position shown in FIGURE 7, through the intermediate position illustrated in FIGURE 8, and into the closed position shown in FIGURE 9.

The drawings, and especially FIGURES 2 and 4 thereof, make evident the fact that the open and closed positions of the closure structure, excepting the spout **30**, are inverted positions defining mirror images of each other. More particularly, the edge **20** and cone-intersecting plane defined thereby establish the geometric center or image plane of the closure structure. The diaphragm **23** in its open position (as shown by full lines in FIGURE 2) lies entirely above such geometric center or image plane. The diaphragm **23** in its closed position (as shown by broken lines in FIGURE 2), lies entirely below such geometric center or image plane. Evidently, in moving between its open and closed positions, the diaphragm **23** is simply inverted through the opening **24** which opening lies entirely within such geometric center or image plane.

Thus, there is an "over-center" characteristic in the closure structure **15** which is effective to positively maintain the same selectively in both the open and closed positions thereof. Further, this same over-center characteristic imparts a pop-open and pop-close motion to the closure structure because once a significant portion of the diaphragm **23** has passed through the opening **24** in moving toward either the open or closed position, the resilient forces then present in the deformed diaphragm tend to continue the motion thereof in the direction in which it is moving until the diaphragm is displaced into either the fully open or fully closed position, both of which tend to establish neutral positions for the diaphragm **23**.

That is to say, when the diaphragm **23** is in either its

open or closed position, any stresses therein are uniformly distributed because the diaphragm then has a conical configuration. Any deformation of the diaphragm from such conical configuration develops non-uniform stresses throughout the diaphragm that tend to restore the same to a conical shape. Thus, as the closure structure is moved from its open toward its closed position, for example, the stresses developed in the diaphragm progressively increase in magnitude and tend to resist such movement and to restore the structure to its fully open position. The magnitude of the stresses continues to increase until the edge **28** reaches a position of substantial coincidence with the edge **20** defining the central geometric plane of the structure. The stresses are maximum in this central position of the closure structure, and the direction of the stresses is neutral at this time. Any displacement of the closure structure from this central plane in either direction gives the stresses a direction corresponding to the direction of such displacement. Consequently, such directionally-oriented stresses tend to displace the structure to the full extent of its movement in the associated direction in order to again establish it in a conical configuration which, in the foregoing example, is the closed position thereof. The same stress conditions but in opposite orientation obtain as the diaphragm is inverted through the opening **24** from its closed to its open position.

The diaphragm **23** is deformed, as shown in FIGURE 8, whenever the closure structure is moved from either its fully open or fully closed position, but the exact path or shape of the deformation may differ from container to container and from time to time. This situation is shown in FIGURE 8, wherein an upwardly convex deformation of the diaphragm **23** is shown by full lines at the time that the closure structure has been displaced into a position intermediate the fully open and closed positions thereof. However, the diaphragm might have assumed an upwardly concave deformation at this time, which alternative configuration is shown by broken lines in FIGURE 8. The inclined orientation of the geometric center or image plane (i.e., the opening **24**) with reference to the plane of the cover **17** of the container **16** permits the spout **30** to lie wholly beneath the upper surface of the cover when the closure structure **15** is completely closed. Thus, the container **16** will have no outwardly extending protuberances which would interfere with the stacking of containers one upon another and the disposition thereof in side-by-side relation when the closure structure is completely closed—such closed position being essentially a mirror image of the open position of the closure structure, whereby the structure is characterized as having a reverse symmetry.

While in the foregoinng specification embodiments of the invention have been set forth in considerable detail for purposes of making an adequate disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in such details without departing from the spirit and principles of the invention.

What is claimed is:

1. An invertible dispensing closure through which the contents of an associated container can be discharged, comprising a flexible diaphragm having an edge forming a substantially closed curve defining an opening and establishing a center plane, said diaphragm having an arcuate wall extending from the center plane at such closed curve and defining a segment of a cone, said diaphragm having also an orifice therealong communicating with said opening to provide therewith a discharge path through which the contents of such container can be dispensed, and said diaphragm being selectively invertible through said opening from one side to the other side of such plane to respectively define open and closed positions of said dispensing closure, said diaphragm having a reverse symmetry such that the open and closed positions thereof are substantially mirror images of each other.

2. The dispensing closure of claim **1** in which said orifice is located along said arcuate wall.

3. The dispensing closure of claim **1** in which said arcuate wall terminates adjacent one end thereof in a transverse disposition with respect to the center line of such cone, said orifice being defined by such termination of said arcuate wall.

4. The dispensing closure of claim **1** and further comprising wall structure connected with said diaphragm along the edge thereof forming such closed curve for connection with a wall of such container, said wall structure being relatively stiff with respect to said diaphragm so as to maintain its shape during inversion of said dispensing closure.

5. The dispensing closure of claim **1** and further comprising a spout connected with said diaphragm about said orifice.

6. The dispensing closure of claim **5** in which said spout is equipped with a removable cap.

7. The dispensing closure of claim **5** in which said spout is provided with a frangible cap.

8. The dispensing closure of claim **1** and further comprising wall structure connected with said diaphragm along the edge thereof forming such closed curve for connection with a wall of such container, said wall structure being relatively stiff with respect to said diaphragm so as to maintain its shape during inversion of said dispensing closure, and further comprising a spout connected with said diaphragm about said orifice.

9. The dispensing closure of claim **8** in which said diphragm, wall structure and spout are hingedly interconnected to permit relative movement along the respective areas of interconnection.

10. The dispensing closure of claim **9** in which said diaphragm, wall structure and spout are integrally formed and have a reduced wall thickness along along their respective lines of mergence defining the aforementioned hinge connections.

11. The dispensing closure of claim **8** in which said orifice is located along said arcuate wall.

12. The dispensing closure of claim **8** in which said arcuate wall terminates adjacent one end thereof in a transverse disposition with respect to the center line of such cone, said orifice being defned by such termination of said arcuate wall.

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