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(54) **DISPENSING VALVE**

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(22) Filed: **Dec. 7, 2005**

Related U.S. Application Data

(63) Continuation of application No. 10/180,746, filed on Jun. 26, 2002, now Pat. No. 7,077,296, which is a continuation of application No. 09/812,129, filed on Mar. 19, 2001, now Pat. No. 6,427,874, which is a continuation of application No. 08/886,567, filed on Jul. 1, 1997, now Pat. No. 6,279,783, which is a continuation of application No. 08/508,472, filed on Jul. 28, 1995, now Pat. No. 5,839,614, which is a continuation-in-part of application No. 08/240,264, filed on May 10, 1994, now Pat. No. 5,439,143, which is a continuation of application No. 08/039,896, filed on Mar. 30, 1993, now Pat. No. 5,339,995, which is a continuation of application No. 07/804,086, filed on Dec. 6, 1991, now Pat. No. 5,213,236.

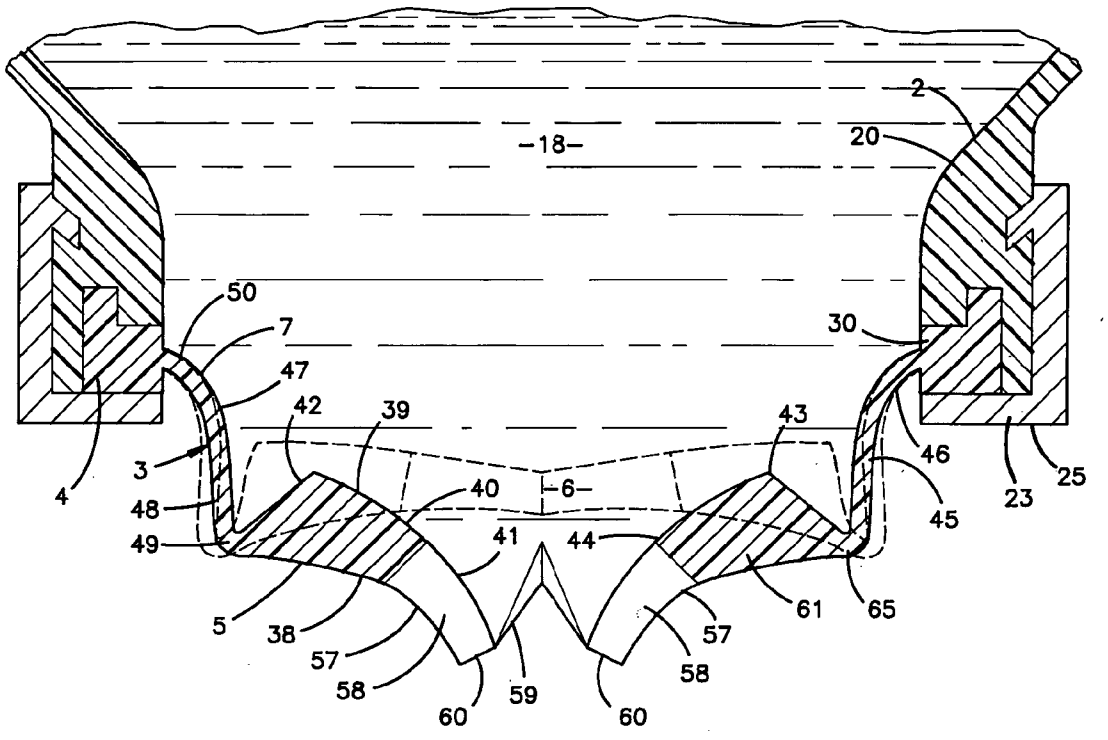
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(51) **Int. Cl.**
F16K 15/14 (2006.01)

(52) **U.S. Cl.** **137/844**

(57) **ABSTRACT**

A dispensing valve is provided for dispensing fluid products. The valve includes a marginal portion, a flexible valve head portion with a discharge orifice therein, and a flexible connector sleeve having one end connected with the valve marginal portion and the opposite end connected with the valve head portion adjacent a marginal edge thereof.



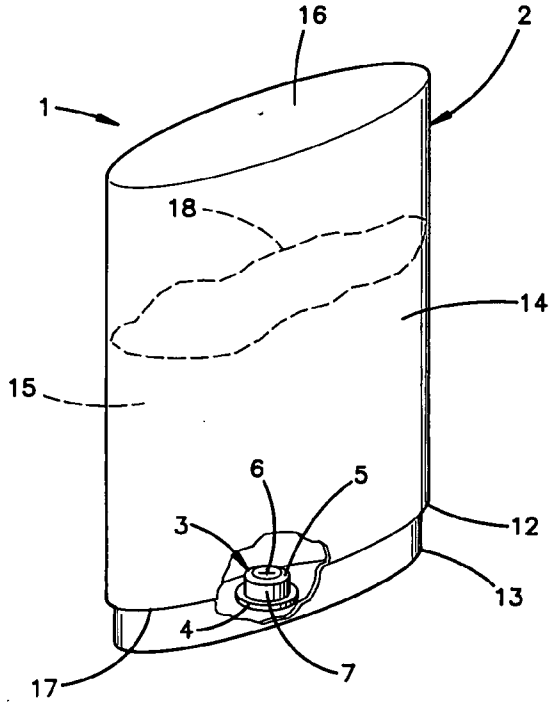


FIG. 1

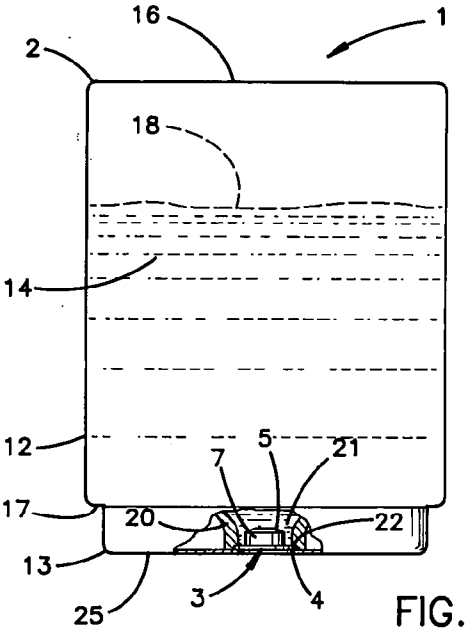


FIG. 2

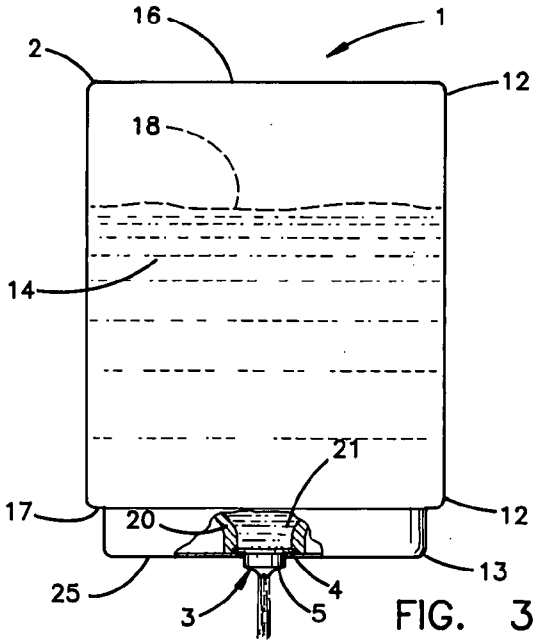


FIG. 3

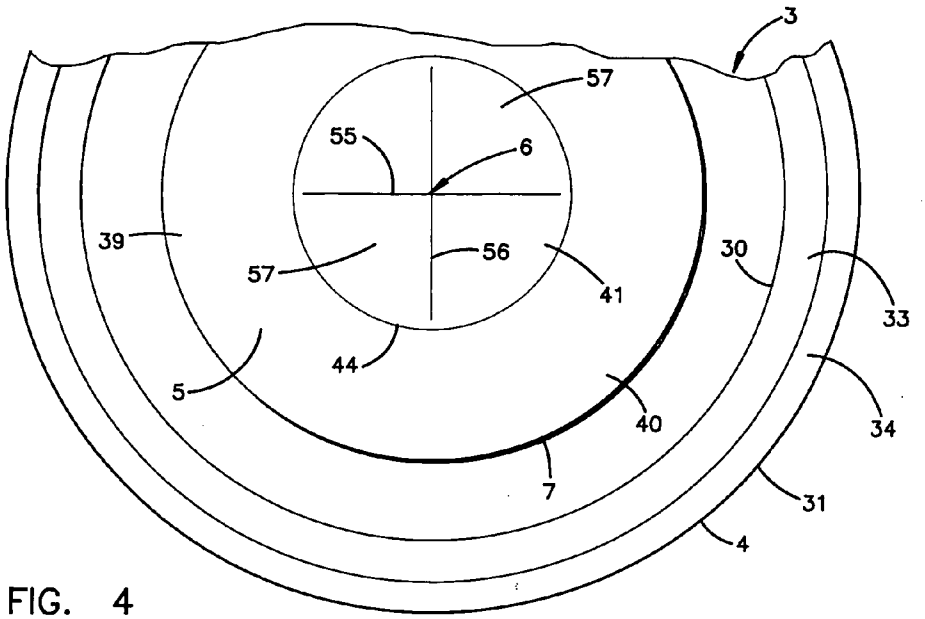


FIG. 4

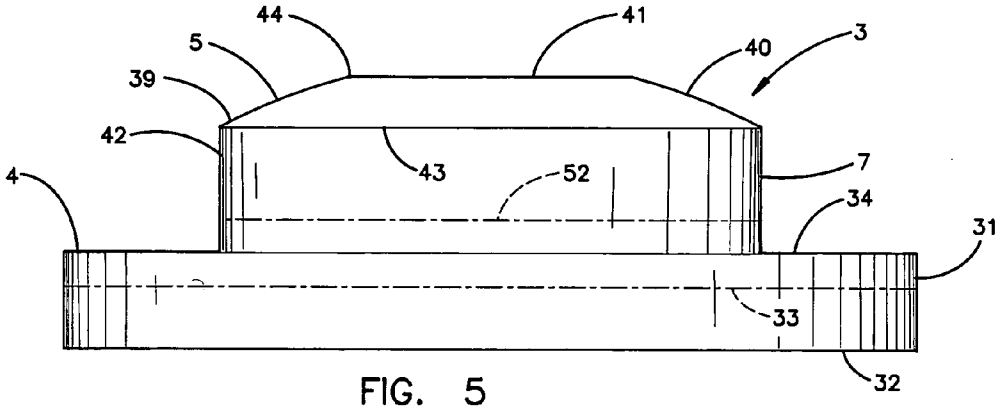


FIG. 5

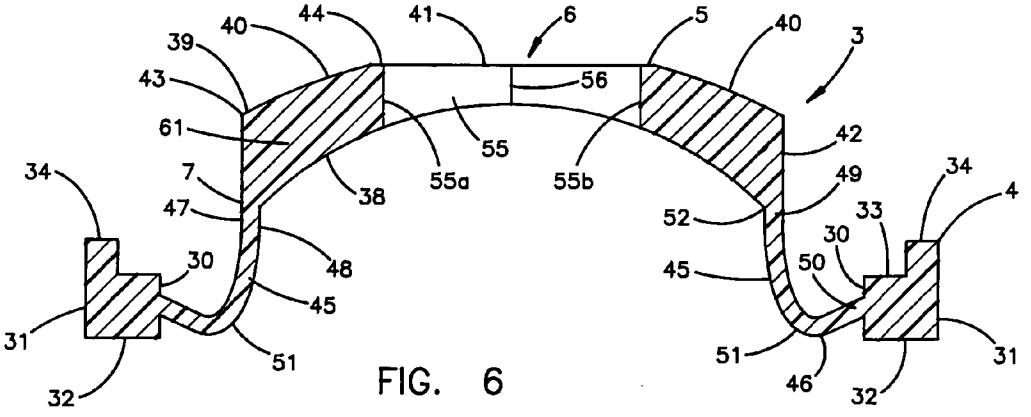


FIG. 6

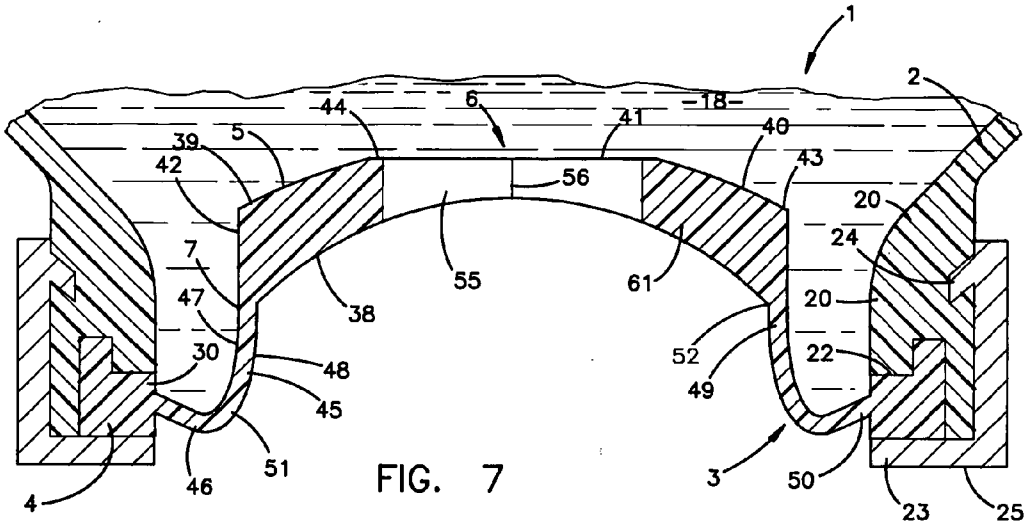

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FIG. 7

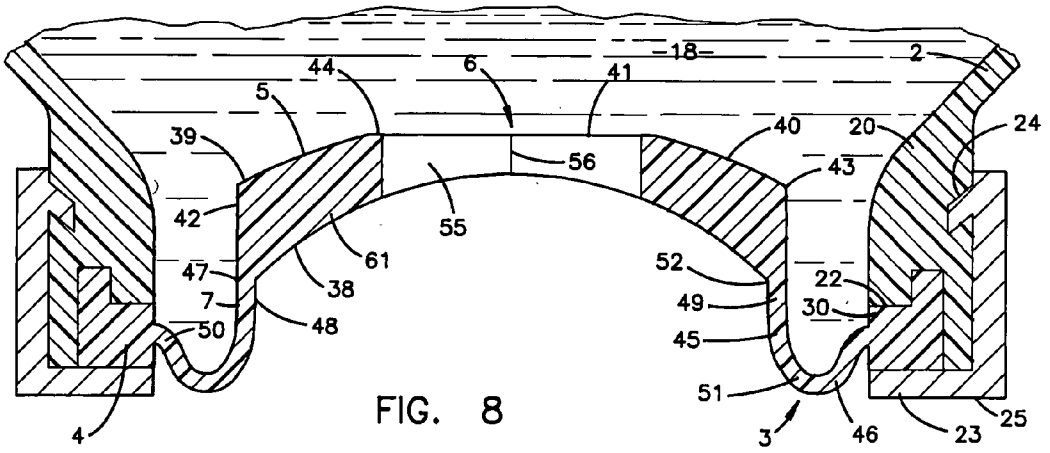

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FIG. 8

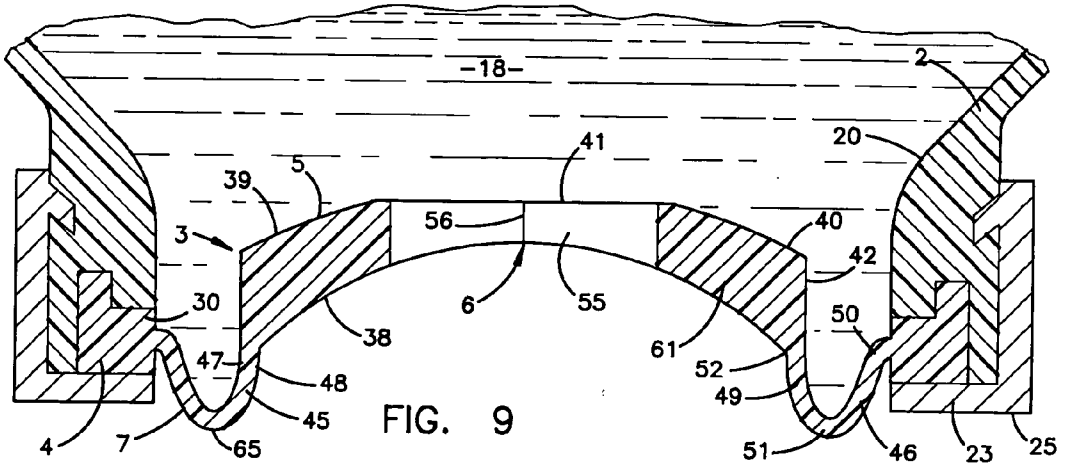

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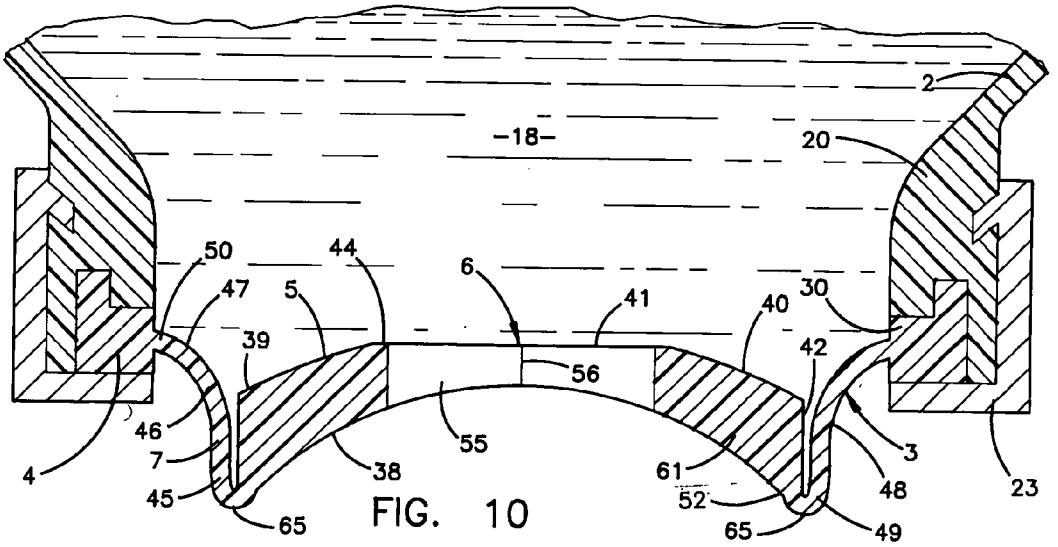

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FIG. 10

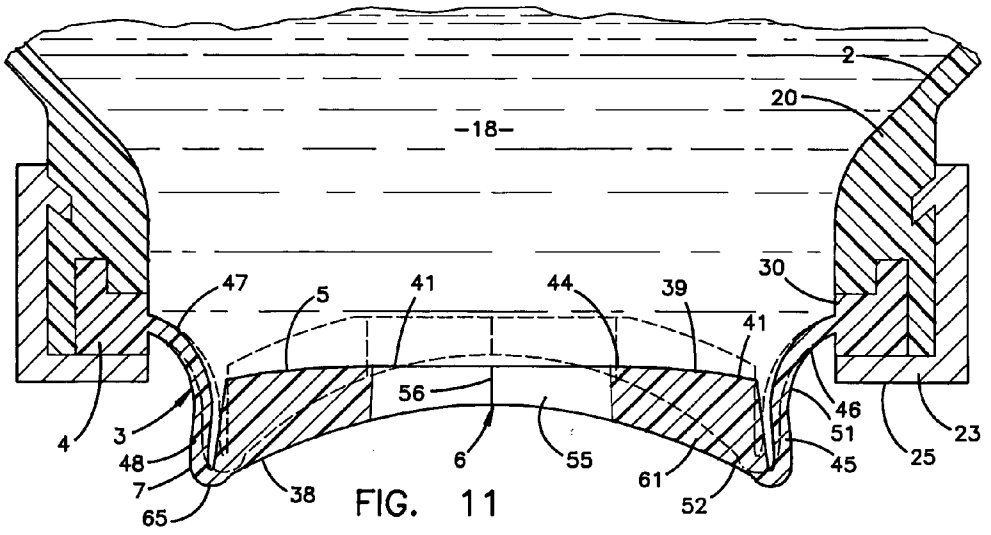

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FIG. 11

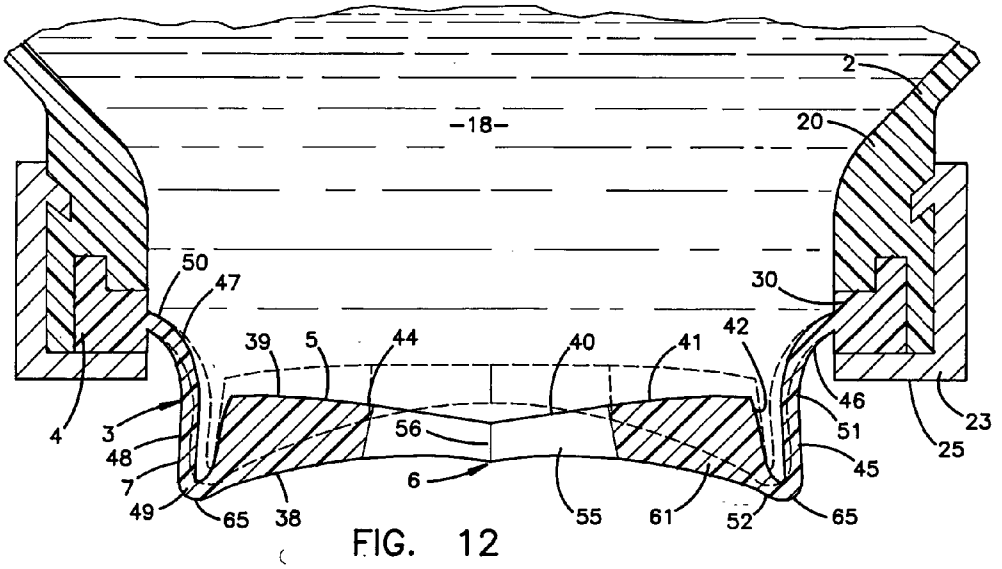

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FIG. 12

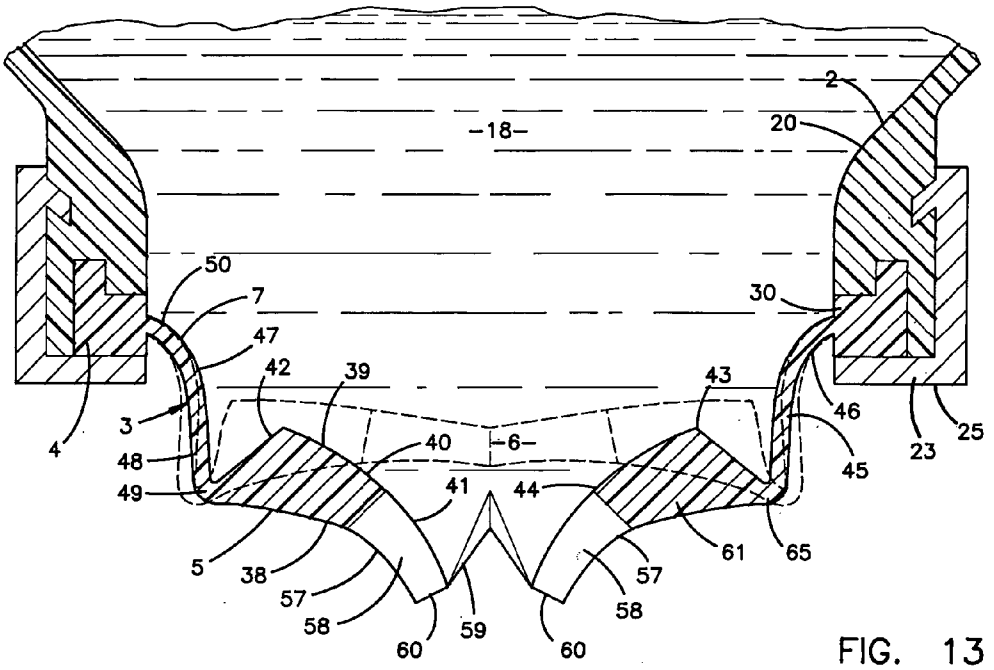

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FIG. 13

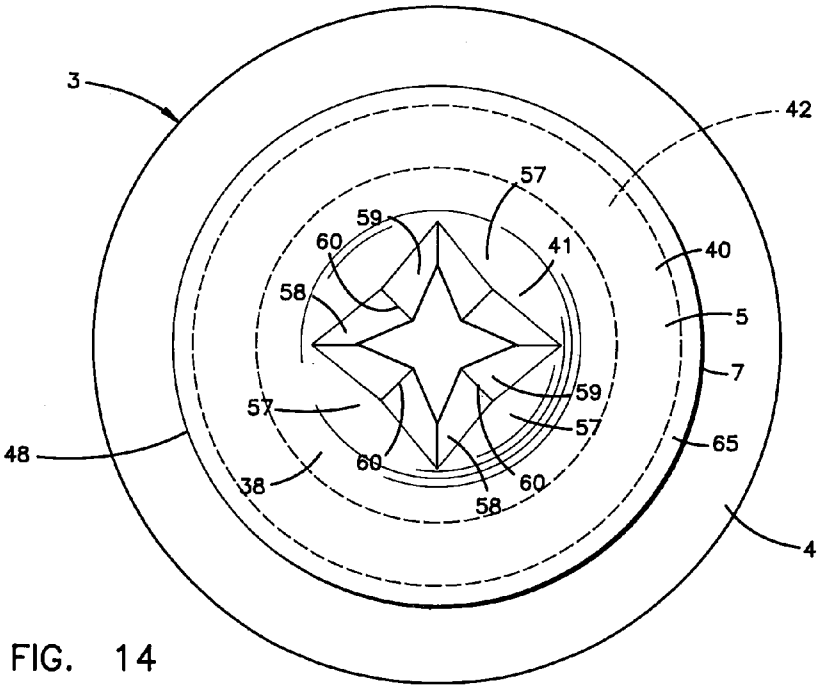

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FIG. 14

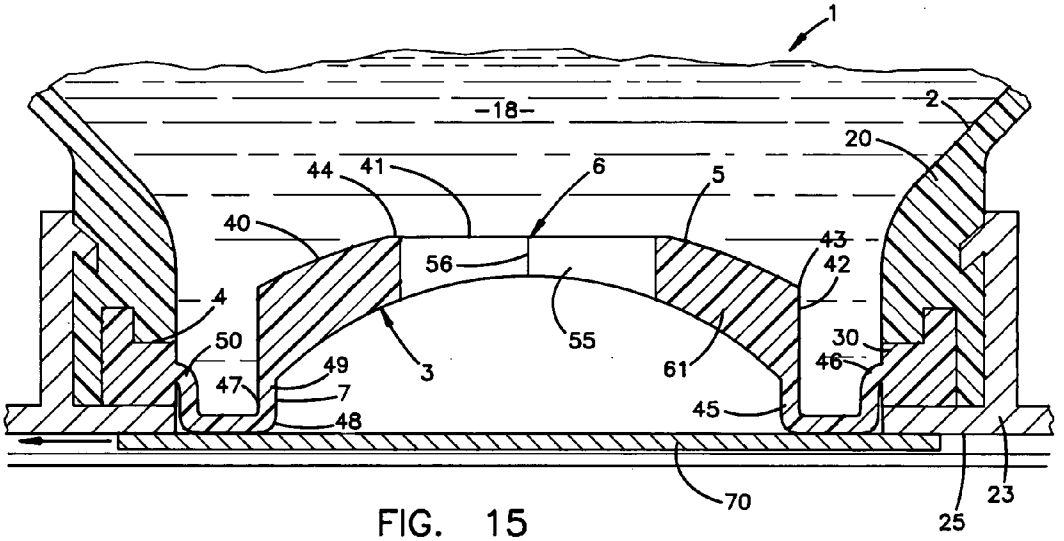

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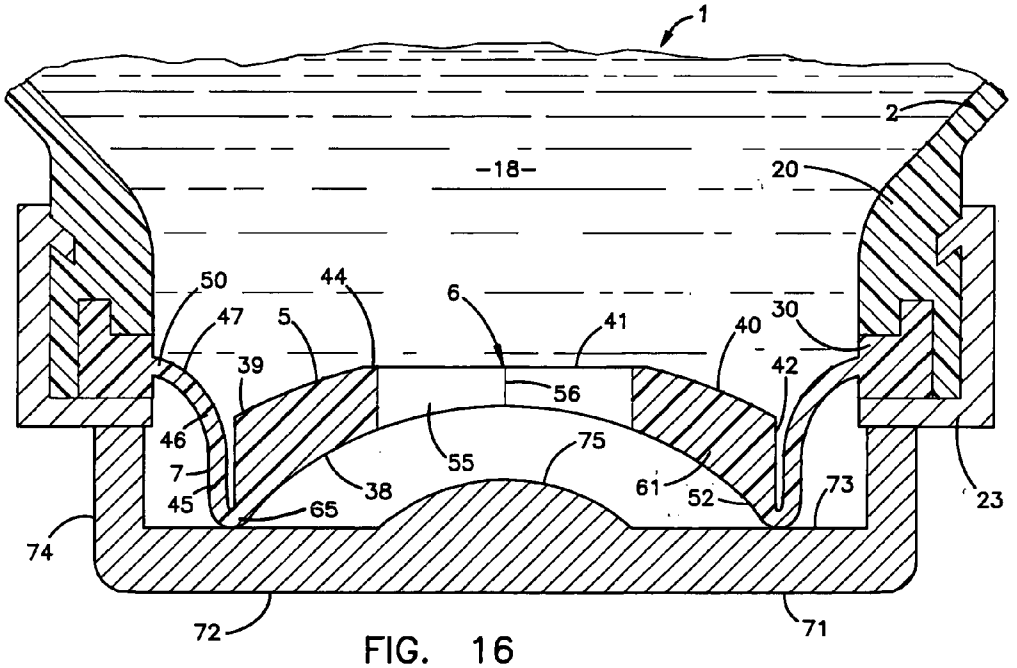

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FIG. 16

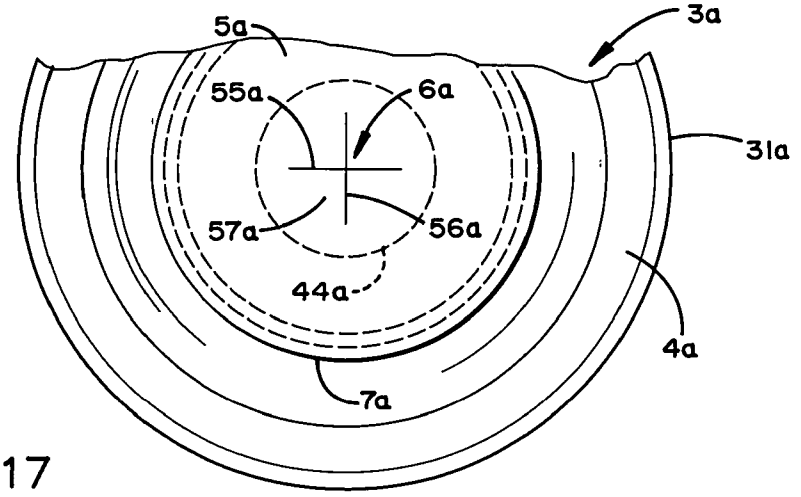


FIG. 17

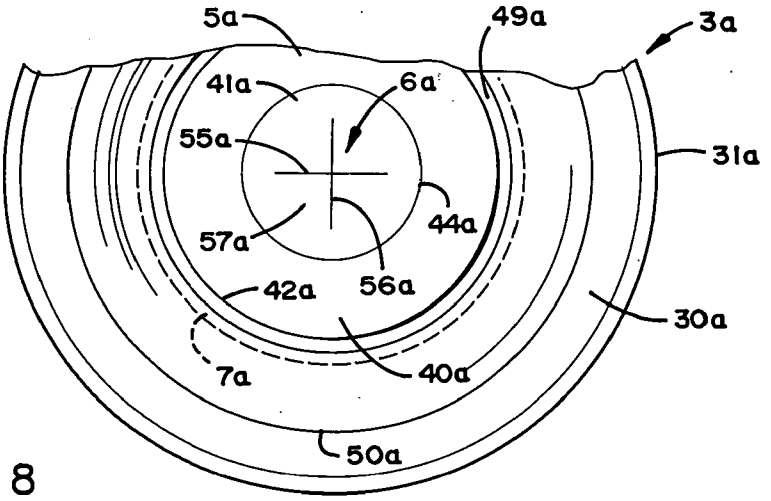


FIG. 18

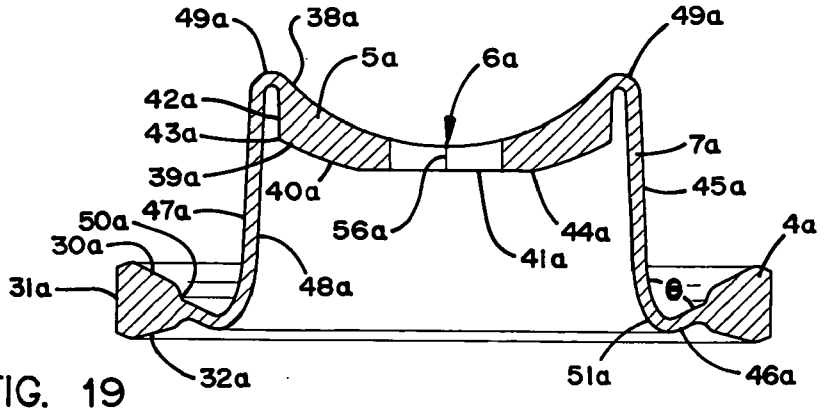


FIG. 19

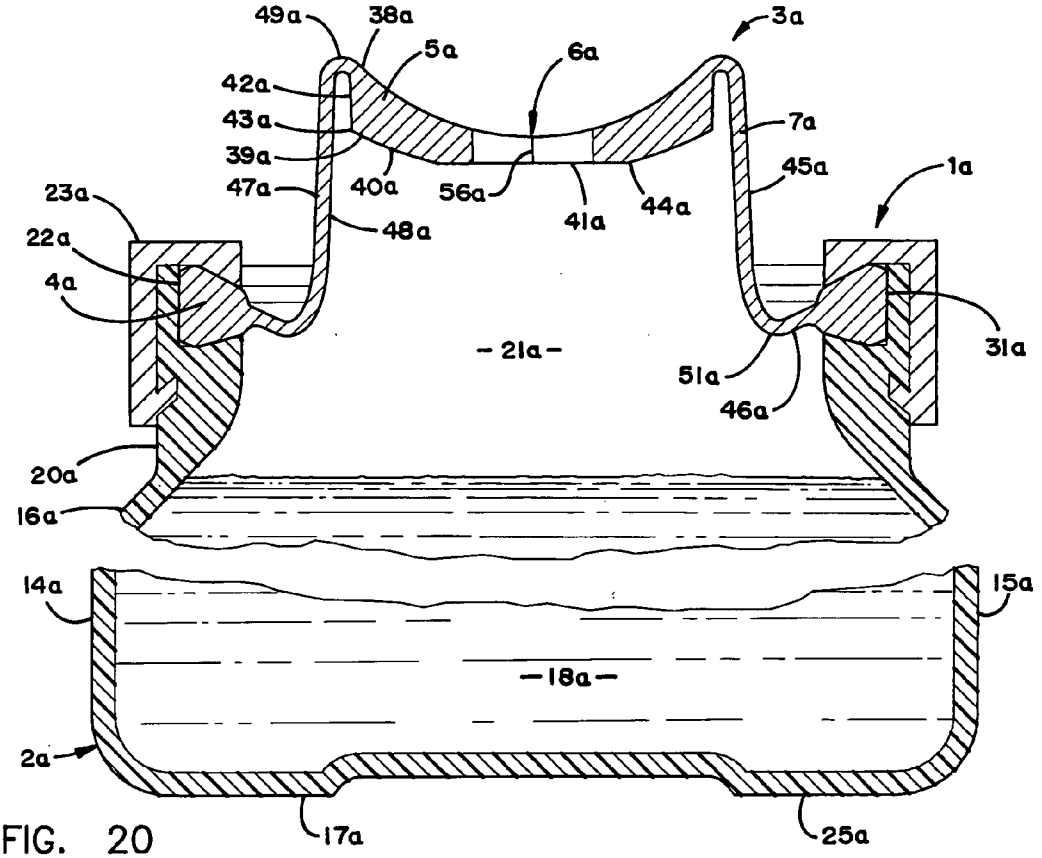

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FIG. 20

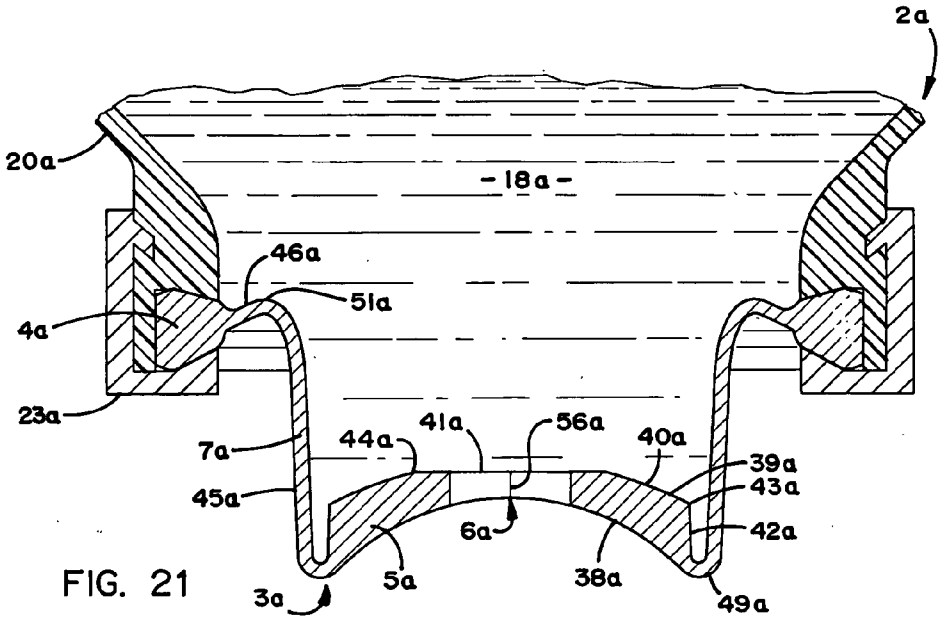

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FIG. 21

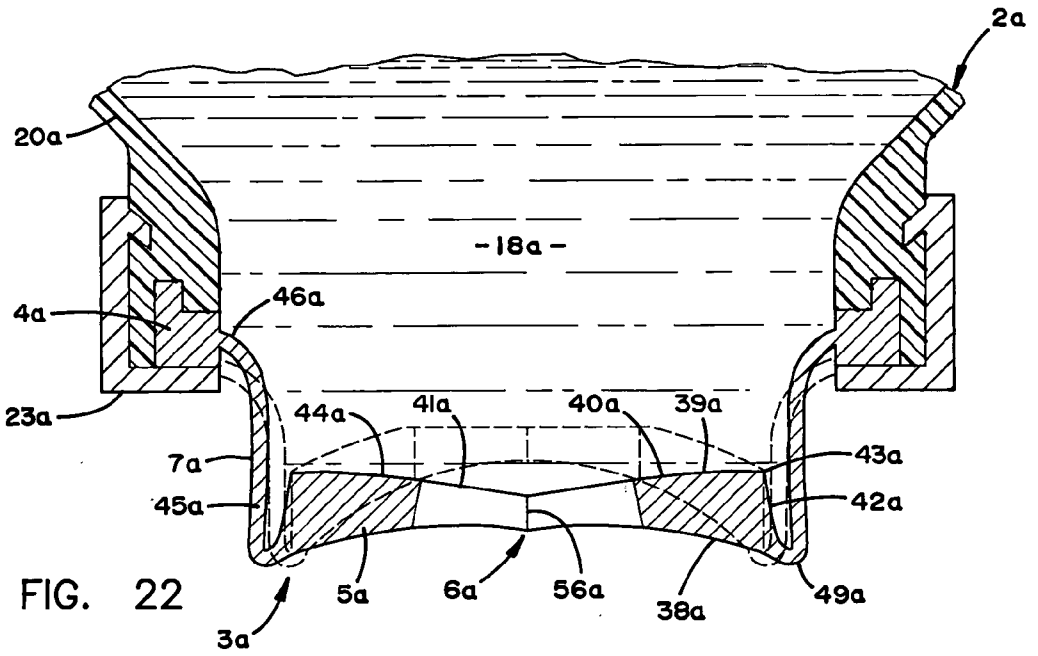

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FIG. 22

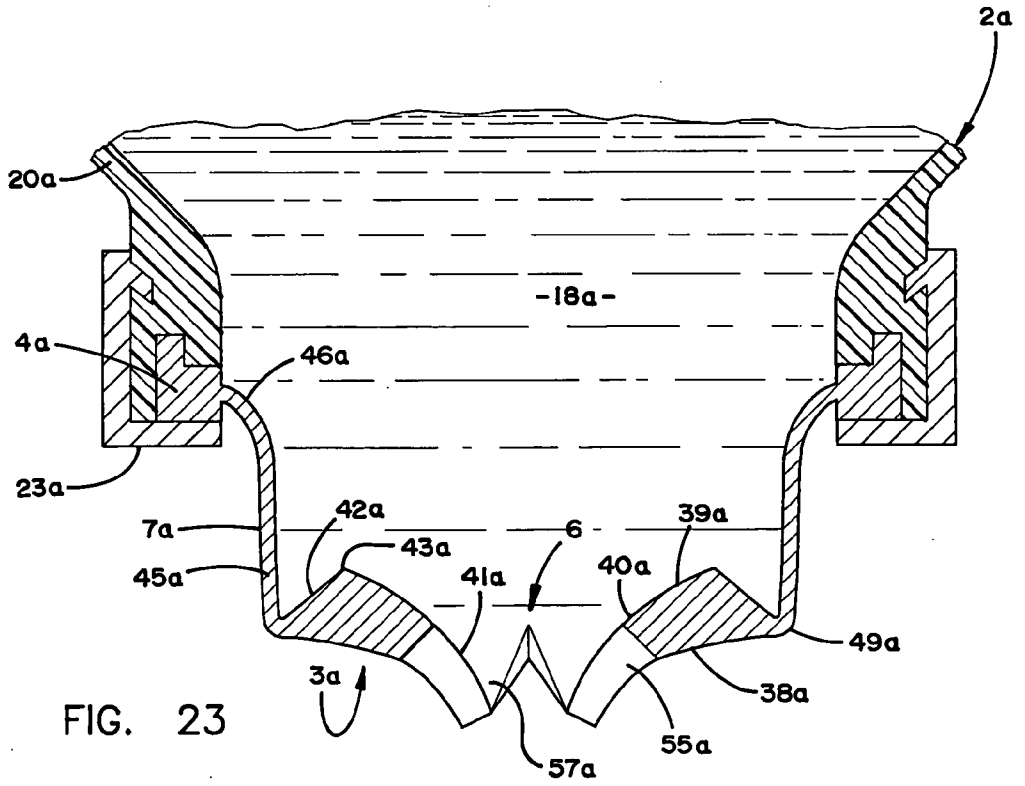

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FIG. 23

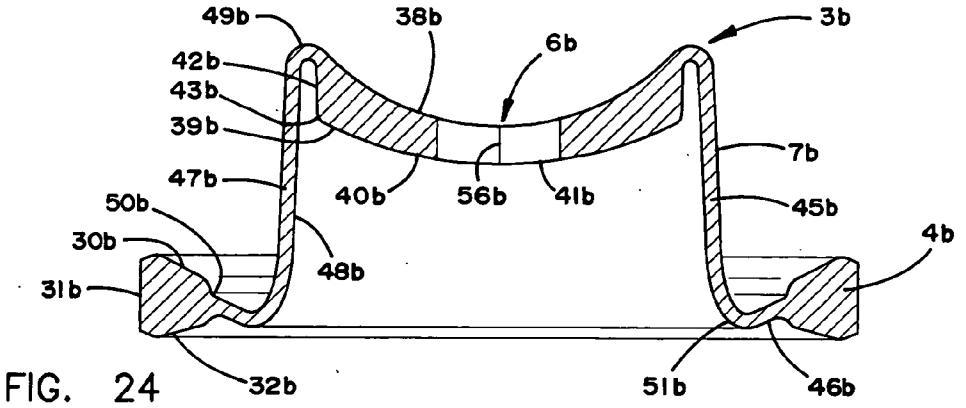


FIG. 24

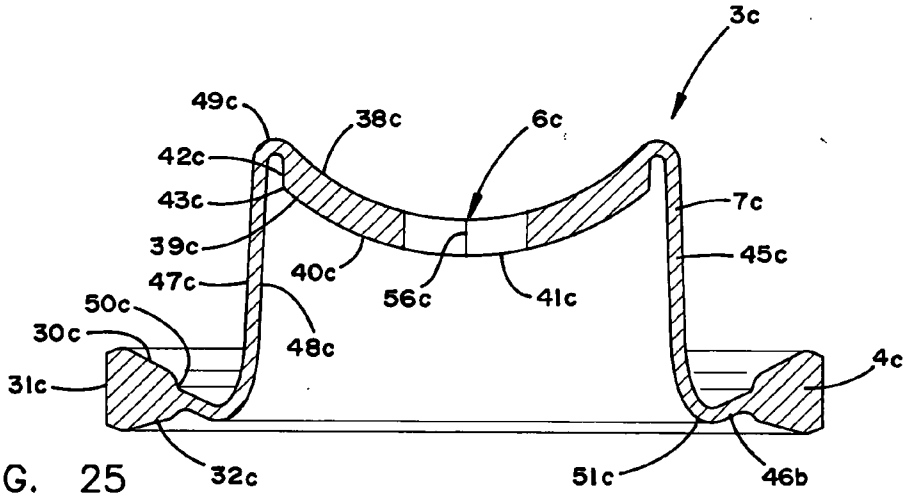


FIG. 25

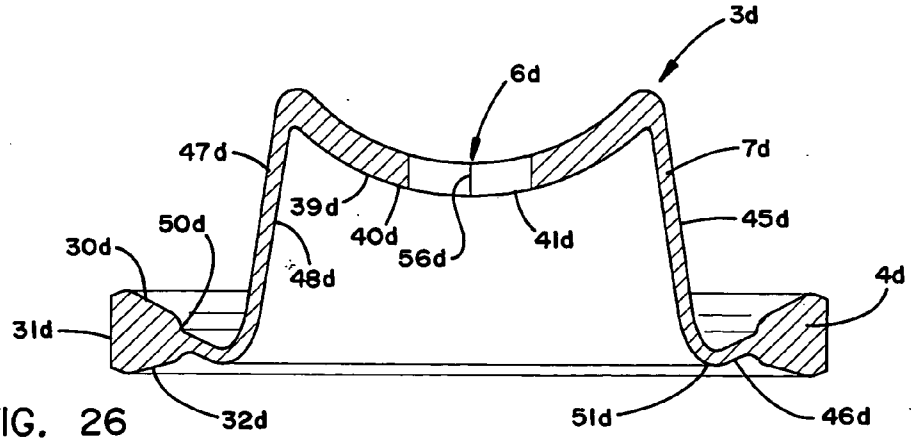


FIG. 26

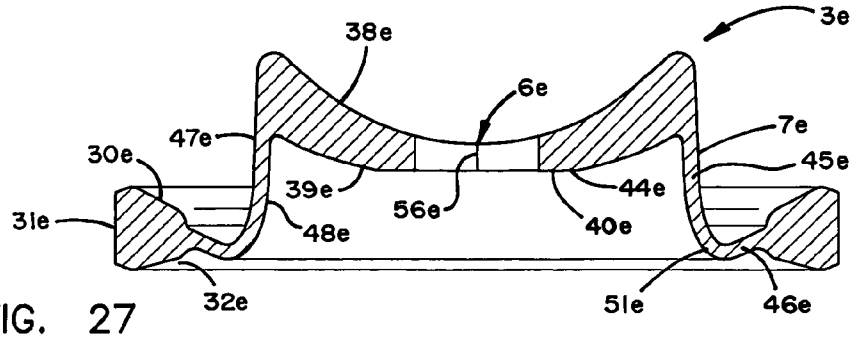


FIG. 27

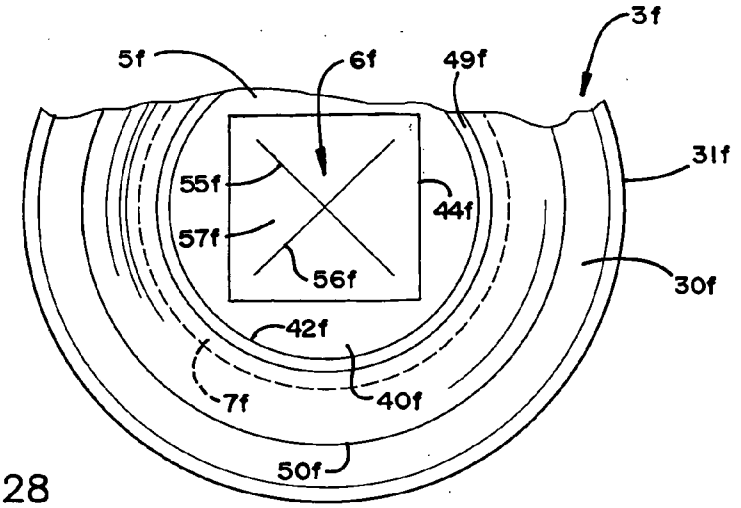


FIG. 28

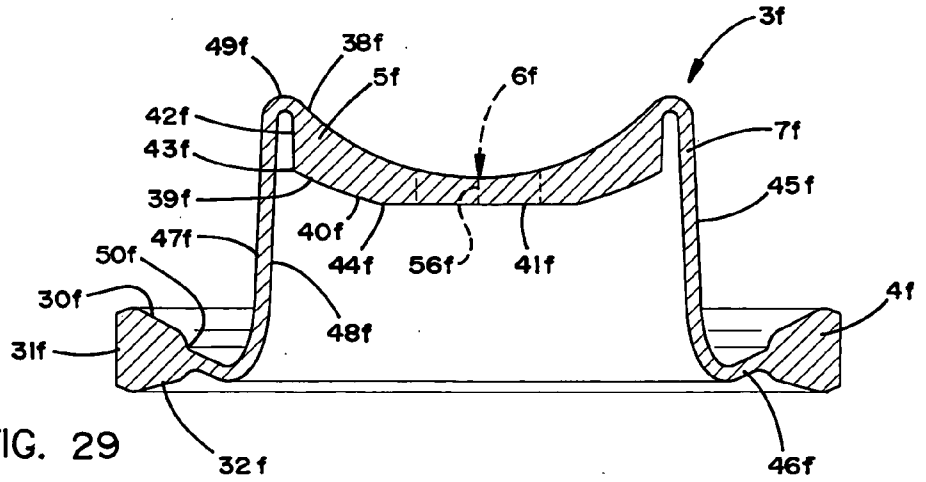


FIG. 29

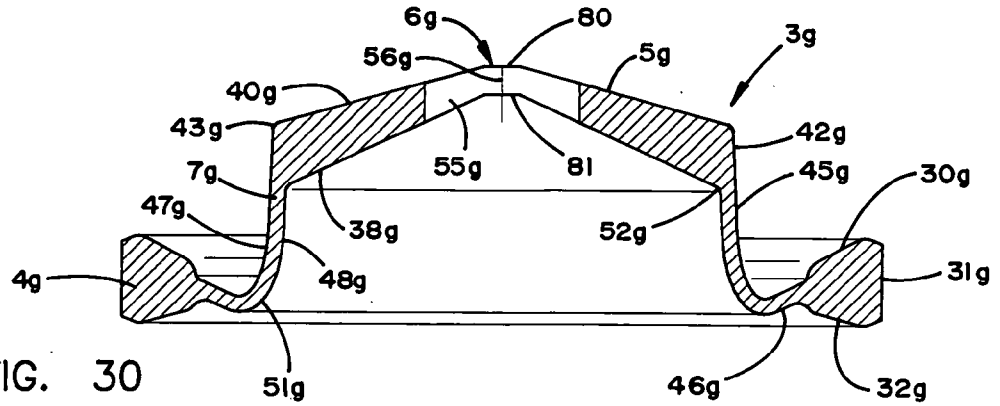


FIG. 30

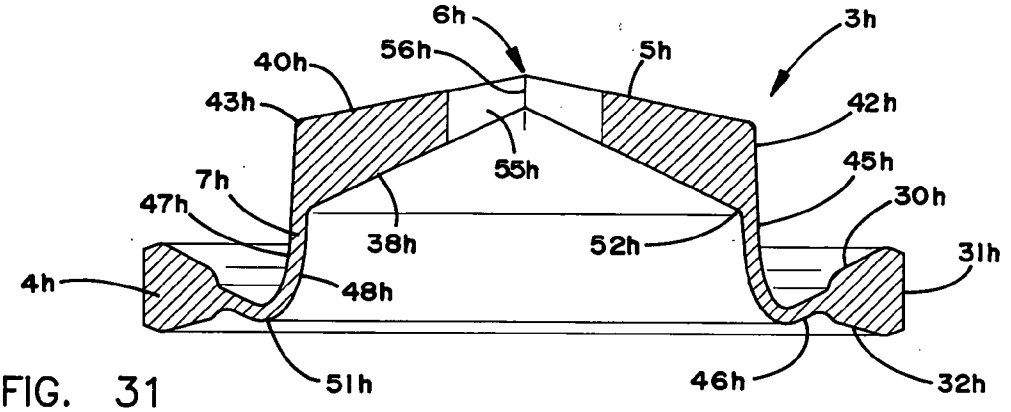


FIG. 31

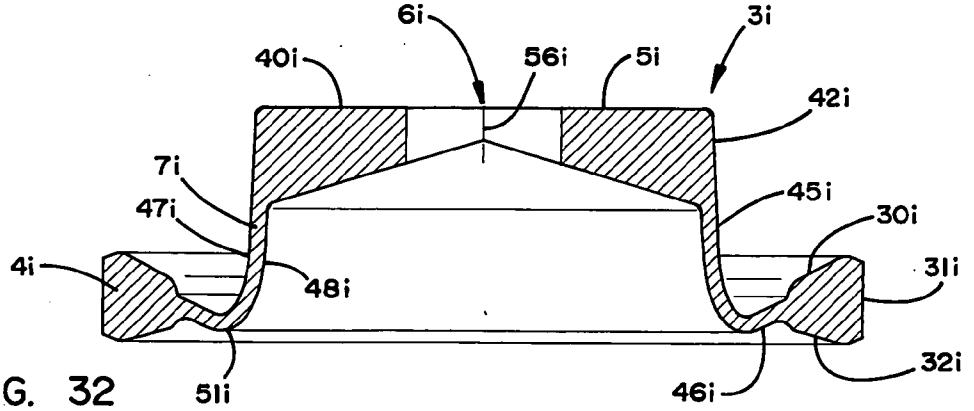


FIG. 32

DISPENSING VALVE

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application is a continuation of commonly assigned, co-pending U.S. patent application Ser. No. 10/180,746, filed Jun. 26, 2002, entitled "DISPENSING VALVE," (Parent Application), which is a continuation of Ser. No. 09/812,129, filed Mar. 19, 2001, entitled "DISPENSING VALVE," now U.S. Pat. No. 6,427,874 (Grandparent Application), which is a continuation of Ser. No. 08/886,567, filed Jul. 1, 1997, entitled "DISPENSING PACKAGE," now U.S. Pat. No. 6,279,783 (Great Grandparent Application), which is a continuation of Ser. No. 08/508,472, entitled "DISPENSING PACKAGE," filed Jul. 28, 1995, now U.S. Pat. No. 5,839,614, (Great Great Grandparent Application), which is a continuation-in-part of Ser. No. 08/240,264, filed May 10, 1994, entitled "DISPENSING PACKAGE," now U.S. Pat. No. 5,439,143 (Great Great Great Grandparent Application), which is a continuation of Ser. No. 08/39,896, filed Mar. 30, 1993, now U.S. Pat. No. 5,339,995 (Great Great Great Great Grandparent Application), which is a continuation of Ser. No. 08/804,086, filed Dec. 6, 1991, now U.S. Pat. No. 5,213,236 (Great Great Great Great Great Grandparent Application).

BACKGROUND OF THE INVENTION

[0002] The present invention relates to product packaging, and in particular to a self-sealing valve for fluid products, and the like.

[0003] Many different types of packages or containers are presently available for packaging non-solid products of the type which are capable of flowing, such as fluid or fluidized materials, including liquids, pastes, powders, and the like, which substances are collectively and generically referred to herein as "fluids". Some such packages include a dispenser which. permits a selected amount of fluid to be discharged from the package, and then reseals to close the package.

[0004] Self-sealing dispensing valves have been used in packaging for certain types of products, such as the container disclosed in U.S. Pat. No. 4,728,006 to Drobish et al, which is designed for shampoos, conditioners, and the like. However, such valves have been known to experience some types of sealing problems, and inconsistent dispensing characteristics, particularly when the packages are exposed to significant temperature variations.

[0005] Valves constructed from most conventional plastic materials cannot be used in at least certain types of packages, since they either react with or adulterate the product. For instance, in food packaging, care must be taken to avoid the use of valve materials which might contain any type of toxin. Furthermore, active ingredients in products can cause the valve to either embrittle or soften, thereby ruining the designed flow rate and/or self-sealing characteristics of the valve.

[0006] Liquid silicone rubber valves have recently been used in some types of packaging, and have proven particularly advantageous since the material is inherently quite inert, and will therefore not either adulterate or react with the packaged product. Examples of such packaging are provided in applicant's U.S. Pat. No. 5,033,655 to Brown. Although liquid silicone rubber possesses many attributes for use in packaging, it also has other characteristics which render such applications problematic. For example, the surfaces of liquid silicone rubber parts are extremely tacky or sticky, having a very high coefficient of friction. As a result, in attempting to attach a dispensing valve to a container by a conventional threaded collar arrangement, the surfaces of the valve flange will stick tightly to the adjacent surfaces of the container and collar before the collar can be tightened securely enough to create a leak-resistant seal. Tightening of the collar often causes the valve flange, as well as the entire valve to distort from its designed shape, thereby preventing the formation of a secure seal, and/or changing the intended dispensing and sealing characteristics of the valve.

[0007] Another drawback associated with the use of liquid silicone rubber in dispensing valves for product packaging is that there is presently no available adhesive capable of connecting the valve to a container in a manner that will withstand the operating pressures to which the valve and container are repeatedly subjected. The unique imperforate nature of the surfaces of the liquid silicone rubber valve precludes the use of conventional adhesives. Hence, the attachment of the liquid silicone rubber valve to a container in a manner that will not leak, and will withstand repeated pressurization and depressurization of the dispensing package is an important consideration.

[0008] Another problem experienced with prior dispensing packages relates to achieving a proper design balance between the package container, valve, and fluid product, so that the product can be repeatedly dispensed without requiring excess force, and will neatly discharge only that amount of product which is desired by the user, particularly in keeping with the type of product involved. For instance, when dispensing highly concentrated fluid products, such as hand soaps, and the like, the user will typically require only a small amount or dollop of soap per application to achieve satisfactory results. In contrast, when using other types of fluid products, such as skin moisturizers, tanning formulas, and the like, larger quantities of product are typically required by the user for each application. The ability of the valve to quickly and readily open in response to moderate pressure on the container is important, as is the ability of the valve to quickly and securely close when the pressure has been released. Also important is the amount of pressure which must be maintained on the container to sustain fluid through the valve once the valve is opened. The ability to quickly and accurately achieve a proper balance between all of these factors is very desirable in designing dispensing packages.

SUMMARY OF THE INVENTION

[0009] One aspect of the present invention is a dispensing package for fluid products and the like, comprising a container having a dispensing valve mounted therein. The dispensing valve includes a marginal flange which seals about a discharge opening of the container, and a valve head with an orifice therethrough which opens and closes in response to the application and release of a predetermined discharge pressure to control fluid flow therethrough. The valve includes a connector sleeve having one end connected with the valve flange, and an opposite end connected with the valve head adjacent a marginal edge thereof. The connector sleeve has a resiliently flexible construction, whereby

when pressure within the container is raised above the predetermined discharge pressure, the valve head shifts outwardly in a manner which causes the connector sleeve to double over and then extend rollingly, and thereby apply a torque to the valve head which assists in opening the orifice.

[0010] Another aspect of the present invention is a dispensing valve for fluid product packaging and the like, having a marginal valve flange shaped to seal about a discharge opening of the container. The valve includes a valve head having a marginal edge, interior and exterior sides, and an orifice extending therebetween which opens to permit fluid flow therethrough in response to communication with a predetermined discharge pressure, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure. A connector sleeve with a resiliently flexible construction, has one end connected with the valve flange, and the opposite end connected with the valve head adjacent to the marginal edge thereof, whereby when pressure in excess of the predetermined discharged pressure is applied to the interior side of the valve head, the valve head shifts outwardly in a manner which causes the connector sleeve to double over and then extend rollingly, and thereby apply a torque to the valve head which assists in opening the orifice.

[0011] Yet another aspect of the present invention is a dispensing package for fluid products and the like, comprising a container having a dispensing valve mounted therein for controlling the flow of fluid product from the container. The dispensing valve includes a marginal valve flange, a valve head with an orifice which permits fluid flow therethrough, and a connector sleeve having one end connected with the valve flange, and an opposite end connected with the valve head adjacent a marginal edge thereof, such that the dispensing valve assumes a generally hat-shaped, side elevational configuration which normally projects inwardly toward the interior of the container. The connector sleeve has a resiliently flexible construction which permits the valve head to shift outwardly through the valve flange by doubling over the connector sleeve, which then extends rollingly outwardly.

[0012] Yet another aspect of the present invention is a dispensing valve, comprising a marginal valve flange, and a valve head with an orifice therethrough which selectively opens to permit fluid flow in response to communication with a predetermined discharge pressure. The valve head is configured such that it assumes a generally convex orientation when the orifice is open. The dispensing valve also includes a connector sleeve, which has a resiliently flexible construction, with one end connected with the valve flange, and an opposite end connected with the valve head adjacent the marginal edge thereof, whereby when pressure in excess of the predetermined discharge pressure is applied to the interior side of the valve head, the valve head shifts outwardly in a manner which causes the connector sleeve to double over and then extend rollingly, and thereby apply a torque to the valve head which resiliently snaps the valve head into its convex orientation to quickly and fully open the orifice.

[0013] Yet another aspect of the present invention is a self-sealing dispensing valve for fluid product packaging and the like, comprising a marginal valve flange, and a valve head with an orifice therein which selectively permits fluid flow through the valve. The interior side of the valve head has an outwardly curving arcuate side elevational shape defined by a first radius, while the exterior side of the valve head has an outwardly curving arcuate side elevational shape defined by a second radius, which is less than the first radius. A connector sleeve is provided with a resiliently flexible construction, and has one end connected with the valve flange, and the opposite end connected with the valve head.

[0014] Yet another aspect of the present invention is a self-sealing dispensing valve for fluid product packaging and the like, comprising a marginal valve flange, and a valve head having a discharge opening therein to selectively permit fluid flow. The valve head includes an exterior side having an outwardly curving arcuate side elevational shape defined by a first radius, and an interior side with a center portion having a generally flat side elevational shape, and a marginal portion having an outwardly curving arcuate side elevational shape defined by a second radius, which is greater than the first radius. The discharge orifice extends from the center portion of the exterior surface to the interior surface of the valve head to achieve easy and complete opening of the discharge orifice when the predetermined discharge pressure is applied thereto, and secure and complete closing of the discharge opening when the predetermined discharge pressure is released.

[0015] Yet another aspect of the present invention is a dispensing valve for fluid product packaging, comprising a marginal valve flange, and a valve head having an orifice therein which opens to permit fluid flow therethrough in response to a predetermined discharge pressure, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure. The dispensing valve includes a substantially imperforate rolling diaphragm positioned between and interconnecting the valve flange and the valve head, which has a flexible construction which permits the valve head to shift between a retracted position on an interior side of the marginal flange for storage, and an extended position on an exterior side of the marginal flange for dispensing. When pressure in excess of the discharge pressure, is applied to the container, the valve head first shifts to the extended position, and then opens the orifice to discharge the fluid product therethrough. Upon release of the pressure, the orifice first closes to shut off the flow of fluid product therethrough, and the valve head then shifts to the retracted position for storage.

[0016] Yet another aspect of the present invention is a valve, comprising a marginal valve flange, and a valve head having a marginal edge, interior and exterior sides, and an orifice extending therebetween which in response to communication with a predetermined discharge pressure, shifts to a fully open position to permit fluid flow therethrough. A connector sleeve is provided, having a resiliently flexible construction, with one end connected with the valve flange, and an opposite end connected with the valve head adjacent the marginal edge thereof, which permits the valve head to shift with respect to the marginal valve flange in a manner which causes the connector sleeve to double over and then extend rollingly, and thereby apply an outwardly directed torque to the valve head which tends to open the orifice. The valve head is configured with a plan shape which expands or dilates as the orifice is shifted to the fully open position, which expansion is resisted by the connector sleeve, so as to

inwardly compress the valve head, which inward compression and torque applied to the valve head by the connector sleeve combine to resiliently maintain the orifice in the fully open position, whereby that pressure required to maintain fluid flow through the orifice is substantially less than the predetermined threshold pressure, so as to provide greater ease of dispensing and flow control.

[0017] Yet another aspect of the present invention is a dispensing package and associated valve for fluid products and the like, comprising a container having the dispensing valve mounted therein. The dispensing valve controls the flow of fluid product from the container, and has a marginal portion sealing about a discharge opening of the container. The valve also has a head portion including a central area with an orifice which opens to permit fluid flow therethrough in response to a predetermined discharge pressure within the container, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure within the container, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure. The valve includes a generally J-shaped connector sleeve, having a resiliently flexible construction with a first leg portion thereof connected with the marginal portion, and a second leg portion thereof connected with the head portion. The first and second leg portions are mutually oriented at an acute included angle, and join one another at an arcuate portion which facilitates movement of the head portion of the valve when dispensing product from the container.

[0018] Yet another aspect of the present invention is a dispensing package and associated valve for fluid products and the like, comprising a container having the dispensing valve mounted therein. The dispensing valve controls the flow of fluid product from the container, and has a marginal portion sealing about a discharge opening of the container. The valve has a head portion including a central area with an orifice which opens to permit fluid flow therethrough in response to a predetermined discharge pressure within the container, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure. The valve also has a resiliently flexible connector sleeve, including a first end portion thereof connected with the marginal portion, and a second end portion thereof connected with the head portion. The second end of the connector sleeve has an inverted J-shape which extends arcuately into the head portion to facilitate movement of the head portion of the valve when dispensing product from the container.

[0019] Yet another aspect of the present invention is a dispensing package and associated valve for fluid products and the like, comprising a container having the dispensing valve mounted therein. The dispensing valve controls the flow of fluid product from the container, and has a marginal portion sealing about a discharge opening of the container. The valve has a head portion including a central area with an orifice which opens to permit fluid flow therethrough in response to a predetermined discharge pressure within the container, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure. The valve also has a head portion including an exterior surface which interfaces with ambient environment and has a generally concave shape when viewed from outside the container, and interior surface which interfaces with the fluid product in the container and has a central area and a generally inclined outer portion which tapers inwardly toward the center area, such that the exterior and interior surfaces converge toward the central area of the head portion to provide a tapered construction with reduced thickness adjoining the orifice.

[0020] Yet another aspect of the present invention is a dispensing package and associated valve for fluid products and the like, comprising a container having the valve mounted therein. The dispensing valve controls the flow of fluid product from the container, and has a marginal portion sealing about a discharge opening of the container. The valve has a head portion including a central area with an orifice which opens to permit fluid flow therethrough in response to a predetermined discharge pressure within the container, and closes to shut off fluid flow therethrough upon removal of the predetermined discharge pressure. The head portion has an exterior surface which interfaces with ambient environment, and an interior surface which interfaces with the fluid product in the container. The exterior and interior surfaces of the head portion taper inwardly toward the center area, such that the exterior and interior surfaces converge toward the central area of the head portion to provide a tapered construction with reduced thickness adjoining the orifice.

[0021] The principal objects of the present invention are to provide a dispensing package and an associated self-sealing valve which are capable of easily and neatly dispensing a wide variety of different types of fluid products. The self-sealing valve is matched with both the container and the type of fluid product to be dispensed, so as to quickly and securely seal, yet readily and fully open when the user applies modest pressure to the container. In preferred embodiments, the valve includes a resiliently flexible connector sleeve which is configured to apply a torque to the valve head which assists in opening the orifice. The connector sleeve has sufficient flexibility that pressure increases in the interior of the container, such as those caused by thermal expansion, are offset by shifting the valve head on the connector sleeve, so as to alleviate excess pressure on the orifice. The connector sleeve is also configured to provide sufficient flexibility that any misalignment and/or distortion of the valve flange when attached to the associated container are not transmitted to the valve head, thereby permitting unhindered opening and closing of the orifice. The connector sleeve is also configured to provide sufficient flexibility that shock impact forces, and the like applied to the container are absorbed by shifting the valve head on the connector sleeve, so as to avoid inadvertent opening of the valve orifice. The valve is configured to provide a generally constant flow rate therethrough, even when exposed to a relatively wide range of container pressures. For those products wherein a substantial amount of material is typically dispensed per application, the valve is configured such that once the orifice is shifted open, the amount of pressure required to maintain fluid flow through the orifice is reduced, so as to provide greater ease of operation, without sacrificing secure sealing of the valve. The valve is extremely versatile, and may be used in either top, bottom or side dispensing packages to accommodate a wide variety of different applications. The valve is very durable, while having reduced manufacturing costs, and an uncomplicated design. design. The overall package is efficient in use, economical to manufacture, capable of a long operating life, and particularly well adapted for many different proposed uses.

[0022] These and other advantages of the invention will be further understood and appreciated by those skilled in the art by reference to the following written specification, claims and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. **1** is a perspective view of a dispensing package embodying the present invention, wherein a portion thereof has been broken away to reveal a self-sealing valve mounted in a bottom portion of an associated container.

[0024] FIG. **2** is a side elevational view of the dispensing package, wherein a portion thereof has been broken away to reveal the valve, which is shown in a fully retracted and fully closed position.

[0025] FIG. **3** is a side elevational view of the dispensing package, wherein a portion thereof has been broken away to reveal the valve, which is shown in a fully extended and fully open position.

[0026] FIG. **4** is an enlarged, fragmentary top view of the valve.

[0027] FIG. **5** is an enlarged, side elevational view of the valve.

[0028] FIG. **6** is an enlarged, cross-sectional view of the valve.

[0029] FIG. **7** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in the fully closed and fully retracted position.

[0030] FIG. **8** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed, and partially retracted position.

[0031] FIG. **9** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed and partially extended position.

[0032] FIG. **10** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed and fully extended position.

[0033] FIG. **11** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed and fully extended position, wherein a valve head portion thereof is shown beginning to snap outwardly.

[0034] FIG. **12** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed, and fully extended position, wherein the valve head portion of which is shown continuing to snap outwardly.

[0035] FIG. **13** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully open, and fully extended position, wherein the valve head portion of which is shown snapped fully outwardly.

[0036] FIG. **14** is an enlarged, bottom plan view of the valve shown in the position illustrated in FIG. **13**.

[0037] FIG. **15** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed, and partially extended position abutting a container closure.

[0038] FIG. **16** is an enlarged, cross-sectional view of the valve installed in an associated container, with the valve shown in a fully closed and fully extended position abutting an alternative container closure.

[0039] FIG. **17** is an enlarged, fragmentary top plan view of another dispensing valve embodying the present invention.

[0040] FIG. **18** is an enlarged, fragmentary bottom plan view of the valve shown in FIG. **17**.

[0041] FIG. **19** is an enlarged, cross-sectional view of the valve shown in FIGS. **17-18**.

[0042] FIG. **20** is an enlarged, vertical cross-sectional view of the valve shown in FIGS. **17-19** installed in an associated top dispense container, with the container in a fully upright orientation, and the valve in a fully closed position.

[0043] FIG. **21** is an enlarged, vertical cross-sectional view of the valve and associated top dispense container shown in FIG. **20**, with the container shown in an inverted orientation, and the valve in its fully closed position.

[0044] FIG. **22** is an enlarged, cross-sectional view of the valve and associated top dispense container shown in FIGS. **20-21**, with the container in the inverted orientation, and the valve in a closed, partially extended position, wherein a valve head portion is shown beginning to snap outwardly.

[0045] FIG. **23** is an enlarged, cross-sectional view of the valve and associated top dispense container shown in FIGS. **20-22**, with the container in the inverted orientation, and the valve in a fully open, and fully extended position, wherein the valve head. portion is shown snapped fully outwardly.

[0046] FIG. **24** is an enlarged, cross-sectional view of yet another valve embodying the present invention.

[0047] FIG. **25** is an enlarged, cross-sectional view of yet another valve embodying

[0048] FIG. **26** is an enlarged, cross-sectional view of yet another valve embodying the present invention.

[0049] FIG. **27** is an enlarged, cross-sectional view of yet another valve embodying the present invention.

[0050] FIG. **28** is an enlarged, fragmentary, bottom plan view of yet another valve embodying the present invention.

[0051] FIG. **29** is an enlarged, cross-sectional view of the valve shown in FIG. **28**.

[0052] FIG. **30** is an enlarged, cross-sectional view of yet another valve embodying the present invention.

[0053] FIG. **31** is an enlarged, cross-sectional view of yet another valve embodying the present invention.

[0054] FIG. **32** is an enlarged, cross-sectional view of yet another valve embodying the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0055] For purposes of description herein, the terms "upper", "lower", "right", "left", "rear", "front", "vertical", "horizontal", and derivatives thereof shall relate to the invention as oriented in FIGS. **1-3**. However, it is to be understood that the invention may assume various alterna-

tive orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise. considered as limiting, unless the claims expressly state otherwise.

[0056] The reference numeral **1** (FIG. **1**) generally designates a dispensing package embodying the present invention. Dispensing package **1** is particularly adapted for dispensing fluid products, such as liquid soaps, household cleaners, polishes, moisturizing creams, foodstuffs, and the like, and includes a container **2** with a self-sealing dispensing valve **3** mounted therein. Valve **3** includes a marginal flange **4**, a valve head **5** with a discharge orifice **6** therein, and a connector sleeve **7**, having one end connected with valve flange **4**, and the opposite end connected with valve head S adjacent a marginal edge thereof. Connector sleeve **7** has a resiliently flexible construction, such that when pressure within container **2** is raised above a predetermined amount, valve head **5** shifts outwardly (FIGS. **8-15**) in a manner which causes connector sleeve **7** to double over and then extend rollingly.

[0057] The container **2** illustrated in FIGS. **1-3** is particularly designed for bottom dispensing, and includes a generally flexible, oblong container body **12** supported on a substantially rigid base **13**. Container body **12** is preferably integrally molded from an appropriate synthetic resin material or the like, so as to create a one-piece construction that includes oppositely oriented sidewalls **14** and **15**, a top **16** and a bottom **17**. The container sidewalls **14** and **15** are laterally flexible to pressurize and depressurize the interior of container **2**, and preferably have sufficient resilience or stiffness that they automatically return to their original shape upon release of any external forces which are applied to container **2** to dispense a fluid product **18** therefrom.

[0058] The container bottom **17** illustrated in FIGS. **2** and **3** includes a downwardly opening neck **20**, which defines a discharge opening **21** about which the marginal flange **4** of valve **3** is positioned. As best illustrated in FIGS. **7** and **8**, the free end of neck **20** includes an annularly shaped groove **22** having a general L-shaped longitudinal cross-sectional configuration, which is shaped to closely receive the marginal flange **4** of valve **3** therein. Container base **13** includes a valve retainer ring **23** positioned adjacent groove **22**, and attached to container body **12** by a snap lock arrangement **24**. Container base **13** (FIGS. **2** & **3**) has a substantially flat bottom **25** adapted to abuttingly support dispensing package **1** on an associated surface, such as a countertop, sink, worksurface, or the like. Neck groove **22** is located inwardly of the bottom **25** of container base **13**, so as to position valve **3** in a generally recessed condition within dispensing package **1**, as explained in greater detail hereinafter.

[0059] With reference to FIGS. **4-6**, the illustrated self-sealing dispensing valve **3** has an integrally formed, one-piece construction. Valve **3** has an interior -side which interfaces with the fluid product **18** in container **2**, and an oppositely oriented exterior side which interfaces with ambient environment. Valve **3** is preferably molded from a resiliently flexible material, and in the illustrated example comprises a silicone rubber which is substantially inert so as to avoid reaction with and/or adulteration of the fluid product being packaged. In one working embodiment of the present invention, valve **3** is produced at relatively high speeds through the molding of liquid silicone rubber.

[0060] The illustrated marginal flange portion **4** (FIGS. **4-6**) of valve **3** has an annular plan shape, and a substantially L-shaped cross-sectional configuration, comprising an inner edge **30**, an outer edge **31**, a bottom **32**, and a top **33** with an outer rim **34** upstanding therefrom. Marginal valve flange **4** has substantial thickness between the bottom **32** and top **33** which is resiliently compressed upon attachment of retainer ring **23** to form a secure leak-resistant seal therebetween. The rim portion **34** of valve flange **4** positively locks valve **3** in neck groove **22** to prevent any radial movement therebetween.

[0061] The illustrated head portion **5** (FIGS. **4-6**) of valve **3** has a circular plan shape, and a generally tapered construction which is thicker at the radially outside portion of valve head **5**, and thinner at the radially inside portion thereof. This tapered construction assists in achieving the snap open/snap close action of valve **3**, as described below. More specifically, in the illustrated example, valve head **5** has an exterior side or surface **38**, which has an arcuately shaped side elevational configuration which opens or curves outwardly, toward the exterior of dispensing package **1**, and is defined by a first, predetermined radius. Valve head exterior surface **38** extends continuously between the interior sidewalls of connector sleeve **7**. Valve head **5** also includes an interior side or surface **39**, which has a marginal portion **40** with an arcuately shaped side elevational configuration which opens or curves outwardly, toward the exterior of dispensing package **1**, and is defined by a second predetermined radius. The radius of marginal portion **40** on interior surface **39** is larger than that of exterior surface **38**, such that the two surfaces converge toward the center of valve head **5** at or adjoining orifice **6**, and provide the above-noted inwardly tapered construction of valve head **5**. The interior surface **39** of valve head **5** also includes a center portion **41**, which has a circular plan shape, with a substantially planar or flat side elevational configuration, oriented generally perpendicularly to discharge orifice **6**. The center portion **41** of valve head **5** assists in improving the opening and closing characteristic of valve **3**, as set forth below. The outer perimeter of valve head **5** is defined by a circular marginal edge **42**, which begins at the outer edge **43** of marginal portion **40**, and extends outwardly therefrom with a slight outward taper, ultimately merging into connector sleeve **7**. The intersection of the marginal portion **40** and the center portion **41** of valve head **5** defines a circular edge **44**. The outside diameter of valve head **5**, as measured along marginal edge **42** is substantially smaller than the inside diameter of marginal flange **4**, as measured along inner edge **30**. As explained in greater detail below, this spacing between valve head **5** and marginal flange **4** permits valve head **5** to shift freely in an axial direction through the center of marginal flange **4**.

[0062] The connector sleeve portion **7** illustrated in FIGS. **4-6** is in the form of a rolling diaphragm, having a hollow circular plan configuration, and a generally J-shaped longitudinal cross-sectional shape, comprising a cylindrical sidewall portion **45**, and a radially outwardly extending base

portion **46**. Connector sleeve **7** has interior and exterior surfaces **47** and **48** respectively, which are spaced equidistantly apart along the length thereof, such that connector sleeve **7** has a substantially uniform thickness. One end portion **49** of connector sleeve **7** is connected with the exterior surface **38** of valve head **5** adjacent the marginal edge **42** thereof, and the opposite end portion **50** of connector sleeve **7** is connected with the inner edge **30** of marginal valve flange **4**. The interior surface **47** of connector sleeve **7** adjacent end **49** is positioned substantially coplanar and contiguous with the marginal edge **42** of valve head **5**, while the opposite end **50** of connector sleeve **7** is connected with marginal valve flange **7** at a medial portion of inner edge **30**, such that the base portion **46** of connector sleeve **7** flares in a radially inwardly direction from marginal valve flange **46**, and also protrudes outwardly toward the exterior of dispensing package **1** at an arcuate portion **51** of connector sleeve **7**. The arcuately flared shape of connector sleeve portion **51** assists connector sleeve **7** in first doubling over, and then rollingly extending as valve head **5** shifts outwardly in the manner described in greater detail below. The marginal attachment point of end **49** of connector sleeve **7** to valve head **5**, as well as its associated geometry, increases the effectiveness of torque forces which assist in snapping valve **3** open, as discussed hereinafter. The exterior surface **48** of sleeve side wall **45** at end **49** of connector sleeve **7** intersects the exterior surface **38** of valve head **5** at an angle which defines a circular edge **52**. In the illustrated example, the exteriormost area of sleeve arcuate portion **51** is disposed substantially in-line with or slightly interior of the bottom **32** of marginal flange **4**, so as to facilitate fabrication. The length of connector sleeve **7** is preferably selected sufficiently short to prevent the same from folding in behind valve head **5** when valve head **5** is in the fully extended position (FIGS. **10-14**), thereby avoiding interference with the retraction of valve head **5**, which is explained in detail below.

[**0063**] The illustrated one-piece valve **3** has a hat-shaped side elevational configuration in its original, normal condition, wherein valve head **5** assumes a generally concave shape. The resilient flexibility of connector sleeve **7** permits the same to double over and then extend rollingly in the manner described hereinafter. Connector sleeve **7** acts as a rolling diaphragm with valve head **5** mounted at the center thereof in a manner which permits valve head **5** to shift or float freely inwardly and outwardly in an axial direction with respect to the opening **21** in container neck **20**.

[**0064**] In the illustrated example, discharge orifice **6** (FIGS. **4-6**) has a cross-slit construction which includes two, intersecting linear slits **55** and **56** that extend through the opposite sides **38** and **39** of center portion **41**. The illustrated slits **55** and **56** are oriented in a mutually perpendicular relationship, and have their opposite ends **55***a* and **55***b* positioned slightly inwardly from the outer edge **44** of center portion **41**. Orifice slits **55** and **56** define four flaps or pedals **57** which flex inwardly and outwardly to selectively permit the flow of fluid product through valve **3**. Slits **55** and **56** are preferably formed by slicing through the center portion **41** of valve head **5**, without removing any substantial amount of material therefrom, so that the opposite side faces **58** and **59** (FIGS. **13** & **14**) of valve flaps **57** closely seal against one another when discharge orifice **6** is in its normally, fully closed position. The length and location of slits **55** and **56** can be adjusted to vary the predetermined opening and closing pressures of valve **3**, as well as other dispensing characteristics of dispensing package **1**. The side faces **58** and **59** of each valve flap **57** intersect at their free ends to define an end edge **60**. That portion of valve head **5** disposed between marginal portion **40**, marginal edge **42**, slit ends **55***a* and **55***b*, and exterior surface **38** defines a ring portion **61** of the valve head **5**, which functions in the manner described in detail hereinafter.

[**0065**] It is to be understood that orifice **6** may assume many different shapes, sizes and/or configurations in accordance with those dispensing characteristics desired. For example, orifice **6** may comprise a single slit, particularly when smaller or narrower streams are desired. Orifice **6** may also include three or more slits, particularly when larger or wider streams are desired, and/or the fluid product contains aggregates, such as some types of salad dressings, and the like. Other forms of orifice **6**, such as holes, duck bills, etc. may also be incorporated into valve **3**.

[**0066**] Self-sealing dispensing valve **3** is preferably especially configured for use in conjunction with a particular container **2**, and a specific type of fluid product, so as to achieve the exact dispensing characteristics desired. For example, the viscosity and density of the fluid product are both important factors in designing the specific configuration of valve **3**, as is the shape, size, and strength of container **2**, particularly when dispensing package **1** is configured for bottom dispensing. The rigidity and durometer of the valve material, and size and shape of both valve head **5** and connector sleeve **7** are also important in achieving the desire dispensing characteristics, and should be carefully matched with both the container **2** and fluid material **18** to be dispensed therefrom.

[**0067**] One working embodiment of the present invention is particularly designed to dispense fluid household products therefrom, such as dishwasher detergents, liquid soap, moisturizing creams, foodstuffs, and the like. When such fluid product materials are to be dispensed from a blow molded, polypropylene container with valve **3** positioned at the bottom **4** thereof for bottom dispensing, one specific valve **3** found to be particularly suited is as follows. The outside and inside diameters of marginal valve flange **4** are 0.7000 and 0.5802 inches respectively, while the outside diameter of the marginal edge **42** of valve head **5** is 0.4391 inches, and the outside diameter of center portion **41** is around 0.2212 inches. The thickness of connector sleeve **7** is approximately 0.0130 inches, and has an overall height, as measured from the bottom **32** of marginal flange **4** to the edge **52** of valve head **5**, of 0.1159 inches. The radius of valve head exterior surface **38** is 0.2900 inches, while the radius of the marginal portion **40** of interior surface **39** is 0.0350 inches. Hence, the total thickness of valve head **5** at marginal edge **42** is around 0.0778 inches and around 0.0530 inches at the middle of center portion **41**. The overall height of valve **3**, as measured from the bottom **32** of marginal flange **4** to the top of center portion **41** is approximately 0.2402 inches. Slits **55** and **56** have a length of around 0.2200 inches, and are centered squarely in valve center portion **41**. The valve is molded integrally from a liquid silicone rubber of the type manufactured under the trademark "SILASTIC LSR" by Dow Corning Corporation.

[**0068**] Experimental tests conducted on valves having the above-identified specific dimensions and characteristics

indicate that valve **3** snaps open when exposed to a pressure inside container **2** equal to approximately 25-28 inches of water. That pressure which causes valve **3** to snap open is generally referred to herein as the predetermined dispensing or opening pressure. Valve **3** will automatically snap closed when the interior pressure of container **2** drops below a pressure equal to approximately 16-18 inches of water. That pressure which causes valve **3** to snap closed is generally referred to herein as the predetermined. closing pressure. While the noted valve **3** is open, a substantially constant flow or stream of fluid product is discharged through orifice **6**, even when extra pressure is exerted on container **2**.

[**0069**] It is to be understood that according to the present invention, valve **3** may assume many different shapes and sizes, particularly in keeping with the type of container **2** and fluid product to be dispensed therefrom. The predetermined opening and closing pressures of valve **3** may be varied widely in accordance with those dispensing criteria desired for a particular product. Flow characteristics of the dispensed fluid product can also be adjusted substantially, such as for relatively wide column-like streams, thin needle-like streams, dollops, and the like.

[**0070**] In operation, dispensing package **1** functions in the following manner. Valve **3** normally assumes the inwardly protruding orientation illustrated in FIG. **7**, wherein valve **3** remains substantially in its original molded shape without deformation, with connector sleeve **7** being fully retracted and discharge opening **6** being fully closed. When valve **3** is mounted in the bottom of container **2**, as is shown in the illustrated bottom dispensing package **1**, valve **3** is configured such that discharge orifice **6** will remain securely closed, even under the hydraulic head pressure applied thereto by the fluid product **18** when the container **2** is completely full.

[**0071**] When additional pressure is communicated with the interior of container **2**, such as by manually flexing container sidewalls **14** and **15** inwardly, connector sleeve **7** functions as a rolling diaphragm, and permits valve head **5** to begin shifting axially outwardly toward the exterior of dispensing package **1** by doubling over connector sleeve **7**, which then in turn, begins to extend outwardly in a rolling fashion, as illustrated in FIG. **8**. The outwardly protruding J-shaped configuration of connector sleeve **7** assists in initiating this rolling motion of connector sleeve **7**. The elastic deformation of connector sleeve **7** from its original molded shape (FIG. **7**), generates a complex pattern of stresses within valve **3** which resiliently urges the same back into its original or normal configuration, which forces include an outwardly directed torque applied by connector sleeve **7** to valve head **5** adjacent marginal edge **42**, which tends to resiliently urge discharge orifice **6** toward its open position, as described in greater detail below.

[**0072**] When additional pressure is communicated with the interior of container **2**, as illustrated in FIG. **9**, valve head **5** continues to shift axially outwardly by rolling connector sleeve **7** over upon itself. The marginal edge **42** of valve head **5** passes through the center of marginal valve flange **4**.

[**0073**] When additional pressure is communicated with the interior of container **2**, valve head **5** continues to extend outwardly toward the exterior of dispensing package **1** until connector sleeve **7** is fully extended, as illustrated in FIG. **10**. When valve heads are in the fully extended position (FIG. **10**), the stress forces built up in connector sleeve **7** cause the sidewall portion **45** of the connector sleeve **7** to assume a generally cylindrical shape concentric with and about the marginal edge **42** of valve head **5**. Sidewall **45** of connector sleeve **7** is folded back 180 degrees from its original molded shape, to an orientation parallel with the marginal edge **42** of valve head **5**, and defines an exterior lip or rim **65**.

[**0074**] When additional pressure is communicated with the interior of container **2**, as illustrated in FIG. **11**, valve head **5** continues to shift outwardly. However, since connector sleeve **7** is fully extended, further outward shifting of valve head **5** longitudinally tenses or stretches connector sleeve **7**, thereby increasing the outwardly directed torque applied to the valve head **5**. Also, the further outward movement of valve head **5** tends to flatten or straighten valve head **5**, particularly along the exterior surface **38** thereof, as best illustrated in FIG. **11**. This flattening motion tends to enlarge or dilate the circular plan configuration of valve head **5**, which enlargement is in turn resisted by radially inwardly directed forces applied to the marginal edge **42** of valve head **5** by connector sleeve **7**, thereby generating another complex pattern of stresses within valve **3**, which forces include those which tend to compress valve head **5** in a radially inward direction. Due to the tapered shape of valve head **5**, the majority of compression strain is believed to take place adjacent the center portion **41** of valve head **5**. As best illustrated by a comparison of the broken line figure and the full line figure provided in FIG. **11**, when connector sleeve **7** is in the fully extended position, as shown in the broken lines, and additional pressure is communicated with the interior side **39** of valve **3**, exterior rim **65** moves axially outwardly and radially outwardly as shown in the full lines of FIG. **11**. The marginal edge **42** of valve head **5** is shown bent or elastically deformed inwardly as a consequence of the torque forces applied thereto by: connector sleeve **7**.

[**0075**] When additional pressure is communicated with the interior of container **2**, as illustrated in FIG. **12**, valve head **5** continues to shift outwardly by further longitudinal stretching of connector sleeve **7**, and further enlargement of the plan shape of valve head **5**. This motion is best illustrated by a comparison of the broken line figure and the full line figure provided in FIG. **12**. Exterior rim **65** moves from the condition illustrated in FIG. **11**, which corresponds to the broken line figure of FIG. **12**, in an axially outwardly and radially outwardly fashion to the position shown in the full lines of FIG. **12**. The marginal edge **42** of valve head **5** is shown more bent or elastically deformed inwardly, as a consequence of the increased torque forces applied thereto by connector sleeve **7**. These combined forces and motions also serve to further compress valve head **5** into a state of bifurcation, as illustrated in FIG. **12**, wherein the combined forces acting on valve head **5** will, upon application of any additional outward force on the interior side **39** of valve **3**, cause the same to quickly open outwardly with a snapping motion to separate valve flaps **57** in the manner illustrated in FIGS. **13** and **14**, and thereby dispense liquid product through discharge orifice **6**. The bifurcation state of valve **3**, as the term is used herein, is illustrated in FIG. **12**, and defines a relatively unstable condition which valve **3** assumes immediately prior to opening into the fully open condition shown in FIGS. **13** and **14**. As valve **3** passes through the bifurcation state shown in FIG. **12**, the combined forces acting on valve head **5** are in a very temporary,

unstable condition of equilibrium for a given moment, and then quickly shift valve head **5** into a generally convex shape, simultaneously opening orifice **6**. In the bifurcation state shown by the full lines in FIG. **12**, valve head **5** assumes the shape of a nearly planar disc, with exterior surface **38** cupped inwardly between rim **65** and flap edges **60**, and interior surface **39** bent slightly outwardly toward the center of orifice **6**.

[**0076**] The snap type opening of valve **3** is achieved, at least in part, by the torque exerted on valve head **5** by connector sleeve **7**, which as noted in the example illustrated in FIG. **12**, is sufficient to substantially distort the shape of the marginal edge **42** of valve head **5**. When valve **3** assumes the fully extended and fully open position illustrated in FIGS. **13** and **14**, valve flaps **57**, as well as the associated rim portion **61** of valve head **5** are bent or elastically deformed outwardly, thereby permitting the rim **65** of valve head **5** to become smaller or constrict slightly. Valve flaps **57** tend to fold openly along lines extending between the ends **55***a* and **55***b* or orifice slits **55** and **56**. The continued radial inwardly compression applied to valve head **5** by connector sleeve **7**, in addition to the outwardly oriented torque applied thereto by connector sleeve **7**, combine to keep discharge orifice **6** in the fully open position, even if the pressure communicated with the interior of container **2** is reduced. Hence, after discharge orifice **6** has been opened through the application of the predetermined opening pressure, that pressure which is required to maintain fluid flow through orifice **6** is reduced, or less than the threshold pressure, so as to provide greater dispensing ease and flow control. Since the resiliency of connector sleeve **7** serves to resist the dilating action of valve head **5**, and thereby compresses the same to achieve a snap open/snap close motion, if the resiliency of connector sleeve **7** is varied somewhat, such as by making connector sleeve **7** thicker or thinner, the amount or degree of snap action can be thereby adjusted for any specific application. Similarly the resilient strength of ring **61** can be adjusted to accomplish the desired snap action.

[**0077**] The combined compressive and torque forces acting on valve head **5** by connector sleeve **7** open valve flaps **57** to a generally predetermined configuration, such that the rate of flow through discharge orifice **6** remains substantially constant, even though significant pressure differences are applied to container **2**. As best illustrated in FIGS. **13** and **14**, after valve **3** passes through the bifurcation state shown in FIG. **12**, in the direction of opening, it quickly and positively assumes the fully open condition shown in FIGS. **13** and **14**, wherein the end edges **60** of valve flaps **57** diverge radially outwardly, such that discharge opening **6** assumes a star shaped plan configuration, as best seen in FIG. **14**. The marginal edge **42** of valve head **5** rotates or pivots inwardly somewhat under the pressure of fluid product **18**, and the resilient torque applied thereto by connector sleeve **5**, which continues to resiliently urge valve **3** back toward its original molded shape (FIG. **7**). Connector sleeve **7** remains tensed both axially and circumferentially under outwardly directed forces generated by the pressures within container **2**, as well as the dynamic flow of fluid product through orifice **6**. The geometry of the illustrated valve **3**, particularly in the shape of valve head **5** and connector sleeve **7**, serve to force valve **3** into the configuration shown in FIGS. **13** and **14** whenever orifice **6** is snapped opened.

[**0078**] When pressure within the interior of container **2** is reduced, discharge orifice **6** will still remain open in substantially the fully open position shown in FIGS. **13** and **14**, until the pressure reaches the preselected closure pressure, at which point, the forces developed in connector sleeve **7** through elastic deformation from its original molded shape (FIG. **7**), pull valve head **5** inwardly, back through the bifurcation state, and into the concave orientation shown in FIG. **10**, thereby positively and securely closing discharge orifice **6** with a snapping action, similar to that action by which discharge orifice **6** opened. The snap closing motion of valve head **5** serves to close orifice **6** very quickly and very completely, so as to sharply cut off the stream of fluid product being dispensed from package **1** without any drops or dribbles, even when very viscous and/or dense products are being dispensed. Valve **3** will continue to assume the fully closed, fully extended position illustrated in FIG. **10**, until such time as the interior pressure in container **6** is further reduced, so as to permit the resiliency in connector sleeve **7** to shift valve head **5** back into the fully retracted, initial position illustrated in FIG. **7**.

[**0079**] At least some of those valves **3** contemplated by the present invention have a relatively high predetermined closing pressure, such as in the nature of 17-18 inches of water, so that orifice **6** will snap securely closed even if container **2** does not provide any suck back, or negative pressure. Furthermore, the connector sleeve **7** of at least some such valves **3** is constructed to provide sufficient resiliency to automatically shift valve head **5** back to the fully retracted position (FIG. **7**) without any suck back or negative pressure from container **2**. Hence, valves **3** can be readily adapted for use in conjunction with containers which include collapsing bags, tubes or the like. Also, valves **3** are particularly adapted for bottom dispensing packages, such as those illustrated in FIGS. **1-3**, where valve **3** normally supports a column of liquid product.

[**0080**] In many embodiments of dispensing package **1**, container **2** will be designed with relatively stiff sidewalls **14** and **15** which resume their original shape after being squeezed. In such embodiments, the suck back of air into container **2** after dispensing fluid product therefrom is typically desired to prevent collapsing the container **2**, and thereby facilitate continued ease of dispensing until container **2** is completely empty. When valve **3** is in the fully closed and fully retracted position (FIG. **9**), the concave configuration of valve head **5** permits orifice **6** to readily open inwardly so that air can be sucked back into the interior of container **2**, yet positively prevents orifice **6** from opening outwardly in a manner which would permit leakage. Hence, even relatively weak, thin walled containers **2** can be used with valve **3** without significant. collapsing of container sidewalls **14** and **15**.

[**0081**] With reference to FIG. **15**, dispensing package **1** may be provided with a positive closure arrangement to prevent inadvertent discharge when dispensing package **1** is being transported, or the like, such as for initial shipping, travel, etc. The dispensing package **1** shown in FIG. **15** includes a sliding closure **70**, which when closed, physically blocks the outward rolling extension of connector sleeve **7** and associated valve head **5**. By constraining the outwardly extending motion of connector sleeve **7**, valve head **5** is prevented from inverting into a convex configuration, and thereby keeps discharge orifice **6** fully closed. When closure

70 is slid sideways out from underneath valve 3, valve 3 is then free to reciprocate and open orifice 6 to dispense liquid product from container 2.

[0082] FIG. 16 is a partially schematic view of an alternative closure arrangement for dispensing package 1, wherein a removable cap 71 is provided for detachable connection with retainer ring 23 by conventional fastener means, such as a snap lock, hinge, etc. (not shown). The illustrated cap 71 has a generally flat exterior surface 72, an interior surface 73, and a cylindrical sidewall 74, which is sized and shaped such that interior cap surface 73 abuts the rim 65 of valve 3 when valve head 5 is in its fully extended position. The central portion of cap interior surface 73 includes an inwardly projecting protuberance 75, which in the illustrated example, is generally in the form of a convex, semi-spherical node that extends inwardly toward valve 3 to a position adjacent to the cupped exterior surface 38 of valve 3. Node 75 is shaped to positively retain valve head 5 in a concave configuration, and thereby securely maintain orifice 6 fully closed.

[0083] The reciprocating motion of valve head 5 on rolling connector sleeve 7 provides dispensing package 1 with several important advantages. For example, connector sleeve 7 is preferably configured with sufficient flexibility that abnormal pressure increases developed within the interior of container 2, such as those caused by thermal expansion, or the like, are offset by the axial shifting motion of valve head 5 with respect to connector sleeve 7, so as to alleviate excess pressure on discharge orifice 6. In this manner, if dispensing package 1 were used in conjunction with a liquid soap or shampoo that was designed for hanging in an inverted condition in a shower or bath, when ambient temperatures within the shower rise, instead of communicating the associated pressure increases directly to discharge orifice 6 in a manner which might cause it to inadvertently open, valve head 5 shifts axially outwardly to relieve any such pressure, and thereby prevent any inadvertent leakage of the fluid product from dispensing package 1.

[0084] Another example of the benefits achieved by the rolling diaphragm action of connector sleeve 7 and axial reciprocating motion of valve head 5, is that connector sleeve 7 is preferably configured with sufficient flexibility that any misalignment and/or distortion of the valve flange 4, such as that experienced when attaching the valve to container 2, are not transmitted to valve head 5, thereby permitting unhindered operation of discharge orifice 6. As previously noted, due to the inherently sticky nature of liquid silicone rubber, the attachment of valves constructed from the same to a container 2 can be quite difficult, and often results in some type of unequal compression and/or distortion of the marginal flange 4 of valve 3. Without the rolling diaphragm action of connector sleeve 7, any such distortion is communicated directly to the valve head 5, which in turn distorts discharge orifice 6, and alters important design characteristics such as its predetermined opening pressure, closing pressure, flow rate, etc. The rolling diaphragm connector sleeve 7 associated with the present valve 3 tends to insulate or isolate valve head 5 from marginal flange 7, such that it can float freely, and thereby avoid such problems.

[0085] Yet another example of the benefits achieved by this aspect of the present invention is that connector sleeve 7 is preferably configured with sufficient flexibility that vibrations, shock impact forces, and the like applied to container 2 are absorbed and/or dampened by shifting valve head 5 on rolling connector sleeve 7, so as to avoid inadvertent opening of discharge opening 6. In the event dispensing package 1 is dropped onto the floor, slammed forcefully against a worksurface, or otherwise jarred or shook, the shock forces arising from the acceleration and/or deceleration of the fluid product within container 2 would otherwise be communicated directly with the discharge orifice 6, and tend to cause it to open inadvertently. However, the rolling connector sleeve 7 action of valve 3 serves as a cushion or shock absorber for such shock impact forces, and thereby greatly alleviates the chance for the inadvertent discharge of fluid product from dispensing package 1. In a similar manner, when dispensing container 1 is used for non-homogenous fluids, such as some types of salad dressings, or the like, which are typically shook prior to use, connector sleeve 7 assists in absorbing these vibrations, and thereby prevent leakage.

[0086] Yet another example of the benefits achieved by this aspect of the present invention is that connector sleeve 7 is preferably configured with sufficient flexibility that only very moderate pressures, substantially lower than the predetermined opening pressure of valve 3, are required to shift valve head 5 from the fully retracted position (FIG. 7) to the fully extended position (FIG. 10), thereby improving the dispensing "feel" of the package 1. When the user grasps container 2,-even a very light squeeze on sidewalls 14 and 15 will rollingly extend connector sleeve 7 and valve head 5 to the fully extended and fully closed position shown in FIG. 10, at which point valve head 5 halts momentarily and further movement of the fluid product is resisted until additional forces are exerted on container 2 which result in an internal pressure within container 2 greater than the predetermined opening pressure of valve 3. This motion of connector sleeve 7 and valve head 5 is sensed by the user through touch or feel, typically in the form of a vibration or ripple experienced in container sidewalls 14 and 15 when valve head 5 reaches the fully extended position (FIG. 10). This ripple motion signals the user that valve head 5 is fully extended, and that further pressure will cause valve 3 to snap open and dispense fluid product. When valve 3 snaps open and snaps closed, similar vibrations or ripples are communicated to the user through container sidewalls 14 and 15 to assist in achieving accurate flow control.

[0087] In the illustrated examples of dispensing package 1, valve 3 is mounted within container 2 in a manner which causes valve head 5 to shift between the fully retracted position shown in FIG. 7 wherein valve 3 is disposed wholly within the interior of container 2 for safely storing valve 3, and the fully extended discharge position shown in FIGS. 13 and 14 wherein valve head 5 and associated orifice 6 are disposed wholly outside container 2 for neatly dispensing the fluid product therethrough. By shifting valve head 5 between these two extreme positions, valve 3 can remain normally unexposed and secure within the container 2 when not in use, without sacrificing neatness when dispensing. Also, valve 3 is preferably positioned in container 2 so that the arcuate portion 51 of connector sleeve 7 is disposed adjacent the bottom 25 of container base 13, so that if dispensing package is slammed down onto a surface, abutment between valve 3 and the surface will prevent valve 3

from shifting to the fully extended position, and thereby keep orifice **6** closed to prevent inadvertent leakage.

[**0088**] Dispensing package **1** is extremely versatile, being capable of easily and neatly dispensing a wide variety of fluid products. The self-sealing valve **3** is matched with both the container **2** and the type of liquid product **18** to be dispensed therefrom, so as to quickly and securely seal, yet readily open upon manipulation by the user, without requiring excess pressure or forces. The resiliently flexible connector sleeve **7**, which is configured to double over and extend rollingly, accommodates for thermal expansion within container **2**, absorbs shock impact forces to the container, accommodates for any misalignment and/or distortion which might be applied to the valve flange in attaching the same to the container, and provides a unique dispensing feel which greatly facilitates accurate dispensing. Valve **3** is configured so that when orifice **6** snaps open, a generally constant flow rate is established therethrough, even when container **2** is subjected to a relatively wide range of pressures. Valve **3** is also preferably configured such that once discharge orifice **6** is open, the amount of pressure required to maintain fluid flow is reduced, so as to provide greater ease of operation and control, without sacrificing secure sealing. Dispensing package **1** is particularly adapted for bottom dispensing configurations, shake containers, and other similar packaging concepts, without leakage.

[**0089**] The reference numeral la (FIGS. **20-23**) generally designates another dispensing package embodying the present invention, which is particularly adapted for dispensing product from the top of the associated container **2***a*. Since dispensing package **1***a* is similar to the previously described dispensing package **1**, similar parts appearing in FIGS. **1-16** and FIGS. **17-23** respectively are represented by the same, corresponding reference numeral, except for the suffix "a" in the numerals of the latter.

[**0090**] The illustrated container **2***a* (FIG. **20**) is particularly designed for top dispensing, and includes a generally flexible, oblong container body that may be integrally molded from an appropriate synthetic resin material or the like, so as to create a one-piece construction that includes oppositely oriented sidewalls **14***a* and **15***a*, a top **16***a*, and a bottom **17***a*. The container sidewalls **14***a* and **15***a* are laterally flexible to pressurize and depressurize the interior of container **2***a*, and preferably have sufficient resiliency or stiffness that they automatically return to their original shape upon release of any external forces which are applied to container **2***a* to dispense a fluid product **18***a* therefrom.

[**0091**] The illustrated container top **16***a* (FIGS. **20-21**) includes a neck **20***a*, which is normally in an upwardly opening orientation when not dispensing, and defines a discharge opening **21***a* about which the marginal portion **4***a* of dispensing valve **3***a* is positioned. The free end of neck **20***a* includes an annularly shaped groove **22***a* having a generally L-shaped longitudinal, cross-sectional configuration, which is shaped to closely receive the marginal portion **4***a* of valve **3***a* therein. A valve retainer ring **23***a* is positioned adjacent groove **22***a*, and is attached to the neck **20***a* of container **2***a* by a snap lock arrangement. Container base **17***a* has a substantially flat, annularly shaped outer bottom **25***a* adapted to abuttingly support dispensing package **1***a* upright on an associated surface, such as a countertop, sink, worksurface, or the like. In the dispensing package **1***a* shown in FIGS. **20-23**, dispensing valve **3***a* is positioned in a generally extended condition within dispensing package **2***a*, as opposed to the generally recessed condition of valve **3** in dispensing package **1** (FIGS. **1-17**), as described hereinabove.

[**0092**] With reference to FIGS. **17-19**, the illustrated dispensing valve **3***a* is generally similar to previously described dispensing valve **3**, and comprising a marginal portion **4***a*, a head portion **5***a* with a discharge orifice **6***a* therein, and a connector sleeve **7***a*, having one end connected with marginal portion **4***a*, and the opposite end connected with head portion **5***a*. Connector sleeve **7***a* has a resiliently flexible construction, such that when pressure within container **2***a* is raised above a predetermined amount, the head portion **5***a* of valve **3***a* shifts outwardly as shown in FIGS. **22** and **23**, so as to dispense fluid product **18***a* therefrom. In contrast to the previously described dispensing valve **1** (FIGS. **1-17**), the connector sleeve **7***a* of dispensing valve **3***a* does not double over and extend rollingly, but simply shifts outwardly to apply opening forces to valve head **5***a* in a manner which causes orifice **6***a* to snap open, as described in greater detailed hereinafter.

[**0093**] The flange or marginal portion **4***a* (FIGS. **17-19**) of the illustrated dispensing valve **3***a* has an annular shape, with a substantially triangular cross-sectional configuration, comprising an upper edge **30***a*, an outer edge **31***a*, and a bottom edge **32***a*. The marginal portion **4***a* of valve **3***a* has a thickness between top and bottom edges **30***a* and **32***a* which is resiliently compressed upon attachment of retainer ring **23***a* to form a secure leak resistant seal therebetween.

[**0094**] The head portion **5***a* (FIGS. **17-19**) of the illustrated dispensing valve **3***a* has a circular plan shape, and a generally tapered construction which is thicker at the radial outside portion of valve head **5***a*, and thinner at the radial inside portion thereof. This tapered construction assists in achieving the snap open/snap close action of valve **3***a*, as described below. More specifically, in the illustrated example, valve head **5***a* has an exterior side or surface **38***a*, which has an arcuately shaped side elevational configuration that opens outwardly, toward ambient environment, and is defined by a first predetermined radius. Valve head exterior surface **38***a* extends continuously between the exterior sidewalls of connector sleeve **7***a*. Valve head **5***a* also includes an interior side or surface **39***a*, which has a marginal portion **40***a* with an arcuately shaped side elevational configuration which curves inwardly, toward the interior of dispensing package **1***a*, and is defined by a second predetermined radius. The radius of marginal portion **40***a* on interior surface **39***a* is larger than that of exterior surface **38***a*, such that the two surfaces converge toward the center of valve head **5***a* at or adjoining orifice **6***a*, and provide the above-noted inwardly tapered construction of valve head **5***a*. The interior surface **39***a* of valve head **5***a* also includes a center portion **41***a*, which has a circular plan shape, with a substantially planar or flat side elevational configuration, oriented generally perpendicularly to discharge orifice **6***a*. The center portion **41***a* of valve head **5***a* assists in improving the opening and closing characteristics of valve **3***a*, as set forth below. Valve head **5***a* has a circular marginal edge **42***a*, which begins at the outer edge **43***a* of marginal portion **40***a*, and extends outwardly therefrom with a slight taper, ultimately merging into connector sleeve **7***a*. Marginal edge **42***a* of valve head **5***a* is spaced radially inwardly of the adjacent

upper portion of connector sleeve **7***a*. The inner section of marginal portion **40***a* and center portion **41***a* of head portion **5***a* define a circular edge **44***a*.

[**0095**] The connector sleeve portion **7***a* of the illustrated dispensing valve **3***a* has a generally J-shaped longitudinal cross-sectional shape, comprising an annular base portion in the form of a first leg portion **46***a*, and a radially inwardly cylindrical sidewall portion in the form of a second leg portion **45***a*. Connector sleeve **7***a* has interior and exterior surfaces **47***a* and **48***a* respectively, which are spaced equidistantly apart along the length thereof, such that connector sleeve **7***a* has a substantially uniform thickness. One end **49***a* of connector sleeve **7***a* is connected with the head portion **5***a* of valve **3***a*, and the opposite end **50***a* of connector sleeve **7***a* is connected with the marginal portion **4***a* of valve **3***a*. The first and second leg portions **46***a* and **45***a* of connector sleeve **7***a* are mutually oriented at an acute included angle, as measured between the exterior surfaces of connector sleeve legs **46***a* and **45***a*, and noted by the Greek letter theta (".theta.") in FIG. **19**. The connector sleeve leg portions **46***a* and **45***a* join one another at an arcuate portion **51***a*, which facilitates movement of the head portion **5***a* of valve **3***a* when dispensing product from the container **2***a*.

[**0096**] In the example illustrated in FIGS. **17-19**, the first leg portion **46***a* of connector sleeve **7***a* is shorter than the second leg portion **45***a*, and the included angle between them is in the range of 65-85 degrees. Also, the first leg portion **46***a* of connector sleeve **7***a* is oriented at an acute angle relative to the axial centerline of the head portion **5***a*, which extends through slit **56***a*. The outer edge **42***a* of valve **3***a* is generally flat, and oriented substantially parallel with the axial centerline of head portion **5***a*. The second leg portion **45***a* of connector sleeve **7***a* is oriented at an acute angle to the axial centerline of head portion **5***a*, at an angle in the range of 2-10 degrees.

[**0097**] The connector sleeve **7***a* of the illustrated dispensing valve **3***a* has an inverted J-shaped end portion **49***a* at the top of leg portion **46***a*, which extends arcuately into the head portion **5***a* of valve **3***a* to further facilitate movement of the head portion **5***a* when dispensing product from the container **3***a*. As previously noted, the outer edge **42***a* of valve head **5***a* is spaced apart from the inside surface of the upper end of connector leg **45***a*. This spacing between valve head **5***a* and connector sleeve **7***a* assists in applying torque to valve head **5***a* when dispensing product from the associated container in the manner described in detail thereinafter. The inverted J-shaped end portion **49***a* of connector sleeve leg portion **45***a* loops around approximately 180 degrees to attach to valve head portion **5***a* adjacent the outer margin of exterior surface **38***a*.

[**0098**] In operation, dispensing package **1***a* functions in the following manner. Valve **3***a* normally assumes the outwardly protruding orientation illustrated in FIG. **20**, wherein valve **3***a* remains substantially in its original molded shaped without deformation, with a major portion of connector sleeve **7***a* as well as head portion **5***a* protruding outwardly from snap ring **23***a*. When valve **3***a* is mounted in the top of container **2***a*, as shown in the illustrated top dispensing package **1***a*, valve **3***a* is not normally subjected to the hydraulic head pressure applied thereto by the fluid product **18***a*.

[**0099**] To dispense product **18***a* from package **1***a*, the user first inverts container **2***a* to the upside down orientation illustrated in FIGS. **21-23**. Preferably, discharge orifice **6***a* is positioned directly over or aligned with the location at which the fluid product **18***a* is to be dispensed. Additional pressure is then communicated with the interior of container **2***a*, such as by manually flexing container sidewalls **14***a* and **15***a* inwardly. Connector sleeve **7***a* permits the head portion **5***a* of valve **3***a* to begin shifting axially outwardly toward the exterior of dispensing package **1***a*, as illustrated in FIG. **22**. The J-shaped configuration of connector sleeve **7***a* assists in permitting the axial shifting of valve head portion **5***a*. The elastic deformation of connector sleeve **7***a* from its original molded shape generates a complex pattern of stresses within valve **3***a* which resiliently urges the same back into its original or normal configuration, which forces include an outwardly directed torque applied by connector sleeve **7***a* to head portion **5***a*, which tends to resiliently urge discharge opening **6** toward its open position.

[**0100**] When additional pressure is communicated with the interior of container **2***a*, the head portion **5***a* of valve **3***a* continues to shift outwardly by further longitudinal stretching of connector sleeve **7***a*, and further enlargement of the plan shape of valve head **5***a* to snap open to the fully open position illustrated in FIG. **23** in a manner similar to that described in detail hereinabove with respect to dispensing valve **1**. Since the upper end of the second leg portion **45***a* is attached to head portion **5***a* adjacent its outer surface **38**, a torque is applied to head portion **5***a* as the same shifts axially outwardly which tends to snap orifice **6***a* open. The inverted J-shaped portion **49***a* of second leg portion **45***a* assists in effectively applying these opening forces to valve head portion **5***a*.

[**0101**] The reference numerals **3***b* (FIG. **24**), **3***c* (FIG. **25**), **3***d* (FIG. **26**), **3***e* (FIG. **27**) and **3***f* (FIGS. **28-29**) generally designate additional alternate embodiments of the present invention, that have slightly different dispensing valve configurations. Since dispensing valves **3***b*-**3***f* are similar to the previously described dispensing valves **3** and **3***a*, similar parts appearing in FIGS. **1-23** and **24-29** respectively are represented by the same, corresponding reference numeral, except for the suffixes "b"-"f" respectively in the reference numerals of the later.

[**0102**] Dispensing valves **3***b*-**3***f* are each specifically designed for top dispense containers, similar to the previously described dispensing valve **3***a*, and operate in a similar manner. More specifically, dispensing valve **3***b* is similar to dispensing valve **3***a*, except that the interior head portion surface **40***b* of dispensing valve **3***b* is completely arcuate, and lacks the circular center portion **41***a* of dispensing valve **3***a*. The radius of interior valve head surface **40***b* is greater than that of the exterior valve head surface **38***b*, such that valve head **5***b* has a tapered configuration, which is thinner at discharge orifice **6***b*.

[**0103**] Dispensing valve **3***c* is similar to dispensing valve **3***b*, except that the opposite surfaces **40***c* and **38***c* of valve head **5***c* are parallel, and of the same radius, such that head portion **5***c* has a substantially uniform thickness. Dispensing valve **3***d* is similar to valve **3***c*, except that the upper end of connector sleeve **7***d* attaches directly to the associated head portion **5***d*, without the inverted J-shape **49***c* of valve **3***c*. Dispensing valve **3***e* is similar to valve **3***a*, except that the upper end of connector sleeve **7***e* attaches directly to head portion **5***e*, without the inverted J-shape **49***a* of valve **3***a*.

Dispensing valve **3***f* is similar to valve **3***a*, except that the interior surface **40***f* of head portion **5***f* has a square shape adjacent orifice **6***a*, instead of the circular shape **44***a* of valve **3***a*.

[**0104**] The reference numerals **3***g* (FIG. **30**), **3***h* (FIG. **31**) and **3***i* (FIG. **32**) generally designate additional alternate dispensing valves embodying the present invention. Since dispensing valves **3***g*-**3***i* are similar to the previously described dispensing valves **3**-**3***f*, similar parts appearing in FIGS. **30**-**32** are represented by the same, corresponding reference numeral, except for the suffixes "g"-"l" respectively in the reference numerals of the later. Dispensing valves **3***g*-**3***i* are each specifically designed for bottom dispense packaging, similar to valve **3**, and operate in a similar manner. More specifically, dispensing valve **3***g* is similar to previously described valve **3**, except that the opposite surfaces **38***g* and **40***g* of valve head **5***g* are frusto-conical, and taper to center circular areas **80** and **81** adjacent discharge orifice **6***g*. Dispensing valve **3***h* is similar to previously described dispensing valve **3***g*, except that the opposite surfaces **38***h* and **40***h* of head portion **5***h* intersect at discharge orifice **6***h*, such that they lack the circular areas **80** and **81** of dispensing valve **3***g*. Dispensing valve **3***i* is similar to previously described dispensing valve **3***h*, except that the exterior surface **40***i* of head portion **5***i* is flat and oriented generally perpendicular to the central axis of the valve **3***i*.

[**0105**] In the foregoing description, it will be readily appreciated by those skilled in the art that modifications may be made to the invention without departing from the concepts disclosed herein. Such modifications are to be considered as included in the following claims, unless these claims by their language expressly state otherwise.

1-**38**. (canceled)

39. A dispensing valve for fluid product packaging of the type having a container with a discharge opening therein, comprising:

a valve marginal portion;

a valve head portion including a central area with an orifice which is at least initially closed to preclude fluid flow therethrough and opens to permit fluid flow therethrough in response to a predetermined discharge pressure differential applied across the valve head portion;

a connector sleeve portion having a first end portion thereof connected with said valve marginal portion and an opposite end portion thereof connected with said valve head portion; and wherein

said connector sleeve portion comprises

(1) a first leg portion that defines (a) said first end portion of said connector sleeve portion which is connected to said valve marginal portion and (b) a second end portion, and

(2) a second leg portion that defines (a) a first end portion connected to said second end portion of said first leg portion and (b) said opposite end portion of said connector sleeve portion which is connected to said valve head portion; and wherein

said second leg portion of said connector sleeve portion is inclined radially inwardly from its first end portion at said second end portion of said first leg portion toward said connector sleeve opposite end portion at said valve head portion and extends axially outwardly to locate the entire valve head portion exterior of said valve marginal portion; and

said connector sleeve opposite end portion defined by said second leg portion includes a change of direction more toward said head portion than the rest of said second leg.

40. A dispensing valve as set forth in claim 39, wherein:

said first leg portion of said connector sleeve portion extends generally radially inwardly and is oriented to form an acute included angle with said second leg portion of said connector sleeve portion as measured between the exterior surfaces thereof.

41. A dispensing valve as set forth in claim 39, wherein:

said second leg portion of said connector sleeve portion is longer than said first leg portion of said connector sleeve portion.

42. A dispensing valve as set forth in claim 39, wherein:

said first and second leg portions of said connector sleeve portion are configured to define a generally J-shaped connector sleeve portion.

43. A dispensing valve as set forth in claim 39, wherein:

said second end portion of said second leg portion of said connector sleeve portion is connected to said valve head portion such that there is no open space between said connector sleeve portion and the periphery of said valve head portion.

44. A dispensing valve as set forth in claim, wherein:

said central area of said valve head portion is of substantially uniform thickness.

45. A dispensing valve as set forth in claim 39, wherein:

in said valve head portion outwardly beyond said central area, said valve head portion includes at least a certain outer portion having a greater thickness than the thickness of the central area of said valve head portion.

46. A discharge valve as set forth in claim 39, wherein:

said valve head portion has (1) an exterior surface which can interface with the external ambient environment, and (2) an interior surface which can interface with a fluid product;

said exterior surface has a generally concave shape when said orifice is in its closed position; and

said interior surface has a generally convex shape when said orifice is in its closed position.

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