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(54) **FORCIBLY SEALED DUCKBILL VALVE**

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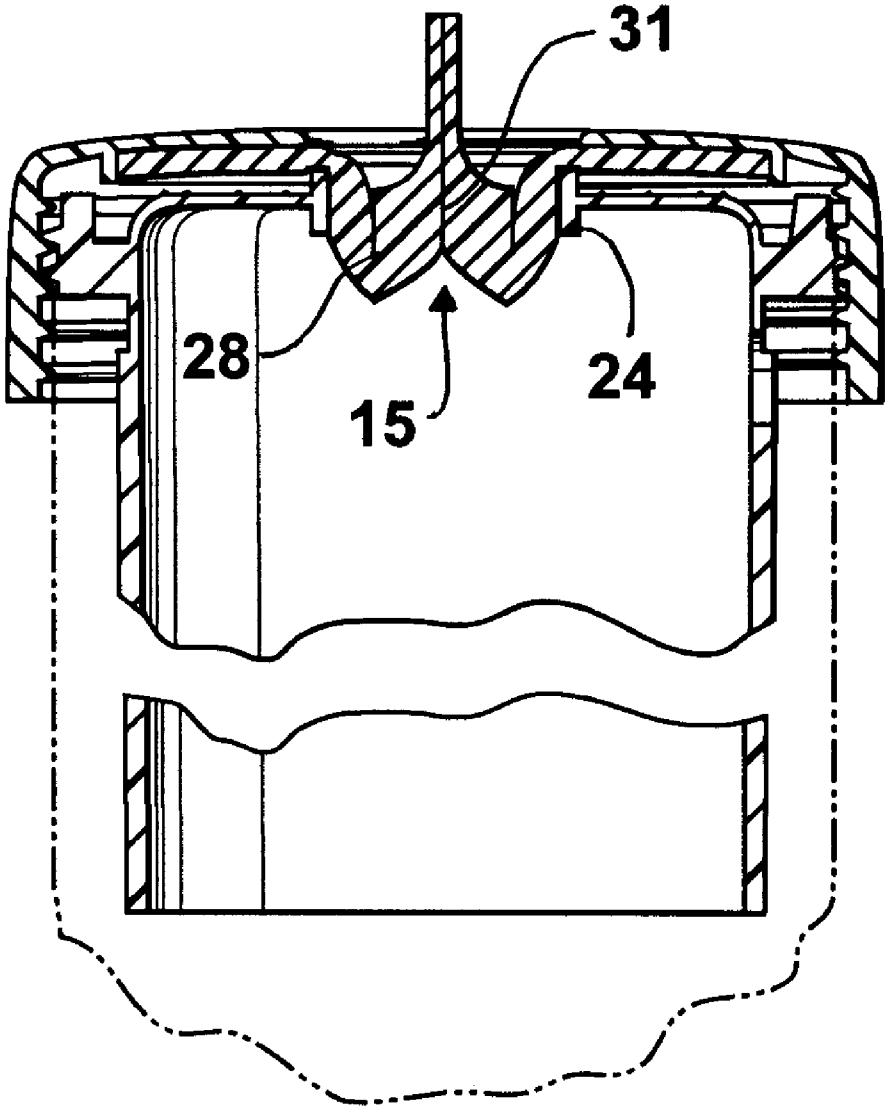
(57) **ABSTRACT**

A resilient invertible duckbill valve is constructed so that it may be pressed downwardly and folded inwardly upon itself to a stopper position of force-fit within a compression ring to apply a direct lateral compressive force between sealing elements of the valve. This provides additional sealing surface area and very high closing pressure which prevents leakage and a tightly sealed storage condition of a container is achieved when not in use. The valve is conveniently a unitary resilient valve member which is supported by a rigid baseplate that includes an aperture in the center which forms a compression ring around the body of the valve. Both the baseplate and the valve member are releasably held between a threaded cap and top rim of the container.



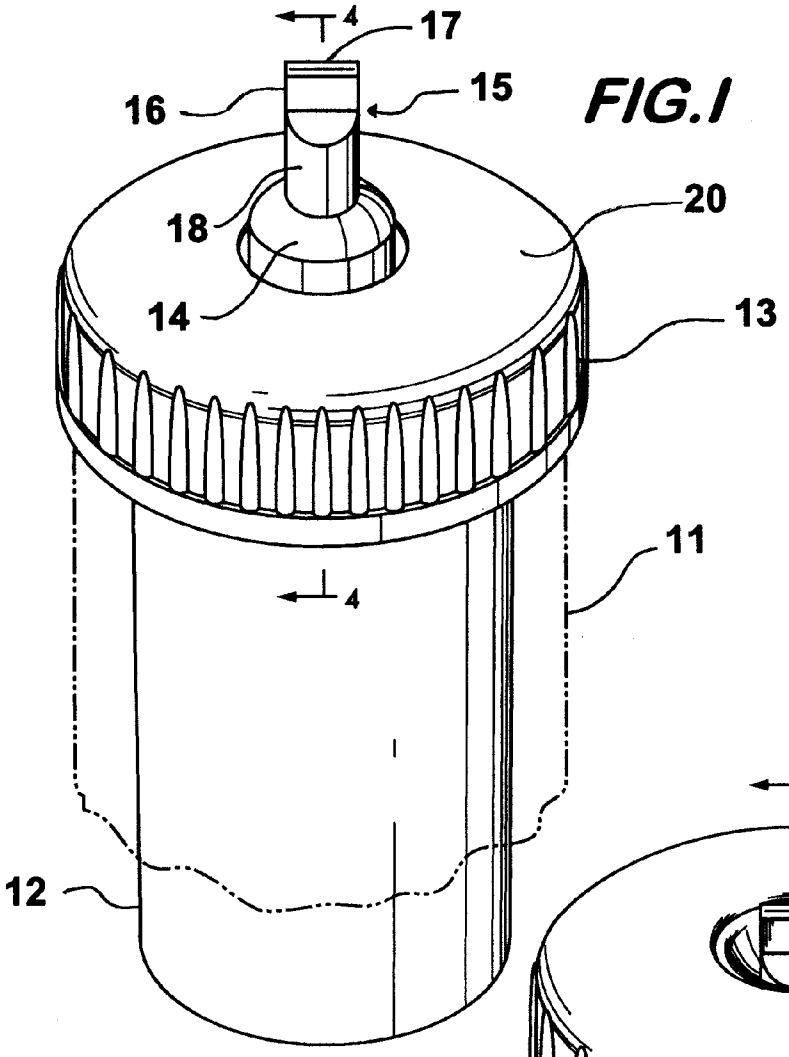


FIG.1

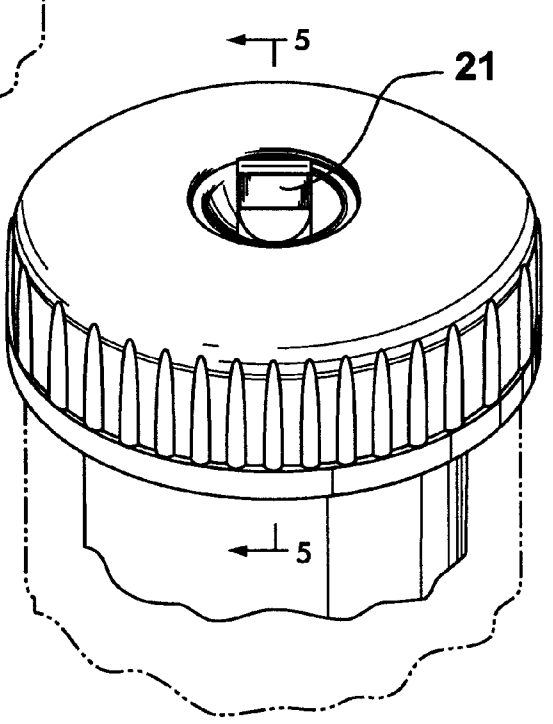


FIG.2

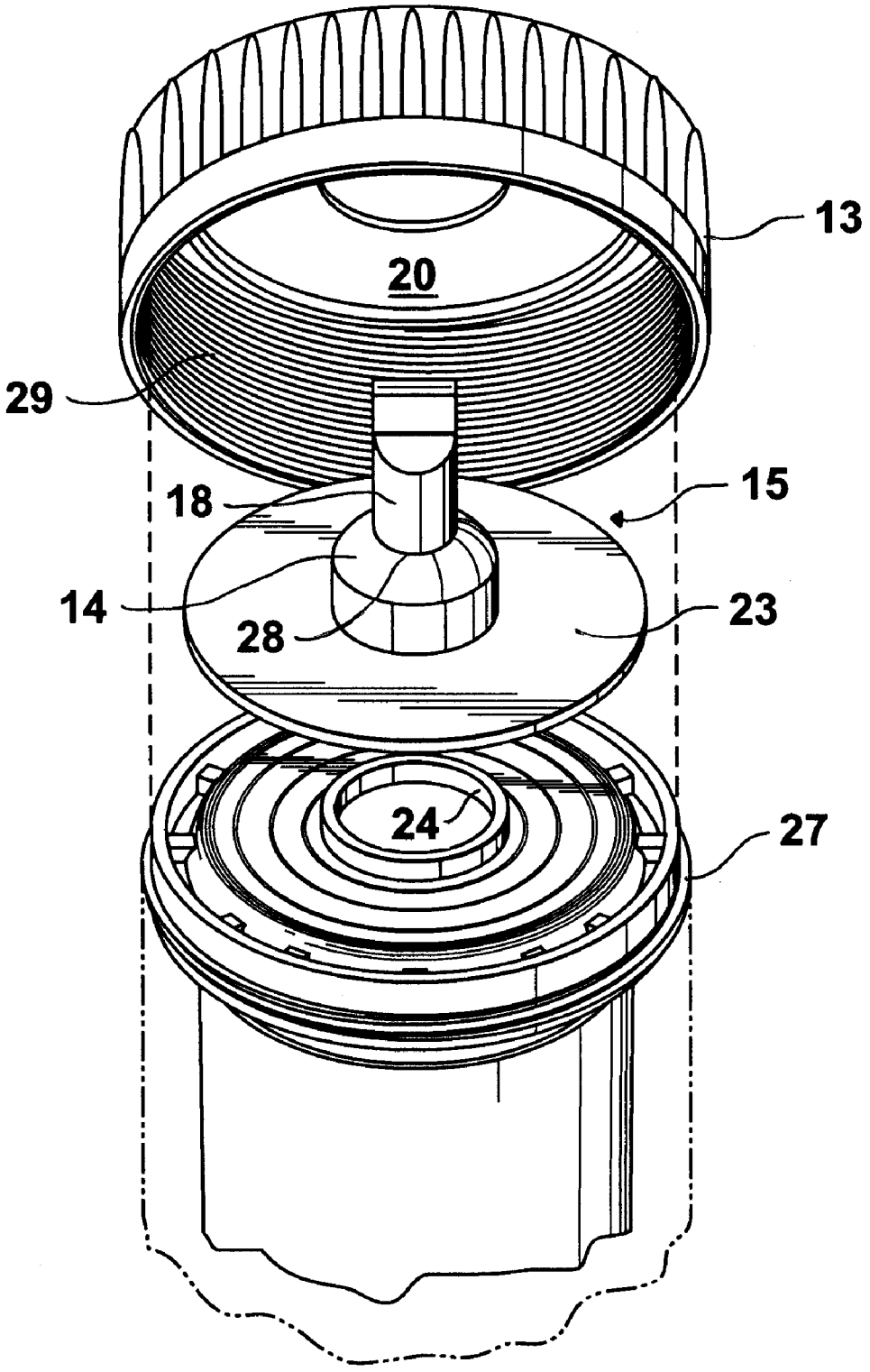


FIG.3

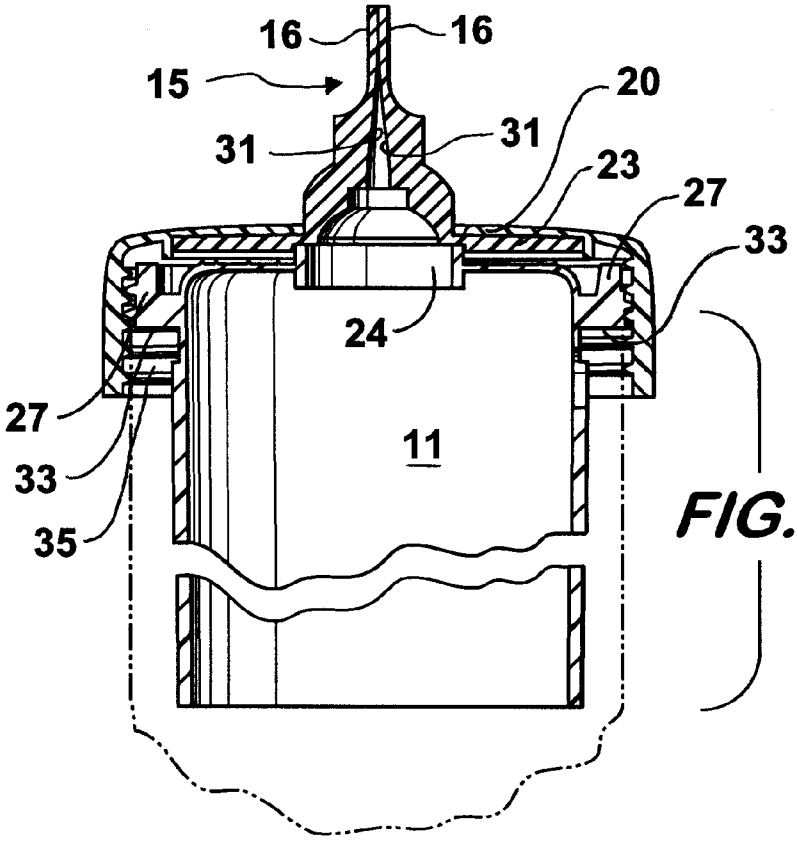


FIG.4

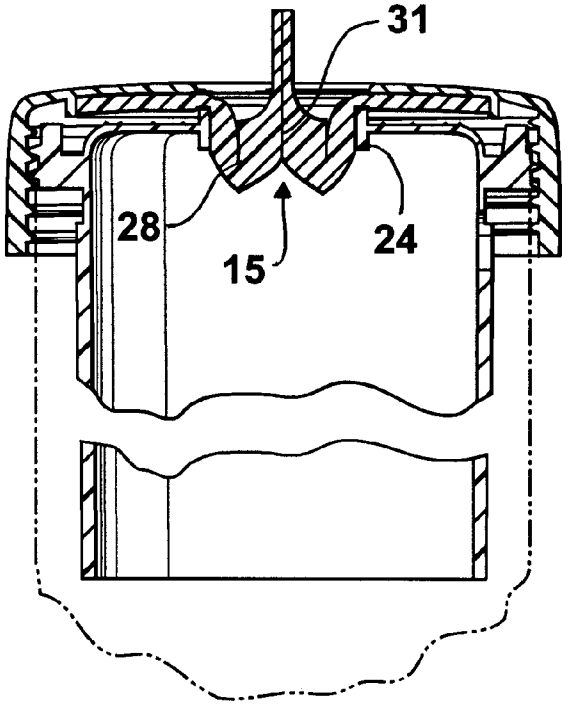


FIG.5

FORCIBLY SEALED DUCKBILL VALVE

FIELD OF THE INVENTION

[0001] The present invention relates to a duckbill valve for use in dispensing flowable materials held in a container, for example water in a sports drinking bottle or food products such as mustard, ketchup, sauces and the like, dispensed from a hand-held container such as disclosed in applicant's co-pending application serial number **11/099,459** entitled "Bag Type Squeeze Bottle."

BACKGROUND OF THE INVENTION

[0002] The use of duckbill valves is common for a liquid dispensing closure because of their high flow rate and low cracking pressure. The problem with this type of valve, however, is that it leaks when not in use. To solve this problem, leakproof or dripless slit-type dispensing valves have been devised. Some prior art devices utilize a secondary valve seat upstream of the slit valve such as shown in U.S. Pat. No. 6,749,092 issued to Olechowski et al. entitled "Deformable Dispensing Valve." Yet others utilize folded valves which apply additional mechanical pressure in their state of non-use and which unfold to reduce the slit closure force in response to pressure of the dispensed fluid. Examples of this technology is shown in U.S. Pat. No. 6,405,901 issued to Schantz et al. entitled "Valve with Rolling Sleeve" and U.S. Pat. No. 5,213,236 issued to Brown et al. entitled "Dispensing Valve for Packaging." Closures for air valves have also employed similar technologies for increasing the slit pressure by inverting the valve upon itself and using the additional sidewall resilience supplied by the folded condition to increase the slit closure pressure. Examples of this technology are shown in U.S. Pat. No. 2,734,308 issued to B. F. Gassaway entitled "Reentrant Inflation Tube and Control Valve for Inflatable Articles" and U.S. Pat. No. 3,517,682 issued to F. G. Smith entitled "Inflation Means."

[0003] None of these examples, however, provides a positively stoppered closure, i.e. an applied direct closure force against the valve sealing surfaces, by changing the position of the valve relative to the container to prevent leakage when not in use. It has been found that this is the best way to economically and conveniently provide a tightly sealed resilient valve for storage. Therefore it can be appreciated that there exists a continuing need for a new and improved valve which includes a leakproof capability for storage when not in use.

SUMMARY OF THE INVENTION

[0004] In order to meet the needs in the art, the present duckbill valve assembly has been devised in accordance with the invention which will be more fully described below with regard to one embodiment thereof. As described herein, a resilient invertible duckbill valve may be pressed downwardly and folded inwardly upon itself to a stopper position of force-fit within a compression ring to apply a direct lateral compressive force between sealing elements of the valve. This provides additional sealing surface area and very high closing pressure which prevents leakage and a tightly sealed storage condition of the container is achieved when not in use. The valve is conveniently a unitary resilient valve member which is supported by a rigid baseplate that includes an aperture in the center which forms a compression ring around the body of the valve. Both the baseplate and the valve member are releasably held between a threaded cap and top rim of the container. This construction provides economy of manufacture in that only a few parts are used and their disassembly and reassembly adds to the ease and convenience of servicing and cleaning the valve.

[0005] More specifically, the applicant has invented a duckbill valve assembly for a dispenser comprising a container for holding a flowable substance having an open mouth along a rim at a top of the container. A rigid annular baseplate is affixed against the rim of the container, the baseplate including an axially extending apertured compression ring in the center thereof. A unitary resilient valve member comprises a radially extending skirt at the bottom in abutment with the baseplate. A convergent dome-shaped valve body immediately adjacent the skirt extends upwardly therefrom. The valve body is downwardly biased when in the storage position. A neck portion extends upwardly from the top of the valve body at a foldline and includes two opposing substantially flat inner walls. A pair of opposing lips forms a resilient closure slit where the inner walls meet at a top end of the valve. The lips include substantially flat outside surfaces adapted for manual grasping to selectively move the valve between the dispensing and the storage positions. A cap is threadably engaged with the container and has a radially extending flange that forcibly captures the valve member and the baseplate against the container rim. The valve member has two stable static positions, a first upwardly biased dispensing position where the closure pressure of the opposing lips is supplied only by their resilience in a free state, and a second inwardly-folded storage position where the valve body is inverted and force-fitted within the compression ring. In the storage position, the outside surfaces of the valve body and the neck portion are folded against each other along the foldline and the inner walls are forcibly held in compression by the compression ring. The ring presses directly against the valve body laterally such that the slit surface area and closure pressure of the valve is greatly increased compared to the first dispensing position.

[0006] In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

[0007] As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods, and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a top front isometric view of the invention with the container body shown in phantom and the valve of the invention in the dispensing position.

[0009] FIG. **2** is a top front isometric view of the invention with the container body shown in phantom and the valve of the invention in the storage position.

[0010] FIG. **3** is a top front exploded view showing the assembly of parts of the invention with the container body shown in phantom.

[0011] FIG. **4** is a side sectional view taken from FIG. **1** as shown in that figure.

[0012] FIG. **5** is a side sectional view taken from FIG. **2** as shown in that figure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] Referring now to FIG. **1**, the resilient valve of the invention **15** is shown in its dispensing position fitted on top of container **11** which includes means for holding a flowable substance **12** in fluid communication with valve **15**. The valve **15** is of the duckbill type having a valve body **14** immediately preceeding an upwardly extending neck portion **18** that terminates at the uppermost end of the valve in two opposing lips **16** that form a resilient dispensing closure through slit **17**. Elements of the valve assembly are affixed to the top of the container **11** by a retaining cap **13** that includes a radially extending flange **20** having a central aperture through which the valve extends.

[0014] Referring now to FIG. **2**, the valve is shown pushed downward into its storage position. This is achieved by manually grasping the valve between the user's fingers on the substantially flat outside opposing surfaces **21** of the lips at the top of the valve and then pushing on the valve. The valve is composed of a compliant and resilient material such that it may be easily moved between the dispensing position shown in FIG. **1** and the storage position shown in FIG. **2** by pulling or pushing on the valve, respectively. As will be more fully described with regard to FIG. **5**, in the storage position the valve is pushed downwardly and folded inwardly upon itself within a rigid compression ring to greatly increase the sealing pressure to prevent leakage when not in use.

[0015] Referring now to FIG. **3**, various major components of the duckbill valve assembly of the invention are depicted. These comprise the retaining cap **13**, a unitary resilient valve element **15**, and a rigid baseplate **27**. The baseplate is apertured in the center with the sidewalls of the aperture forming a compression ring **24**. The valve element **15** includes a laterally extending skirt **23** at the bottom, a dome-shaped valve body **14**, and an upwardly extending neck **18**. The valve body joins the neck along a foldline **28**. The cap includes screw thread means **29** which engage threads around the circumference of the container so that the valve element and baseplate components become forcibly fastened to the top of the container by the flange **20** of the retaining cap **13**.

[0016] Referring now to FIG. **4**, the valve of the invention is shown in its upwardly extended dispensing position as previously shown in FIG. **1**. In this position, the valve element **15** is positioned on the baseplate **27** above the compression ring **24** and the closure pressure between the lips **16** at the top of the valve is supplied only by the resilience of the valve material in its free state. A dispensing slit between the lips forms a closure at the top of the valve where the inner walls **31** of the valve are resiliently joined at the top. As previously described, the valve element includes a skirt portion **23** which is secured against the rigid baseplate **27**, both being captured between a flange **20** of the cap and a rim **33** at the mouth of container **11**. The cap is threadably engaged at the top of the container by like screw threads **35**.

[0017] Referring now to FIG. **5**, the valve is shown in its inwardly folded storage position depicted in FIG. **2**. By virtue of the dimensions of the valve and the resilience of its composition, the valve **15** may be pushed downward and folded inwardly upon itself in a stable stoppered force-fit condition within and through the compression ring **24** of the baseplate. In this position, the valve body is inverted and the outside surfaces of the valve body and neck portion are folded against each other along the foldline **28** forming a folded stopper. As illustrated in this figure the inner walls of the valve are forcibly held by the compression ring, pressing directly against the valve body laterally such that the slit surface area and closure pressure of the valve is greatly increased compared to the first dispensing position as shown in FIG. **4**. Furthermore, owing to the compressibility of the material and the dimensional characteristics shown in this embodiment, a static stable position of the valve is achieved because a greater volume of its material resides below the compression ring. The constriction force of the ring causes the sides of the valve to be downwardly biased but further movement is stopped by the interference between the inner walls **31**.

[0018] Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as being new and desired to be protected by Letters Patent of the United States is as follows:

1. A duckbill valve assembly for a dispenser, comprising:

a container for holding a flowable substance having an open mouth along a rim at a top of the container;

a rigid annular valve baseplate affixed against the rim of said container, said baseplate including an axially extending apertured compression ring in the center thereof, a unitary resilient valve member, comprising:

a radially extending skirt at the bottom in abutment with said baseplate;

a convergent valve body immediately adjacent said skirt extending upwardly therefrom;

a neck portion extending upwardly from the top of said valve body at a foldline and including two opposing substantially flat inner walls; and

a pair of opposing lips forming a resilient closure slit where said inner walls meet at a top end of said valve;

a cap engaged with said container and having a radially extending flange that forcibly captures said valve member and said baseplate against said container rim; and

said valve member having two stable static positions, a first upwardly biased dispensing position where the closure pressure of said opposing lips is supplied only by their resilience in a free state, and a second inwardly-folded storage position where the valve body is inverted and force-fitted within said compression ring, the outside surfaces of said valve body and said neck portion being folded against each other along said

foldline and said inner walls being thereby forcibly held in compression by said compression ring pressing directly against said valve body laterally such that the slit surface area and closure pressure of said valve is greatly increased compared to said first dispensing position.

2. A duckbill valve assembly, comprising:

a rigid annular valve baseplate affixed against the rim of said container, said baseplate including an axially extending apertured compression ring in the center thereof,

a unitary resilient valve member comprising a radially extending skirt at the bottom in abutment with said baseplate, a convergent valve body immediately adjacent said skirt extending upwardly through an aperture of said ring, a neck portion extending upwardly from the top of said valve body at a foldline and including two opposing substantially flat inner walls, and a pair of opposing lips forming a resilient closure slit where said inner walls meet at a top end of said valve; and

said valve member having two stable static positions, a first upwardly biased dispensing position where the closure pressure of said opposing lips is supplied only by their resilience in a free state, and a second inwardly-folded storage position where the valve body is inverted and force-fitted within said compression ring aperture and said inner walls are forcibly compressed together laterally thereby.

3. The duckbill valve assembly of claim **2** wherein said valve member and said baseplate are fastened against a container rim, said container including fluid holding means in fluid communication with said valve member.

4. The duckbill valve assembly of claim **3** further including a cap engaged with said container and having a radially extending flange that forcibly captures said valve member and said baseplate against said container rim.

5. The duckbill valve assembly of claim **4** wherein the outside surfaces of said valve body and said neck portion are folded against each other along said foldline forming a positively stoppered closure when the valve is in said second storage position.

6. The duckbill valve assembly of claim **4** wherein said cap is threadably engaged with said container.

7. The duckbill valve assembly of claim **4** wherein the valve member is forcibly captured between the cap flange and said baseplate.

8. The duckbill valve assembly of claim **1** wherein said valve body is dome shaped.

9. The duckbill valve assembly of claim **1** wherein said valve lips include substantially flat outside surfaces adapted for manual grasping to selectively move said valve between said dispensing and said storage positions.

10. The duckbill valve assembly of claim **1** wherein said valve body is downwardly biased when in the storage position.

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