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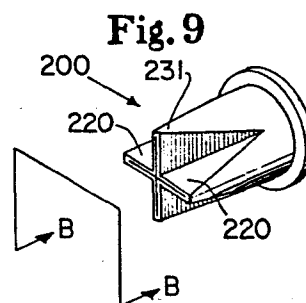
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Dispensing closure (1111111).

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An externally mounted integral, self-sealing check valve dispensing closure for use in a fluid product dispenser is described which is formed with a substantially tubular open inlet end and a normally closed outlet end of a resilient plastic or elastomer having a durometer in the range of between approximately 10 Shore A and 95 Shore A (46 Shore D) and having a wall thickness in the range of from about .25 to 1.3 mm. The outlet end of the dispensing closure converges toward its closed end along an inflexed non-planar surface to a normally closed non-linear discharge slit. The distal edge of the inflexed non-planar surface mates with at least one other, oppositely disposed surface of the closure to form the discharge slit, with these mating surfaces having substantially flat lands of contact along the slit. The inflexed non-planar surface forms an acute angle at the slit with any line drawn through the slit parallel to the central axis of the closure and is adapted to resiliently deflect outwardly in response to the application of product pressure from within, thereby opening the closure and permitting product flow therethrough. Upon release of product pressure therewithin, the inverted non-planar surface returns to its inflexed closed condition thereby sealing the closure.



DISPENSING CLOSURE

JAMES L. DROBISH

5 TECHNICAL FIELD

This invention relates to a dispensing closure for use in a fluid product dispenser, and, more particularly, to an externally mounted, self-sealing, pressure actuated check valve dispensing closure for fluid product dispensers.

10 BACKGROUND ART

Discharge closures and dispensing closures having a dispensing orifice which automatically increases in diameter in response to fluid pressure within are not new to the art. For example, U.S. Patent 591,067, which issued to David Wallace on
15 October 5, 1897, discloses an automatic siphoning device comprising a flexible sleeve having a discharge end which concentrically converges and contracts to a small orifice. The circumference of the small orifice is formed or molded into a number of flute-shaped corrugations B which extend from the contracted orifice
20 end C axially toward the connecting end D over a length of several inches. Such corrugations are described as being preferably of equal breadth and depth and arranged in close successive order around the circumference of the device. In operation, liquid can normally pass through the small orifice in
25 the contracted end C of the device, and as the pressure of the liquid increases the corrugated folds of the device begin to expand, thus increasing the size of the orifice. The expansion of the orifice will continue under continual increasing liquid pressure until the orifice area is nearly as large as the area of the cylindrical portion A of the siphoning device. The corrugated folds
30 return to their original shape as the liquid pressure is decreased.

A dispensing closure for collapsible type fluid containers is disclosed in U.S. Patent 2,937,795, which issued to Pasquale Ciliberti on May 24, 1960. A dispensing closure device 10 is

described as including a conical closure member 11 provided with a plurality of intersecting slits 14 which serve to divide the tip of closure member 11 into a plurality of individual flexible quadrants 15. Closure member 11 is hollow, and increased internal pressure of the contents 16 therewithin acts to force the quadrants 15 apart thereby permitting the dispensing of the contents there-through. Upon release of the internal pressure, the quadrants 15 return to their normally closed position.

U.S. Patent 4,109,836, which issued to Anna Falarde on August 29, 1978, discloses a self-sealing paste dispensing device 12 which comprises a body portion 15 with a neck portion 20 extending therefrom and a closure wall 21 at its discharge end. The closure wall 21 may exist either as a laterally extending wall, as shown in Figure 7, or as the end wall of a plurality of pairs of walls helicoidally arranged and coming together at their ends to form radiating slits from a generally central point. The neck 20 of dispensing device 12 is to be formed of a plastic material having a stiffness and elasticity proportioned to the viscosity of the paste to be dispensed such that internal pressure within the paste will press the internal walls of the paths to each of the slits (slits 22-25) thereby moving the walls defining the path apart and opening the slits. Upon release of such internal pressure, the resulting force on the sides of the paths to the slits will also be released and the slits will helically return to a closed position.

A unitized three-leaflet heart valve is taught in U.S. Patent 4,222,126, which issued to John Boretos et al. on September 16, 1980. The tri-leaflet heart valve 10 comprises a rigid frame 12 covered with a one-piece membrane 14 forming the three leaflets 14a, 14b and 14c which are bonded to the frame 12 to form an integral unit. Membrane 14 is also provided with a thickened lip 18 which forms the free ends of the leaflets 14a, 14b and 14c. The thickened nature of lip 18 serves to increase its tear strength and increases the reliability and longevity of valve 10.

A transitional area 20 in the upper regions of frame 12 serves to distribute fluxural stress at the points at which the membrane 14 is attached to frame 12. Additionally, the radiating lines 22 consisting of heavier areas provide strength without bulk to the valve. As shown in Figure 2, blood under pressure forces the valve leaflets into an open position. Upon release of such pressure, the valve resiliently returns to its normally closed state.

Despite all the prior work done with regard to self-sealing dispensing closures and the like, as evidenced by the above-cited patents, there remain problems of complexity of the devices, complexity of the required manufacturing procedures for the devices, reliability of function, and excessive cost. The valving structures of the prior art require complex structures, multi-part devices, complex manufacturing procedures, and still are not always reliable in operation. Further, prior art self-sealing dispensing devices do not teach dispensing nozzles which create minimal back pressure to dispensing operations while at the same time serving as an effective check valve to air even when subjected to vacuum pressure from within.

20 DISCLOSURE OF THE INVENTION

It is an object of this invention to obviate the above-described problems.

It is an object of the present invention to provide an improved one-piece self-sealing check valve dispensing closure which exhibits improved product cut off at the end of a dispensing operation.

It is also an object of the present invention to provide a check valve which will effectively seal in the presence of air (i.e., to the atmosphere or to air entrapped within fluid to be dispensed).

It is also an object of the present invention to provide an improved dispensing closure which permits the extrusion of larger volumes per unit length of extrudate of the dispensed product with clean product cut off at the end of a dispensing operation.

It is another object of the present invention to provide an improved dispensing closure for fluids which can maintain a fluid-tight seal when subjected to negative product pressure within.

It is still another object of the present invention to provide
5 a dispensing closure and check valve which can be mounted externally on a dispensing device in order to better control the messiness normally associated with dispensing devices.

In accordance with one aspect of the present invention, there is provided an externally mounted integral, self-sealing
10 check valve dispensing closure for use in a fluid product dispenser which is formed of a resilient plastic or elastomer having a durometer in the range of between approximately 10 Shore A and 95 Shore A (46 Shore D) and having a wall thickness in the range of from about .25 mm to about 1.3 mm (.01 to .05 inches).
15 The closure includes a substantially tubular open inlet end and a normally closed outlet end. The outlet end converges from a substantially tubular shape along at least one inflexed non-planar surface which mates along its distal edge with at least one other, oppositely disposed surface of the closure to form a non-linear
20 discharge slit. The inflexed non-planar surface converges toward the normally closed discharge slit in such a manner as to form an acute angle at the slit with any line drawn through the slit parallel to the central axis of the nozzle and mates with the other oppositely disposed surface along substantially flat lands of
25 contact along the length of the slit. The inflexed non-planar surface is adapted to resiliently deflect outwardly in response to the application of product pressure from within the closure, thereby opening the closure and allowing product to be dispensed therethrough. Upon release of product pressure therewithin, the
30 inflexed non-planar surface resiliently returns to its closed condition thereby sealing the closure.

BRIEF DESCRIPTIONS OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is

believed that the same will be better understood from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a perspective view of one embodiment of the closure of the present invention;

Figure 2 is a vertical cross-sectional view of the closure of Figure 1 taken along line 2-2 of Figure 1;

Figure 3 is a perspective view of the embodiment of Figure 1 in a partially opened condition;

Figure 4 is a partially exploded perspective view depicting a method for attaching the closure of Figure 1 to a dispensing package;

Figure 5 is a perspective view of a second embodiment of the closure of the present invention;

Figure 6 is a plan view of the closure of Figure 5 viewed along the line-of-sight A-A of Figure 5;

Figure 7 is a cross-sectional view of the closure of Figure 5 taken along the line 7-7 of Figure 6;

Figure 8 is a perspective view of the closure of Figure 5 shown in a partially opened condition;

Figure 9 is a perspective view of a preferred embodiment of the closure of the present invention;

Figure 10 is a plan view of the closure of Figure 9 viewed along the line-of-sight B-B of Figure 9; and

Figure 11 is a cross-sectional view of the closure of Figure 9 taken along the line 11-11 of Figure 10.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, wherein like numerals indicate the same elements throughout the views, Figures 1 through 4 illustrate the self-sealing check valve dispensing closure 10 which is preferably molded of silicone rubber (e.g. Silastic^(TM) MDX 4-4526 available from Dow-Corning of Midland, Michigan), although a wide variety of materials (e.g., any resilient plastic or elastomer such as silicone rubber or plasticized polyvinyl

chloride) and molding procedures can be used. As will be seen in greater detail below, to operate properly, the check valve dispensing nozzle 10 must be resiliently flexible enough to readily open in response to increased pressure within a product dispenser, while at the same time exhibiting sufficient rigidity to maintain its general conformation and to return to its closed condition upon release of product pressure therewithin. It has been found that resilient plastics or elastomers having a durometer in the range of between approximately 10 Shore A and 95 Shore A (46 Shore D) and having a wall thickness in the range of from about .25 mm to 1.3 mm (.01 to .05 inches) provide such desired characteristics. Accordingly, it can be seen that stiffer materials would necessarily have to be thinner to maintain the required resilient flexibility. Check valves exhibiting wall thicknesses of less than .25 mm generally do not provide sufficient rigidity to maintain their general conformation as is required for proper operation. Such thinner walls would necessitate additional support structure, thereby unnecessarily adding complexity and cost to the closure.

Self-sealing dispensing closure 10 includes a substantially tubular open inlet end 30 and a normally closed outlet end 31. An attachment flange 34 is integrally formed about the periphery of open end 30 and extends outwardly in a plane substantially perpendicular to the central axis of closure 10.

Outlet end 31 converges from a substantially tubular shape toward its closed end along the inflexed non-planar surface 20 to the normally closed non-linear discharge slit 33. The distal edge of inflexed non-planar surface 20 mates with the lower tubular-shaped surface 32 along the curved discharge slit 33. The lands of contact 35 (seen best in Figure 2) between the inflexed non-planar surface 20 and the oppositely disposed tubular shaped surface 32 are substantially flat and have a width (measured along the central longitudinal axis of closure 10) of preferably approximately .66 mm (.026 inches) in a closure having an inside

diameter of its tubular inlet end 30 of approximately 8 mm (.315 inches). Inflexed non-planar surface 20 is formed in an inclined relationship relative to the central longitudinal axis of closure 10 and forms an acute angle at slit 33 with any line drawn through slit 33 parallel to the central axis of the closure. As will be seen in greater detail below, this angular relationship importantly augments the ability of closure 10 to perform as a self-sealing check valve by permitting the nozzle to maintain an effective seal.

Closure 10 is preferably formed of silicone with a durometer of 35 Shore A with a wall thickness of approximately .76 mm (.03 inches) in its cylindrical open end 30 and approximately .51 mm (0.02 inches) in its inflexed non-planar surface 20. The distal edges of inflexed surface 20 and the lower tubular shaped surface 32 are attenuated in the immediate vicinity of slit 33 to permit their surfaces to mate along the substantially flat lands of contact 35, as shown in Figure 2. In a preferred execution of closure 10, such attenuation results in a wall thickness at the distal edge of inflexed surface 20 of approximately .076 mm (.003 inches) when inflexed surface 20 forms a forty five degree angle at slit 33, as described above, and the lands of contact 35 have a width of approximately .66 mm (.026 inches), as described in greater detail below. It has been found that such flat lands of contact at the discharge slit insure a reliable seal of closure 10 along discharge slit 33 and provide the closure the ability to effectively seal a container at an air/product interface (i.e., closure 10 can effectively seal a container and act as a check-valve to isolate the contained product from ambient air subsequent a dispensing operation).

Closure check valve 10 is to be mounted externally onto a dispensing package, such as, for example, in place of the dispensing outlets and check-valves of the dispensers disclosed in U.S. Patent 3,088,636 which issued to Spatz on May 7, 1963, or U.S. 4,154,371 which issued to Kolarzinski et al. on May 15, 1979, or U.S. 4,301,948 which issued to Czech et al. on

November 24, 1981. Such external mounting situates the closure of a dispensing system at the outermost point, thereby reducing messiness by providing positive product cut-off after dispensing operations. Such positive product cut-off also makes the closures desirable alternatives for other closure devices in applications not requiring a check valve (e.g., collapsible tubes containing products such as pastes, gels, creams and the like). An example of a means for attaching closure 10 to a dispensing package is illustrated in Figure 4. The cylindrical open end 30 of closure 10 is telescoped over the protuberance 88 formed on dispensing package 80 and circumscribing the outlet passageway 83, and is positively held in place by a retaining ring 90 which slides over the exterior of closure 10 and is snapped passed the inwardly extending retention rib 87 formed on the inner surfaces of the retaining wall 86. Retaining ring 90 is preferably made of polypropylene or polyethylene, but can be made of any relatively rigid material. The dimensions of retaining ring 90 in the location of the rib 87 are such as to insure that upon its application the ring 90 will be biased against flange 34, thereby establishing a tight seal of flange 34 against the outlet base ring 84 of dispensing package 80. The manner of attachment of closure 10 to the package is not critical, however, and can be accomplished by a variety of ways known or conceivable by those skilled in the art, such as by adhesives, heat sealing, or other mechanical arrangements.

During a dispensing operation, product pressure within the dispenser is built up either manually or by pressure varying means on the dispenser. Such product pressure exerts increasing outward normal forces against the inner surfaces of closure 10 as the pressure builds within the dispenser. The rising pressure resiliently pushes outwardly from within closure 10 and deflects or deforms inflexed non-planar surface 20 outwardly, thereby opening closure 10 and permitting flow of product therethrough. Closure 10 is shown in Figure 3 in a partially opened condition.

The pressure required to initiate dispensing through closure 10 can be predetermined and controlled by varying the material characteristics of closure 10 (e.g., a closure formed of material of higher durometer or flexural modulus would require more pressure to deflect outwardly the inflexed surface 20), and by varying the wall thicknesses and/or the diameter thereof while taking into consideration the viscosity of the product to be dispensed (product having lower viscosity will generally require less pressure to dispense). As an example, in a preferred embodiment of the closure shown in Figure 1 having an inside diameter of open end 30 of approximately 8 mm. (.315 inches), wall thicknesses as described above, a durometer of approximately 35 Shore A, a dispensing passageway 83 having a diameter of 6.4 mm (approximately .25 inches), with inflexed non-planar surface 20 forming an angle of approximately forty five degrees (45°) at slit 33 with any line drawn through slit 33 parallel to the central axis of the closure, and used with a fluid product of 300,000 cp (Brookfield) viscosity, the dispensing pressure at which there is appreciable product flow is approximately 0.10 kg/cm^2 [1.5 lbs. per square inch (psig)]. In this example, if a product flow rate of approximately 1.45 to 2.9 cc/sec. is desired, a dispensing pressure of approximately 0.14 kg/cm^2 [2.0 lbs. per square inch (psig)] would be required.

The closures of the present invention exhibit low back pressure to product dispensing not only because of the resiliently flexible material properties, but also because of the non-planar overall conformation of their discharge slits. As can be seen in Figure 3, deflection of non-planar surface 20 does not require flexing of the end points 21 of discharge slit 33. Likewise, a corresponding relationship can be seen by the non-flexure of end points 121 in Figure 8. Closures with linear discharge slits (e.g., common duckbill closures) generally exhibit greater back pressures because the end points of their slits must be deflected inwardly to allow opening of the slits. Because such deformation

of end points is not required in the closures of the present invention, pressure required to open the subject closures can be minimized.

As described above, when the pressure within the dispensing package reaches the required dispensing pressure, product
5 will be dispensed at the desired rate of flow and such dispensing will continue until the pressure in the dispenser falls below that required pressure. Upon release of the force causing the increased pressure within the dispenser, pressure in the dispenser
10 will begin to drop. When such internal pressure approaches atmospheric pressure, closure 10 will resiliently tend to close due to the elastic memory of its material. Further reduction of pressure within the dispenser below atmospheric pressure will cause such ambient pressure to act upon the
15 exterior surfaces of closure 10, further closing and sealing the slit 33 in a substantially fluid-tight condition. The closure 10 can therefore be successfully utilized as a check valve against the flow of fluids (including air) into a dispenser.

In a preferred execution of the closure 10, the flat lands of
20 contact 35 have a width of approximately .66 mm (.026 inches), measured in a direction parallel to the central axis of closure 10. It has been found that although the land width can be as small as approximately .2 mm (.008 inches), a better seal against the inflow of fluids through the slit 33 is achieved by lands of contact
25 35 being wider than such minimum value. Because the closures of the present invention must exhibit a certain degree of softness so as to be flexible as well as resilient, it is conceivable that a negative pressure within the sealed closure could cause the outlet end 31 to collapse inwardly. It has been observed that
30 wider lands of contact augment the closure's resistance to such back pressure, and will better resist the tendency to collapse under negative pressure. Therefore, while the width of lands 35 can be widely varied without significant deterioration of the check valve capabilities of closure 10, the preferred range for the width

of lands 35 is between approximately 0.5 and 1.0 mm (.02-.04 inches). It has also been found that to insure the capability of slit 33 to fully close, it is preferred that closure 10 be molded without slit 33, and thereafter cutting slit 33 while closure 10 is in an unstressed condition. Cutting slit 33 in this manner forms the flat lands of contact 35 which permit slit 33 to exactly close whenever closure 10 is unstressed--making closure 10 a very effective self sealing outlet.

Figures 5 through 8 illustrate an alternate embodiment of the subject check valve dispensing closure of the current invention. Particularly, Figures 5 through 8 illustrate check valve dispensing closure 100 comprising a generally cylindrical open inlet end 130 and an outlet end 131 which terminates at a normally closed non-linear discharge slit 133. An attachment flange 134 corresponding to the attachment flange 34 of the first described closure 10 is integrally formed about the bottom peripheral edge of open end 130. Outlet end 131 converges toward its closed end along three inflexed non-planar surfaces 120 which are equally spaced about the central axis of closure 100. Inflexed non-planar surfaces 120 correspond to the inflexed surface 20 of closure 10, however, the surfaces 120 each include a centrally located groove 122 which causes each inflexed non-planar surface 120 to assume a more angular overall conformation (i.e., a multiplanar surface). The more angular shape of the inflexed surfaces 120 facilitates the close mating of the distal edges of surfaces 120 along a normally closed discharge slit 133. It can be seen that while portions of surface 120 can be planar, the overall surface 120 must be non-planar to maintain the advantages of the closures described herein. Likewise portions of discharge slit 133 can be linear; however, overall, the discharge slit must be non-linear in conformation.

Corresponding to closure 10, closure 100 is preferably formed with wall thicknesses of approximately .76 mm (.03 inches) in its cylindrical open end 130 and .5 mm (.02 inches) in its

inflexed non-planar surfaces 120. Also corresponding to closure 10, as described above, the distal ends of the non-planar surfaces 120 can be attenuated in the immediate vicinity of the slit 133 to facilitate the establishment of the flat lands of contact 135, as can be seen best in Figure 7. It is also apparent in Figure 7 that the distal ends of the lands of contact 135 are squared off as opposed to being tapered to a point. Because it is preferred to mold the closures of the present invention in a closed condition and thereafter to cut the non-linear discharge slit 133 as desired, it has been found that the squared off tip facilitates the slit-cutting process and allows better control of resulting slit conformation. Also as described with regard to closure 10 above, each of the inflexed non-planar surfaces 120 of the closure 100 converge toward the closed end, and each forms an acute angle at the slit 133 with any line drawn through slit 133 parallel to the central axis of closure 100. By establishing an acute angle with the non-linear discharge slit, inflexed non-planar surfaces 120 tend to maintain their normally closed position more effectively, especially when subjected to a vacuum pressure from within.

It has been found that by forming the inflexed non-planar surfaces of a check valve dispensing closure as described herein in such a way that each forms an acute angle with any line drawn through its non-linear discharge slit parallel to the central axis of the closure, such a closure will tend to return to its normally closed condition when product pressure within is released and will successfully maintain that closed position while resisting an external collapsing force caused by atmospheric pressure when said product pressure within the closure is reduced below atmospheric. Extremely good product cut off and check valve operation is achieved when such geometrically arranged inflexed non-planar surfaces are combined in a closure exhibiting substantially flat lands of contact at its non-linear discharge slit.

Closure 100 is to be mounted externally on a dispenser in the same manner as described above with regard to closure 10.

The operation of closure 100 also corresponds to the operation of closure 10, as described above. Increased product pressure within nozzle 100 exerts outward forces normal to the inner surfaces of inflexed non-planar surfaces 120. When the product pressure reaches a certain required dispensing pressure, such pressure forces the inflexed non-planar surfaces 120 to resiliently flex outwardly and to eventually deform sufficiently to fully open closure 100 (as shown in Figure 8) permitting product flow there-through at a desired rate of flow. Upon release of the product pressure therewithin, the inflexed non-planar surfaces 120 resiliently return to their original inflexed positions thereby sealing closure 100.

Figures 9 through 11 show a preferred embodiment of the check valve dispensing closure of the subject invention. Closure 200 is constructed in a manner identical to that described above regarding closure 100, with the exception that closure 200 comprises four inflexed non-planar surfaces 220 equally spaced around the central axis. A comparison of Figures 9 through 11 with the Figures 5 through 7 shows that the only significant difference between the two embodiments is the additional inflexed non-planar surface 220 of closure 200. Closure 200 operates in a manner identical to that described regarding closure 100; however, it has been found that the addition of the fourth inflexed non-planar surface 220 permits closure 200 to open to a slightly larger diameter than does closure 100, thereby permitting a greater volume of product per unit length of extrudate to flow through the open closure. It is observed that the additional surface 220 also provides a non-planar dispensing slit which has even more effective sealing characteristics at its mating surfaces than the previously described embodiments, and thereby maintains a better seal in its normally closed condition. Closure 200 has also demonstrated a higher resistance to forces tending to collapse the outlet end 231 inwardly when the closure is subjected to negative pressure from within.

It is envisioned that any number of inflexed non-planar surfaces can be incorporated into a dispensing closure made in accordance with the current disclosure. It has been found, however, that closures comprising a great number of inflexed
5 non-planar surfaces in their converging outlet end tend to suffer decreased efficiency in product cut-off and positive sealing due to the interference of such inflexed non-planar surfaces with one another during opening and closing operations.

Various modifications and uses of the described invention in
10 addition to those discussed above will be apparent to those skilled in the art. Accordingly, the scope of the present invention should be considered in terms of the following claims and is understood not to be limited to the details of structure and operation described and shown in the specification and drawings.

CLAIMS

1. An externally mounted, integral, self-sealing check valve dispensing closure for use in a fluid product dispenser, characterized in that it is formed of a resilient plastic or elastomer having a durometer in the range of between 10 Shore A and 95 Shore A (46 Shore D) and having a wall thickness in the range of from .25mm to 1.3 mm, said closure further comprising a substantially tubular open inlet end and a normally closed outlet end, said outlet end converging toward its closed end along at least one inflexed non-planar surface to a normally closed non-linear discharge slit, the distal edge of said inflexed non-planar surface mating with at least one other, oppositely disposed surface of said closure to form said discharge slit, said mating surfaces having substantially flat lands of contact along said slit, said inflexed non-planar surface forming an acute angle at said slit with any line drawn through said slit parallel to the central axis of the closure and being adapted to resiliently deflect outwardly in response to the application of product pressure from within, thereby opening said closure, and to return to its closed condition upon release of product pressure therewithin, thereby sealing said closure.

2. The self-sealing check valve dispensing closure of claim 1, characterized in that said mating surfaces are attenuated in the immediate vicinity of said slit to a minimum thickness along said lands of contact.

3. The self-sealing check valve dispensing closure of claim 2, characterized in that said outlet end converges toward its closed end along a plurality of inflexed non-planar surfaces to said normally closed non-linear discharge slit, said inflexed non-planar surfaces mating with one another at their distal edges to form said discharge slit.

4. The self-sealing check valve dispensing closure of claim 3, characterized in that said outlet end converges toward its closed end along three inflexed non-planar surfaces to said normally closed non-linear discharge slit, said inflexed non-planar surfaces mating with one another at their distal edges to form said discharge slit.

5. The self-sealing check valve dispensing closure of claim 3, characterized in that said outlet end converges toward its closed end along four inflexed non-planar surfaces to said normally closed non-linear discharge slit, said inflexed non-planar surfaces mating with one another at their distal edges to form said discharge slit.

6. The self-sealing check valve dispensing closure of claims 4 or 5, characterized in that said inflexed non-planar surfaces are arranged in an equally spaced relationship around the central axis of said closure.

7. The self-sealing check valve dispensing closure of claim 6, characterized in that said resilient plastic or elastomer is silicone, said durometer is approximately 35 Shore A, and the wall thickness is in the range of .45 to .80 mm.

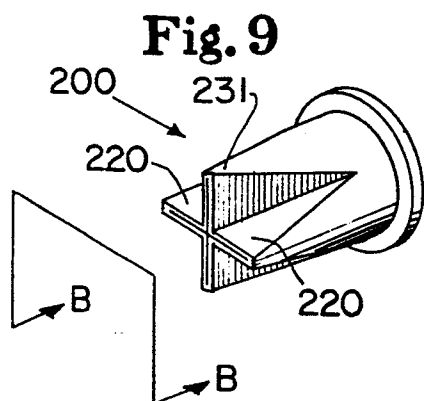
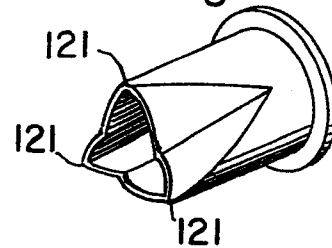
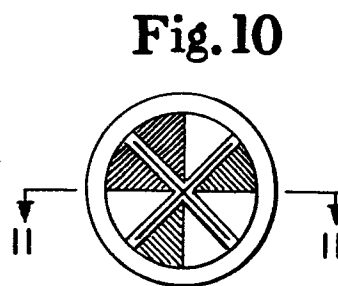
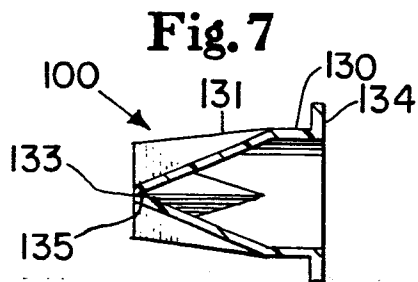
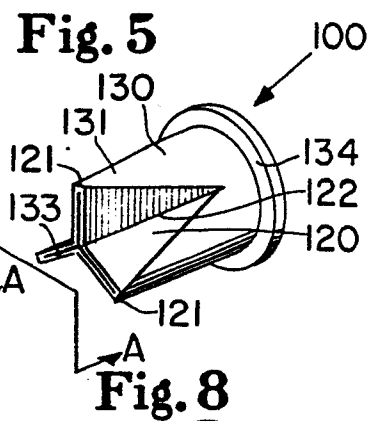
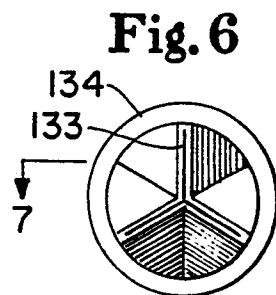
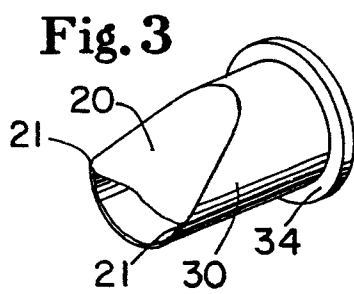
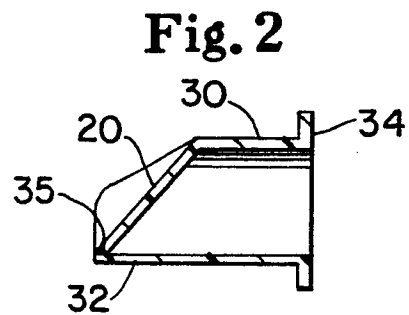
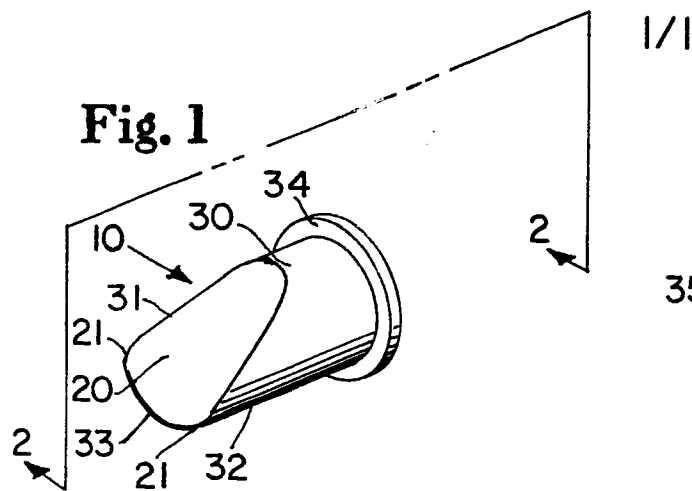


Fig. 11

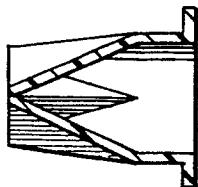


Fig. 4

