Feb. 1, 1966 V. J. ESPOSITO, JR 3,232,499

MOLDED BOTTLE CAPS WITH INTEGRAL VALVE STRUCTURE

Filed March 21, 1963 2 Sheets-Sheet 1

Fig. 1.

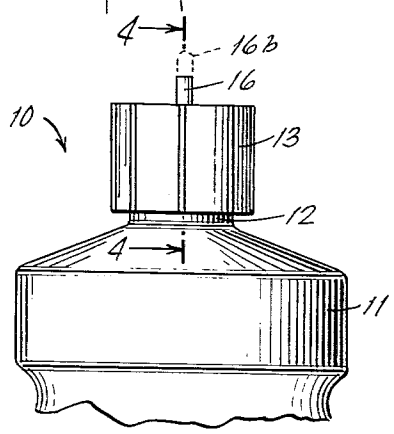


Fig. 2.

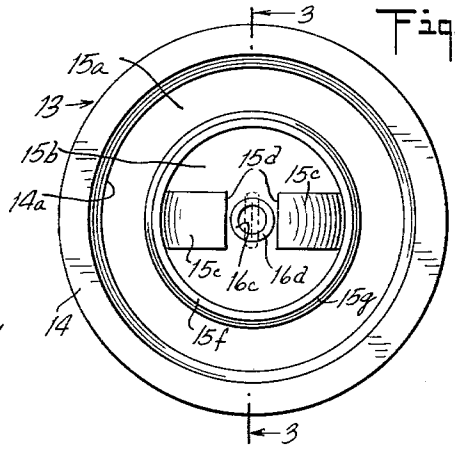


Fig. 4.

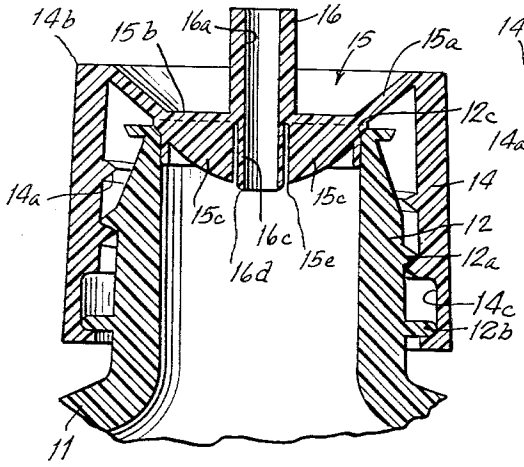
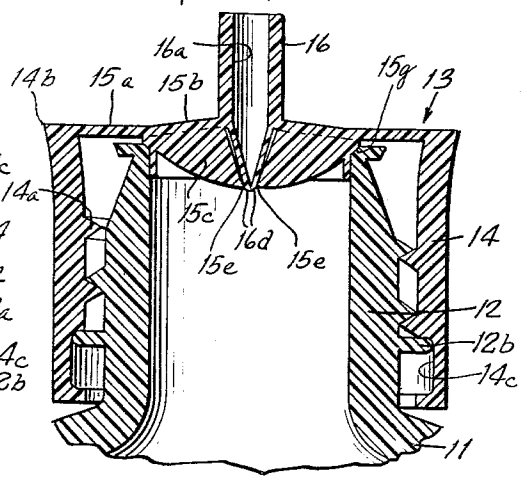


Fig. 5.



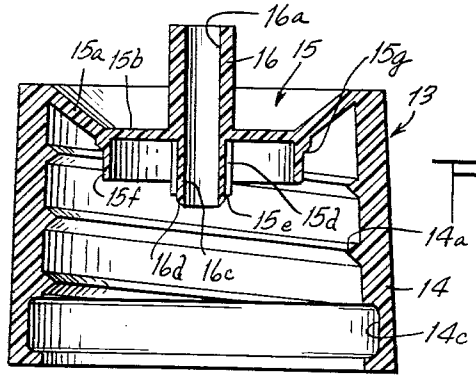


Fig. 3.

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Fig. 6.

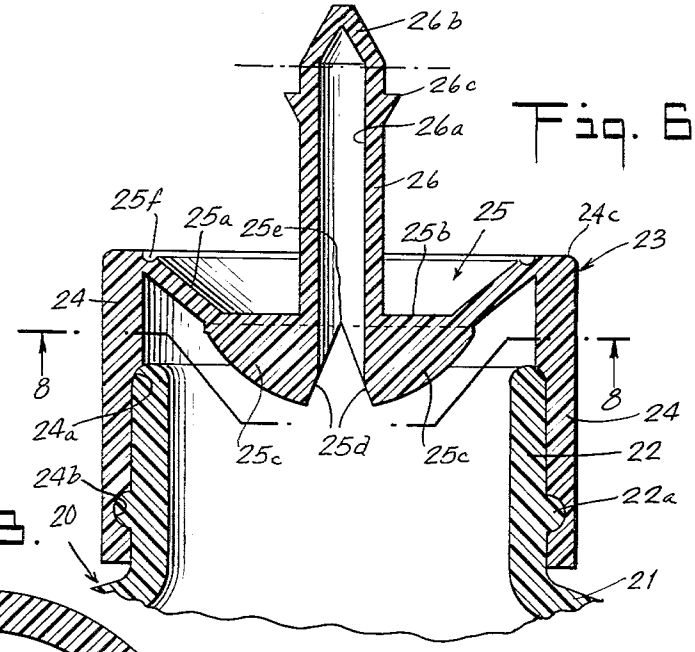


Fig. 8.

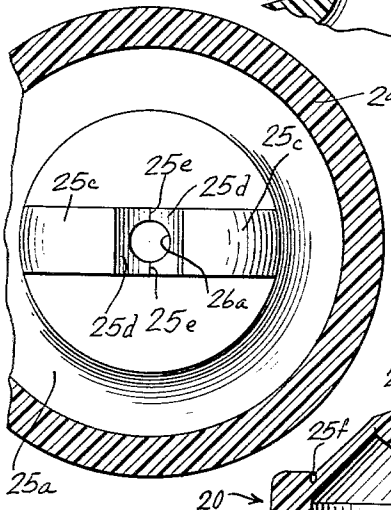
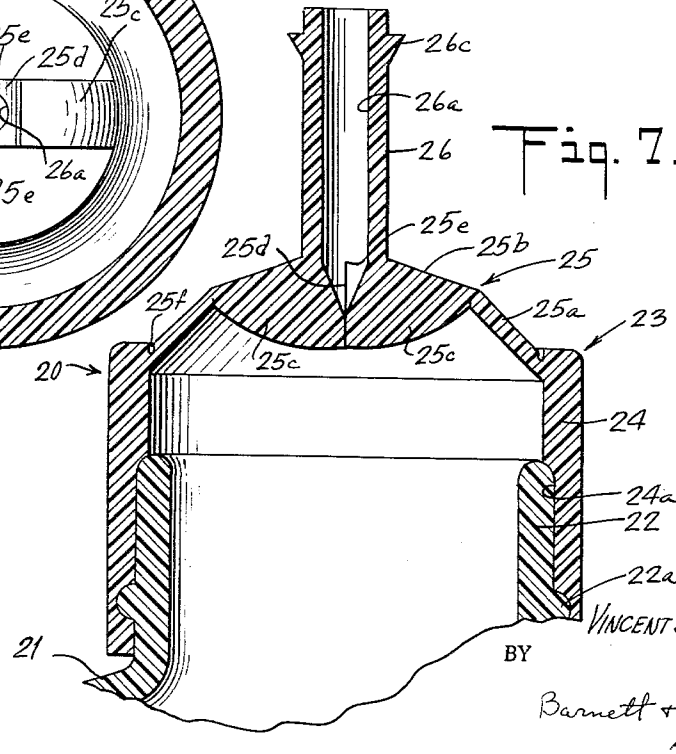


Fig. 7.



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MOLDED BOTTLE CAPS WITH INTEGRAL VALVE STRUCTURE

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16 Claims. (Cl. 222—499)

This invention relates to closures for bottles and the like containers and more particularly is directed to molded caps of elastomeric plastic resinous material having integral valve means for selectively dispensing fluid contents and sealing the container.

Among the objects of the invention is to generally improve plastic molded caps of the character described, which shall comprise a single, unitary, integral, molded piece of elastomeric material, which shall be economical to manufacture in quantity production by modern molding methods, which shall provide a resilient top wall with a conduit for dispensing the fluid contents of a container and a valve structure incorporated in said top wall to selectively open and close the conduit on deflection of the top wall from a concave to a relatively flat or convex position, which valve structure in one form may be operated by engagement between the cap top wall structure and the lip of the container on relative movement of the cap with respect to the neck of the container or, in another form, by manipulation of the cap top wall structure through an exterior finger grip projection, which conduit may be initially provided with an integral tip closure of the snip-off type to seal the container for shipping but which conduit in normal household use after removal of the tip closure shall require solely the integral valve structure for normal sealing to prevent accidental spilling and the like, which shall be foolproof in operation, practical and efficient to a high degree in use.

Other objects of the invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists of features of constructions, combinations of elements and arrangements of parts which will be exemplified in the constructions hereinafter disclosed, the scope of the application of which will be indicated in the claims following.

In the accompanying drawings in which various embodiments of the invention are shown:

FIG. 1 is a fragmentary elevational view of an upper portion of a bottle fitted with a screw-on cap constructed to embody the invention, the snip-off tip being shown in broken lines.

FIG. 2 is an enlarged bottom view of the cap shown in FIG. 1 removed from the bottle and showing the interior construction with the valve in open position in full lines and indicated in closed position by broken lines.

FIG. 3 is a vertical sectional view taken along line 3—3 in FIG. 2.

FIG. 4 is a vertical sectional view taken along line 4—4 in FIG. 1 and through toggle bosses showing the valve in open position.

FIG. 5 is a vertical sectional view taken through the toggle bosses similar to FIG. 4 after the cap is rotated on the bottle neck raising the concave top wall to effect the valve closure.

FIG. 6 is an enlarged fragmentary sectional view taken similar to FIG. 4 showing a relatively permanent bottle neck and cap connection of the snap-on type, the cap having a modified construction formed for valve actuation by manipulation of an exterior delivery spout stem, the valve being shown in open position.

FIG. 7 is a sectional view of the bottle neck and cap in FIG. 6 with the valve shown in closed position, and

FIG. 8 is a sectional view taken on line 8—8 in FIG. 6 showing the modified valve structure in open position.

Referring in detail to the drawing 10 generally denotes a capped receptacle for liquids comprising bottle 11 having a neck 12 fitted with a valved closure and dispensing cap 13 constructed to embody the invention. Bottle 11 may be made of glass, metal or the like material but is here shown as preferably made of a suitable resinous plastic, such as, a polyolefin, polyvinyl or the like to provide a flexible walled, relatively unbreakable squeeze type bottle, neck 12 being formed with conventional external threads 12*a*.

Cap 13 may be molded as an integral unit of a suitable material having elastomeric properties, such as, rubber, polyolefins, polyvinyls, polyurethanes and the like, to comprise a tubular skirt 14 having internal threads 14*a* for engaging external threads 12*a* of bottle neck 12 and a top closure wall 15 terminating the upper end of skirt 14 having an axially disposed spout 16 through which conduit 16*a* extends terminated by a conventional snip-off closed tip 16*b*.

An integral valve structure is provided in cap 13 selectively operable by means of a toggle action incorporated in top closure wall 15. To this end, as is clear from FIGS. 2 and 3, top wall 15 is molded into a generally concave contour having an outer annular area 15*a* and an inner circular area 15*b*. Annular area 15*a* is shaped to slope downwardly toward the center of wall 15 providing substantially all the concavity thereof. Inner circular area 15*b* may be substantially flat when top wall 15 is in its normal configuration and the valve structure, which is hereinafter more fully described, is in its open position.

In the embodiment of the invention shown in FIGS. 1 to 5, inclusive, the integral valve structure is seen to comprise a downward interior extension 16*c* of spout 16 and a pair of toggle bosses 15*c* symmetrically formed to extend downwardly from the interior surface of inner circular area 15*b* along a diameter thereof spaced on opposite sides of spout interior extension 16*c*. The latter, for the purpose hereinafter described, may have a wall thinner than that of spout 16 and may terminate in a feathered edge 16*d*. Toggle bosses 15*c* have interior facing surfaces 15*d* formed with edges 15*e* spaced from top wall 15 to provide a pair of pinchers for clamping the feathered edge 16*c* of spout interior extension 16*b*, as is clear from FIGS. 2 and 5.

In order to improve the seal between cap 15 and bottle neck 12 and prevent leakage of the fluid contents through the threaded interconnection therebetween, a circular concentric flange 15*f* having a base shoulder 15*g* may be formed to extend downwardly from the interior surface of top wall 15 and is positioned to abut the interior surface of neck 12 with base shoulder 15*g* engaging the mouth thereof. Where the mouth of bottle neck 12 is formed with an interior bevel 12*c*, base shoulder 15*g* may likewise be beveled to conform thereto as is clear from FIGS. 3, 4 and 5.

Suitable limiting and relatively permanent retaining means may be incorporated in neck 12 and skirt 14 to insure proper engagement between flange 15*f*, base shoulder 15*g* and the mouth of neck 12 when the valve structure is in the open position shown in FIG. 4 and also to prevent inadvertent removal of cap 13 from neck 12. Such limiting and retaining means may be a tongue and groove arrangement shown in FIGS. 4 and 5 as an exterior flange 12*b* extending laterally from a lower portion of neck 12 and engaging a relatively wide groove 14*c* provided on the interior of skirt 14 spaced adjacent the lower open end thereof.

The operation of capped receptacle **10** will now be apparent. After cap **13** is molded into the one piece integral structure hereinbefore described and bottle **11** is filled with a liquid contents, such as, for example, a fluid detergent, polish, cleaner, bleach, water conditioner, lotion, food product or other household product and the like, cap **13** with closed tip **16***b* is forced and threaded onto neck **12** so that threads **12***a* and **14***a* interengage and flange **12***b* seats in groove **14***c* to properly close bottle **11** for shipping and handling purposes. With closed tip **16***b* terminating spout **16**, capped receptacle **10** may be shipped and stored with the integral valve structure in open position. As shown in FIG. 4, when top wall **15** is in a normally convex configuration with the valve in said open position, flange **12***b* abuts the bottom side wall of groove **14***c* and coacts to position flange **15***f* and base shoulder **15***g* in proper sealing engagement with the mouth of neck **12** preventing leakage and evaporation of the fluid contents through the threaded interconnection.

The consumer by merely snipping off closed tip **16***b* may dispense the fluid contents of bottle **11** through conduit **16***a* of spout **16** without removing cap **13**. Where bottle **11** is of the squeeze bottle type, the exertion of pressure on the walls thereof will aid in dispensing the fluid content. Thereafter, to seal off spout **16**, cap **13** is merely tightened on neck **12** by rotating the former in the conventional clockwise direction. Rotation of cap **13** approximately ½ turn, that is, about 180° will lower cap **13** on neck **12** from the position shown in FIG. 4 to that shown in FIG. 5, the width of groove **14***c* allowing for the relative movement of flange **12***b* therein. In so doing, top wall **15** is sprung by the mouth of neck **12** from a concave configuration to a raised, substantially flat disposition with normally concave outer circular area **15***a* flattened and inner circular area **15***b* slightly bowed outwardly, that is, slightly convex to bring the interior facing surfaces **15***d* of toggle bosses **15***c* into angular relation so that edges **15***e* thereof pinch off downward interior extension **16***c* of spout **16**. Capped receptacle **10** is now sealed for household purposes against spilling by accidental tipping and against normal evaporation.

It will thus be apparent that liquid contents may be dispensed from bottle **11** without removal of cap **13** from neck **12**, spout **16** being selectively opened and closed by the rotation of cap **13** with respect to neck **12** through approximately ½ turn, the coaction of groove **14***c* with flange **12***b* limiting the loosening of cap **13** on neck **12** to a predetermined position. Where more freedom of movement is desired flange **12***b* and groove **14***c* may be omitted.

A partial diaphragm action is initiated by the raising of top wall **15** to increase the effective area thereof thereby stretching the upper rim **14***b* of skirt **14**. The elastomeric properties of the material acts to return the skirt upper rim **14***b* and the top wall **15** to their normal configurations upon rotation of cap **13** in a counterclockwise direction to the position shown in FIG. 4.

If so desired cap **13** may be molded with an open ended spout **16**, that is, without snip-off closed tip **16***b* in which case any suitable small throw-away cap or stopper may be used to initially seal off the upper delivery end of conduit **16***a* or capped receptacle **10** may be shipped and stored with the valve in the closed position shown in FIG. 5.

Although downward interior extension **16***c* of spout **16** may be greater in length and/or wall thickness than shown in the drawings, a reduction in wall thickness correspondingly reduces the required constricting force while application of a constricting force adjacent an end of the tubular structure of extension **16***c* rather than in a midportion thereof has been found also to reduce the constricting force requirements. Thus, using a minimum wall thickness for extension **16***c* and applying the constricting force close to the feathered edge **16***d* contribute to a satisfactory, practical and efficient valve structure.

A modified form of the invention is shown in FIGS. 6, 7 and 8 as capped receptacle **20** comprising a bottle **21** having neck **22** fitted with cap **23**, the latter having a tubular skirt **24** formed with an interior seat **24***a* sized and shaped to snugly receive neck **22**. A suitable snap-on tongue and groove interconnection may be provided for retaining cap **23** on neck **22**, as for example, annular boss **22***a* engaging interior annular groove **24***b* provided in skirt **24**.

Cap **23** may be molded in a manner similar to cap **13** to comprise a skirt **24** and a top closure wall **25** having an axially disposed stem **26**, through which conduit **26***a* extends providing a dispensing spout for cap **23**, terminated by a snip-off closed tip **26***b*. Stem **26** may be made slightly longer than spout **16** for manual operation thereby of the diaphragm action incorporated in top wall **25** and may be formed with an annular protuberance **26***c* adjacent the free end thereof to facilitate finger gripping and manipulation.

Top wall **25** is molded similar to top wall **15** of cap **13** with an outer annular area **25***a* and an inner circular area **25***b* but, in order to be self sustaining in the closed position in the manner hereinafter more fully described and shown in FIG. 7, has an annular groove **25***f* defining a thin walled bendable structure between outer annular area **25***a* and skirt **24**.

In the embodiment of the invention shown in FIGS. 6, 7 and 8, the integral valve structure is seen to comprise a pair of toggle bosses **25***c* symmetrically formed to extend downwardly from the interior surface of inner circular area **25***b* along a diameter thereof. Each of the toggle bosses **25***c* has an abutment joint surface **25***d* disposed in angular relation to and joining with each other along a pivotal axis **25***e* when top wall **25** is in a concave configuration so that abutment joint surfaces **25***d* form extensions of stem **26** on the interior of wall **25** with conduit **26***a* communicating with the interior of cap **23**. Surfaces **25***d* may be abraded to improve the sealing quality of the abutment joint.

The total diaphragm action of top wall **25** and associated operation of toggle bosses **25***c* to effect selective opening and closing of conduit **26***a* will now be apparent. The exertion of an upward pull on stem **26** deforms top wall **25** first into a flattened condition and then into the convex configuration shown in FIG. 7, flexure being facilitated by annular groove **25***f*, whereby abutment joint surfaces **25***d* of toggle bosses **25***c* pivoting along **25***e* are brought together in face to face relation to close conduit **26***a*. In order to either open or close abutment joint surfaces **25***d*, top wall **25** is deformed, that is, sprung in a diaphragm action from a concave to a convex condition or vice versa. Force applied through manual pulling or pushing of stem **26** to respectively close or open conduit **26***a* causes top wall **25** to flatten initially, increasing its effective area and resiliently stretching the upper rim **24***c* of skirt **24**. The resiliency of rim **24***c* and the curved contour of outer annular area **25***a* cooperate to retain top wall **25** in either extreme concave or convex configuration. When in the convex configuration shown in FIG. 7, sufficient stress is applied on toggle bosses **25***c* to maintain an effective closure. It will also be clear from FIG. 7 that any outward pressure of the fluid contents as may be applied by tipping or inverting of capped receptacle **20** increases the pressure acting to seal the joint between surfaces **25***d*.

It is intended in practicing the invention, when desirable, to utilize the pinch type valve comprising a downward interior extension having constricting toggle bosses similar to spout extension **16***c* and bosses **15***c* in a self sustaining stem actuated top wall structure similar to top wall **25** and to also utilize the abutment joint type valve with surfaces similar to abutment joint surfaces **25***d* in a

bottle mouth actuated top wall structure similar to top wall **15**.

It is thus seen that there are provided molded bottle caps with integral valve structures whereby the several objects of this invention are achieved and which are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matters herein set forth or shown in the accompanying drawing are to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A bottle cap of the character described molded as an integral structure of elastomeric material comprising a skirt for fitting over a neck of a bottle, a top wall terminating an upper end of the skirt for extending across a mouth of the bottle neck and having a protruding stem formed with a bore providing a dispensing spout for fluid contents of the bottle, said stem and bore extending below the top wall into the interior of the cap, said top wall being molded into a normally substantially curved configuration and being resiliently deformable into a second predetermined configuration, a pair of spaced toggle bosses positioned on the top wall on opposite sides of said interior stem extension, said toggle bosses having opposing portions positioned to be brought together and clampingly constrict said interior stem extension closing said bore when the top wall is deformed into said second predetermined configuration.

2. The bottle cap defined in claim **1** in which said interior stem extension is formed with a feathered edge and said clamping constriction is aplied by said opposing toggle boss portions adjacent said edge.

3. In combination with a bottle neck having a mouth and external threads, a dispensing and sealing cap threaded on said neck, said cap being integrally formed as a unitary structure of elastomeric material having a top wall extending across the mouth in abutment therewith and having an axially disposed conduit therethrough for dispensing fluid contents from the bottle, said top wall being molded into an annular area concentric with a central circular area shaped to provide a normally substantially concave configuration and being resiliently deformable into a substantially convex configuration by said mouth on tightening the cap, valve means on the interior of said circular area responsive to said top wall deformation to open said conduit when the top wall is in said normal concave configuration and to close the conduit upon tightening the cap on the neck whereby the mouth deforms the top wall to said convex configuration.

4. The combination defined in claim **3** in which said conduit has an interior tubular extension, and said valve means includes a pair of spaced toggle bosses symmetrically arranged on opposite sides of said conduit interior extension, said toggle bosses having opposing edges positioned to be brought together and clampingly constrict said conduit interior extension in said closed position.

5. The combination defined in claim **3** in which said valve means includes a pair of toggle bosses symmetrically arranged on opposite sides of said conduit, each boss having an abutment joint surface disposed in angular relation to and joining with each other along a pivotal axis when said top wall is in said concave open position, said abutment joint surfaces being constructed and arranged to pivot with respect to each other along said axis and be brought together in abutment in said closed position.

6. The combination defined in claim **3** including an auxiliary seal between said top wall and mouth formed as a circular flange concentric with said annular and circular areas and extending into the mouth opening in abutment with the interior surface of the neck, said auxiliary seal being effective in both said open and closed valve positions to prevent leakage between said threads.

7. A bottle cap of the character described molded as an integral structure of elastomeric material comprising a skirt for fitting over and sealingly interconnecting with a neck of a bottle, a top wall terminating an upper end of the skirt having a protruding axial stem formed with a bore providing a dispensing spout for fluid contents of the bottle and being of a length for finger grip manipulation, said top wall being molded into a normally concave configuration and having an annular groove defining a thin walled bendable structure adjacent the skirt to permit diaphragm action of the top wall to a convex configuration, valve means on the interior of said top wall responsive to said diaphragm action to open said bore when the top wall is in said concave configuration and to close the bore when the top wall is deformed by pulling up on said stem to said convex configuration.

8. The bottle cap defined in claim **7** in which said top wall is formed with an annular area concentric with a central circular area, said annular groove being located on the periphery of said annular area, said stem having an interior tubular extension, said valve means including a pair of spaced toggle bosses extending from the central area symmetrically arranged on opposite sides of said stem interior extension, said toggle bosses having opposing edges positioned to be brought together and clampingly constrict said stem interior extension in said closed convex position.

9. The bottle cap defined in claim **7** in which said top wall is formed with an annular area concentric with a central circular area, said annular groove being located on the periphery of said annular area, said valve means including a pair of toggle bosses extending from the central area symmetrically arranged on opposite sides of the bore of said stem, each boss having an abutment joint surface disposed in angular relation to and joining with each other along a pivotal axis when said top wall is in said concave open position, said abutment joint surfaces being constructed and arranged to pivot with respect to each other along said axis and be brought together in abutment in said closed convex position.

10. A bottle cap of the character described having a top wall formed with a central axially extending stem formed with a bore providing a dispensing spout for fluid contents of the bottle and being of a length for finger grip manipulation, said top wall being molded to selectively assume by diaphragm action a concave and a convex configuration upon application of a motivating force to said stem, valve means integrally formed on the interior of said top wall responsive to said diaphragm action to open the spout when the top wall is in said concave configuration and to close the spout when the top wall is moved to said convex configuration.

11. In combination with a bottle neck having a mouth, a dispensing and sealing cap having a skirt mounted on said neck for relative axial movement, said cap being formed of elastomeric material and having a top wall extending across the mouth in abutment therewith, said top wall having an axially disposed conduit therethrough for dispensing fluid contents from the bottle and being molded into a normally substantially concave configuration, said top wall being resiliently deformable into a second predetermined configuration by pressure of the mouth on axial movement of the cap, valve means integrally formed on the interior of said top wall responsive to said deformation to open said conduit when the top wall is in said concave configuration and to close said conduit when the top wall is moved to said second predetermined configuration, said top wall having an auxiliary sealing means for preventing leakage between the neck and cap abutting said mouth in both axial positions of said cap, and means coacting between said neck and cap to limit said aixal movement and retain said auxiliary sealing means in a sealed abutment relation with said mouth.

12. The combination defined in claim **11** in which said auxiliary sealing means includes a circular flange ex-

tending into the mouth opening in abutment with the interior surface of the neck.

13. The combination defined in claim 11 including a threaded interconnection between said cap and neck to effect said axial movement on rotation of the cap on said neck.

14. The combination defined in claim 11 in which said axial movement limiting means comprises a tongue and groove interengagement between said skirt and neck.

15. A bottle cap of the character described molded as an integral structure of elastomeric material comprising a skirt for fitting over a neck of a bottle, a top wall terminating an upper end of the skirt for extending across a mouth of the bottle neck and having a conduit therethrough for dispensing fluid contents from the bottle, said top wall being molded to assume a normal concave configuration and being deformable by diaphragm action into a convex configuration, a pair of spaced toggle bosses positioned on said top wall to open said conduit when the top wall is in said concave configuration and having cooperating portions adapted to be brought together to close said conduit when the top wall is deformed into said convex configuration.

16. The bottle cap defined in claim 15 in which said skirt has interior cap positioning means for engaging companion means on the neck of the bottle, said cap positioning means and companion means being so constructed and arranged to provide relative axial movement of the cap with respect to said bottle mouth, whereby said mouth engages said top wall to deform the latter into said convex configuration on movement of said cap from a first to a second axial position on said neck.

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