

[54] **BOTTLE STOPPER** 487,809 12/1953 Italy..... 215/40
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both of France 504,303 4/1939 United Kingdom..... 215/40

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[30] **Foreign Application Priority Data**
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[52] **U.S. Cl.**..... **215/253, 215/352, 215/353,**
 215/364

[51] **Int. Cl.**.....**B65d 39/04, B65d 41/32**

[58] **Field of Search**..... 215/31, 40, 41, 42, 47,
 215/48, 1 R, 1 C, 253, 352, 353, 364

[56] **References Cited**

UNITED STATES PATENTS

40,415	10/1863	Kline.....	215/47
844,400	2/1907	Radbruch	215/47
2,674,472	4/1954	Meyer.....	215/40
3,415,405	12/1968	Rausing et al.	215/48
3,604,583	9/1971	Linkletter	215/47
3,610,306	10/1971	Summers	215/41

FOREIGN PATENTS OR APPLICATIONS

21,443	5/1896	United Kingdom.....	215/40
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[57] **ABSTRACT**

Combination of bottle neck and stopper therefor in which frusto-conical internal and external coaxial surfaces of the neck and stopper respectively, cooperate to move a resilient sealing ring upwardly on and along the external surface of the stopper, by and in response to insertion of the stopper into the neck until, in final upward position the stretched ring snaps into an annular channel in the stopper and at the same time sealingly engages an inwardly curled rim at the top of the bottle neck. In this final position an external flange integral with the stopper engages the top surface of the rim and assists in effecting a gas- and liquid-tight seal of the stopper with the neck. The construction is particularly suitable for use with bottles of synthetic plastic material and in containing liquids with occluded gas such as beer, soda water, etc. because the seal effected by the ring increases in effectiveness with increase in gas pressure within the bottle.

10 Claims, 6 Drawing Figures

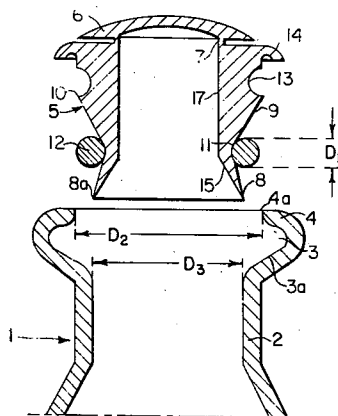


FIG. 1

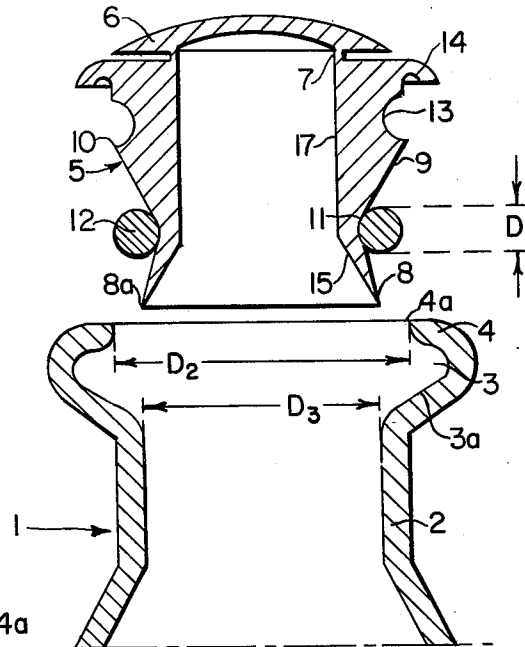
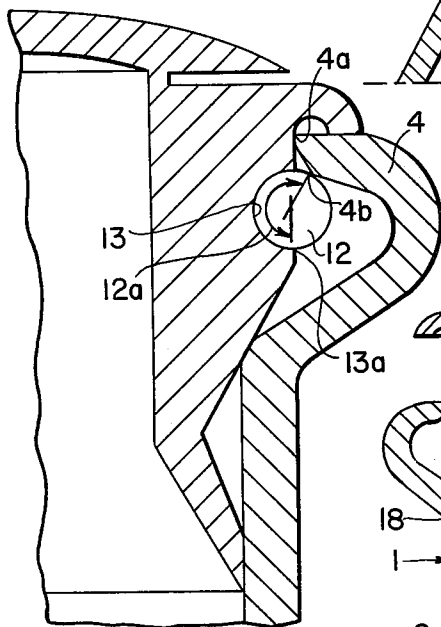


FIG. 4a

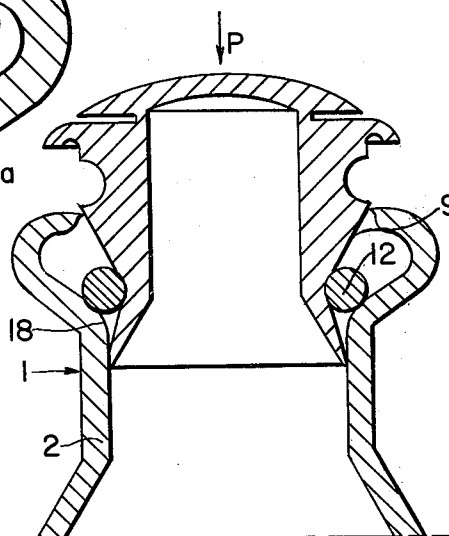


FIG. 2

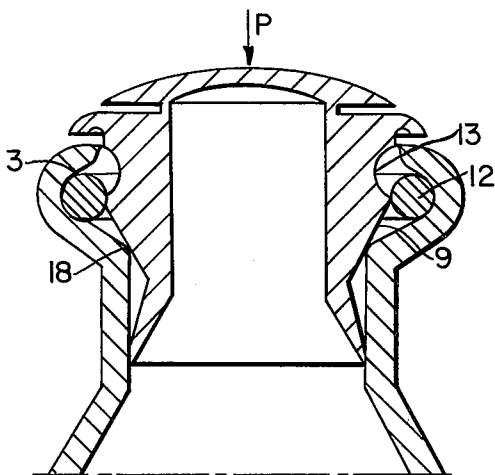


FIG. 3

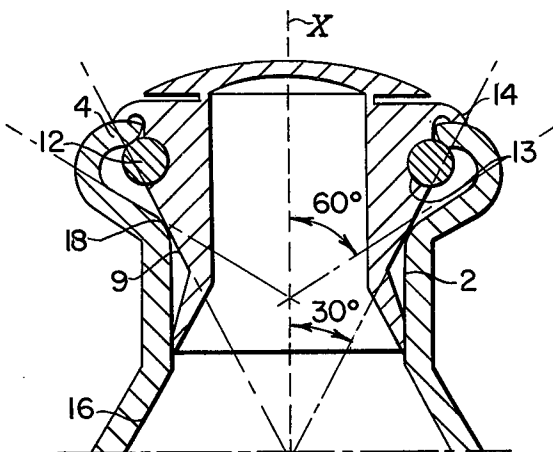


FIG. 4

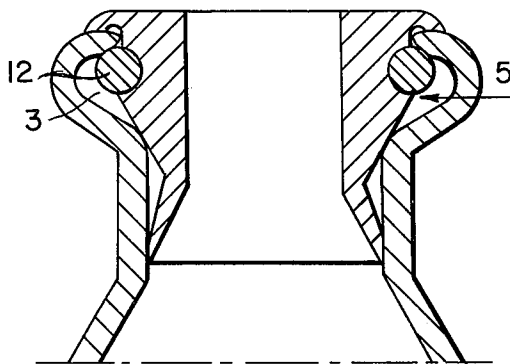


FIG. 5

BOTTLE STOPPER

BACKGROUND OF THE INVENTION

This invention relates to a stopper for bottles, especially those of plastic materials and intended to contain liquids under pressure such as beer, gas-charged mineral waters, sodas and the like. It also relates to the combination of such stopper, with a cooperatively formed bottle neck.

Prior art stoppers or caps intended for the aforesaid use are usually mounted over the top of the bottle neck, and comprise a normally fluid-tight joint effected by a cap having a depending rim fitting down over and crimped beneath an exterior rim or bead integral with the top end of the neck. Such devices are not, however, entirely satisfactory in use because the internal pressure developed by the gas-occluding liquid or beverage within the bottle, unavoidably tends to force the cap off its seat on and over the pouring opening of the neck. The sealing joint of the cap is usually a gasket or ring of compressible material such as cork, expanded polyvinyl chloride, or the like. Thus the internal pressure generated by the gas-charged contained liquid may force the cap loose from its seat and thereby permit the escape of some of the carbonic or other gas which, desirably should be retained dissolved in the beverage. It has been found that the internal pressure within a bottle containing a carbonated liquid may attain a value of from 3 to 4 bars at a temperature of 20° C., the actual value of course depending upon the quantity of gas initially occluded per unit mass of liquid. When the quantity of gas is increased to about 6 grams per litre of liquid, the pressure at 45° to 50° C. may rise as high as 6 to 8 bars, thereby becoming sufficient to cause leakage from the necks of bottles, particularly those made of plastic materials. The leakage is, of course, of greater severity and importance as the temperature of the liquid rises.

SUMMARY OF THE INVENTION

The present invention has for its main object and purpose, a bottle neck and stopper which cooperate to obviate the aforesaid prior art defects. The invention is of particular usefulness in connection with bottles made of synthetic plastic materials.

At its top end the neck of the bottle has an upwardly and outwardly sloping or flared frusto conical ramp surface with upper edge curled inwardly to define a circular inwardly facing channel. The stopper is a hollow body with a generally cylindrical internal surface, and sized for insertion into the neck of the bottle. At its top the stopper is closed by a cover or cap integrally united with the body thereof along a thin or weakened band which may be readily cut or torn off or otherwise easily detached when the contents of the bottle are to be poured.

The body of the stopper has an outer surface defined in part by lower and upper frusto conical surfaces smoothly and integrally united at their smaller ends to form a constriction within which an O ring seal of elastomeric material may be temporarily seated and retained. When seated in the aforesaid constriction the ring has a diameter smaller than the internal diameter of the channel formed as aforesaid at the top of the bottle neck, but greater than the internal diameter of the cylindrical neck portion which extends downwardly from the channel. The upper frusto conical surface ter-

minates at its upper end in a circular ridge forming the lower rim of an outwardly facing channel semicircular in radial planes through the central longitudinal axis of the stopper. The ridge has a diameter slightly less than the minimum diameter of the inwardly curled top edge or rim of the neck. The aforesaid semi-circular channel has a depth or radius a little smaller than the radius of the O ring seal or gasket.

The stopper is pressed into then neck by a force exerted on its upper end. During this movement, as the stopper continues to penetrate into the neck, the O ring seal is in effect cammed or rolled upwardly over and along the upper frusto conical surface of the stopper and, at the same time rolls or slides upwardly on and along the interior surface of the ramp portion of the bottle neck. Upward movement of the ring on and over the upper frusto conical portion of the stopper tensions it further and causes it, in the final emplaced position of the stopper, to snap into a channel therein, semicircular in transverse section. The final position is such that the ring presses against the under surface of the curled edge of the rim of the neck. Thus the rim which is slightly yielding, urges the stopper downwardly to firmly seat the flanged top thereof against the rim surface of the neck.

When the force inserting the stopper into the neck is released the gas pressure of the contained liquid or beverage, urges the stopper outwardly along the neck. But this force merely causes the ring to seat with greater sealing pressure against the curled rim of the neck. In other words the greater the internal pressure within the bottle, the greater the sealing pressure of the ring against the inwardly curled rim. As such internal pressure increases with temperature of the beverage, the stopper, bottle neck and ring cooperate to produce an excellent fluid and gas-tight seal, without danger of escape of liquid or gas, such as might be caused by deformations and/or the separation of sealing parts of prior art joints.

The bottle is opened by removing the top or cap portion only of the stopper. This is easily effected because the top is connected to the body of the stopper by and along an integral weakened band. In accordance with an advantageous embodiment the hollow stopper has an internal wall which is essentially cylindrical over its upper portion but at its lower end is flared outwardly to form a generally frusto-conical surface which merges smoothly into the internal surface at the juncture of the neck and body portion of the bottle. Due to this form, when the bottle is opened and tipped the beverage flows out in a smooth stream, without turbulence, thus aiding in preventing the undesirable escape of occluded gas, as in the case of soda water and beer. This construction is a decided advance over the prior art wherein the neck has an internal channel terminating at its outward end in a ridge which creates undesirable turbulence as the beverage flows out.

In a particularly advantageous feature, the upper part of the stopper is shaped to form an outward lateral annular flange which normally presses down against the upper curled rim portion of the bottle. The flange thus opposes upward deformation of the curled rim portion, as the stopper is urged outwardly by the pressure of occluded gas in the beverage. This aids in assuring complete sealing.

The construction and operation will be better understood after a study of the following detailed description

of a non-limiting example, in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical axial section showing the stopper axially aligned with but out of contact with the neck of the bottle, as the parts would be when the stopper is being moved into sealing relation with the neck;

FIG. 2 is a view like FIG. 1 but showing the stopper inserted part way into final or sealing relation;

FIG. 3 is a view corresponding to FIG. 2, showing the stopper nearing its final emplaced position and with the O-ring about to snap into its channel seat in the stopper;

FIG. 4 shows the stopper in its final emplaced and sealing position;

FIG. 4a is a fragmentary view similar to that of FIG. 4 shown at an enlarged scale; and

FIG. 5 shows the parts in the same relation as in FIG. 4, with the top cap or closure of the stopper cut off or otherwise removed to permit pouring of the contents of the bottle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to FIG. 1, the upper or neck part of a bottle is generally identified at 1, including a cylindrical neck 2 with its upper end sloping or flared upwardly and outwardly as at 3a, to define a first inverted frusto-conical ramp. At its top this ramp is curled inwardly as at 4 to thus define an internal circular channel 3. The bottle may be formed of synthetic plastic material such as polyvinyl chloride extruded by blowing. The interior diameter of the rim 4a of top portion 4 is, as shown, somewhat greater than that of neck portion 2.

The stopper generally identified at 5 is a hollow item which may also be formed of molded synthetic plastic such as polypropylene, a material not readily deformed by heating, and is sized for a proper fit within the bottle neck. The top end of the stopper is closed by a cover or cap 6 integrally attached to the generally internally cylindrical part by a thin or weakened band of material 7 which may be readily cut or broken off to afford access to the contents of the bottle.

The external shape of stopper 5 includes a lower circular rim 8a of about the same, or slightly greater, diameter than the internal diameter of neck 2. From this rim the surface flares or slopes upwardly and inwardly in an erect frusto-conical surface at 8 to a constriction at 11, then upwardly and outwardly in a second inverted frusto-conical surface as indicated at 9. At its upper end surface 9 terminates in a circular ridge 10. Thus the two frusto-conical surfaces 8 and 9 integrally united at their smaller ends of equal diameter, define the constriction 11 within which an O-ring seal 12 of elastomeric or resilient rubbery material may seat and be temporarily retained. It is important to note that the diameter of the upper ridge 10 of surface 9 is a little less than the internal diameter 4a of top rim 4; and also that when ring 12 is in the position shown upon FIG. 1, its maximum or external diameter is a little less than that of ridge 10, but greater than that of lower rim 8a.

Proceeding upwardly from ridge 10, the external surface of stopper 5 is formed with a channel 13 which as clearly shown upon FIG. 1, is semi-circular in transverse section. The diameter of the channel is appropri-

ately about the same or a little less than that of a radial cross section of O-ring 12 so that, as subsequently explained the ring may stretch and roll up surface 9 to snap into channel 13 in response to pressing of the stopper into the bottle neck. In the new or final position the ring, as is clear from inspection of FIG. 4, has an exterior diameter greater than the internal diameter of rim 4a.

Above channel 13 the stopper is flanged outwardly and then downwardly as at 14 to define a downwardly facing and slightly yielding circular rim surface which as seen in FIG. 4 may have sealing contact with the upper surface of rim 4a of the neck and oppose deformation under the action of pressure of gas occluded in the beverage in the bottle.

Interiorly the stopper is flared or beveled downwardly and outwardly at its lower end as indicated at 15, FIG. 1, and thus defines an internal frusto-conical surface having a lower edge snugly and yieldingly fitting the lower end of the cylindrical neck 2. As seen in FIG. 4, when the stopper is fully emplaced this frusto-conical surface is essentially a smooth continuation of the interior surface 16 of the bottle as it enlarges downwardly from neck 2. From the top edge of beveled surface 15 the interior cavity of the stopper is essentially cylindrical as indicated at 17. This helps to regulate the flow of beverage and obviates turbulence which especially where the bottle contains beer or soda, creates excessive frothing.

OPERATION

FIG. 2 shows the stopper after it has been moved downwardly from the position of FIG. 1, into initial contact with the neck. In this position of FIG. 2, rim 8a has frictionally entered cylindrical neck portion 2, and sealing ring 12 has engaged the ramp surface 3a of the neck but is not yet displaced out of its initial location in constriction 11.

By continued force upon the stopper as indicated at P, FIGS. 2 and 3, the latter moves further and axially into the neck. During this movement O-ring 12 stretches and rolls or slides upwardly over and in contact with frusto-conical surface 9 due to a camming action or cooperation by and between surfaces 3a and 9. Simultaneously it rolls or glides upwardly over ramp surface 3a of the neck. In the position shown upon FIG. 3, O-ring 12 is stretched outwardly to about maximum diameter and is about to ride over ridge 10. Then on slight further downward movement of the stopper the ring snaps into channel 13 and in this position, in cooperation with the inwardly curled rim 4 of the neck, cams the stopper to final position wherein top flange 14 presses firmly on the upper surface of rim 4. It is also noted that in this final position the internal circular junction formed between the upper end of cylindrical neck 2 and the lower edge of integral ramp 3a, makes a continuous and sealing contact with frusto-conical surface 9 of the stopper.

As soon as the force being applied at P is released, the pressure exerted on the stopper by the carbonated liquid or beverage urges it outwardly. The channel 13 is sufficiently deep so that O-ring 12 is retained therein and is powerfully wedged or pinched between shoulder 10 and inwardly extending rim 4 at the top of the neck. Since the flexible or resilient top flange remains somewhat distorted and therefore continues to exert a downward force on the annular top surface 4a of rim 4, the

rim is thereby constrained against upward flexure by ring 12.

Thus a perfectly gas- and liquid-tight joint is provided between the O-ring, the stopper and the neck, and which becomes more effective and efficient with increase in pressure within the bottle. As is also evident from FIG. 4, the effectiveness of the seal is enhanced by the zone of contact between ridge 18 of the neck and surface 9 of the stopper, as well as by the annular zone of contact between the yielding or resilient rim 8a at the base of the stopper, and the contiguous wall of neck 2.

The figures of the drawing are essentially accurate in scale and thus show correct angles, slopes and relative dimensions of the parts giving the beneficial new and useful results above set forth. In the preferred embodiment shown, the surfaces 3a and 9 are frusto-conical surfaces belonging to cones which are both coaxial in the axis of symmetry XX (FIG. 4), when the stopper and bottle are assembled. These cones possess generating angles of 60° and 30° respectively. In such case the diameter D_1 of a radial cross section of the O-ring is about two-thirds the difference between the diameter D_2 of the rim 4a and the internal diameter D_3 of the cylindrical portion of neck 2. The diameter of channel 3 may be a little less than that of the ring, as previously explained. In other words, in this example the ramps 3a of the neck and 9 of the throat on the stopper constitute frusto-conical surfaces whose cones have generating angles of 60° and 30° respectively, measured of course from the axes of those conical surfaces. When the stopper and bottle are assembled together as in FIG. 4, these axes coincide as shown at XX in FIG. 4, where these angles are shown. The diameter of the ring 12 constituting the toric joint is about two-thirds of the difference between the diameter D_2 of the upper lip 4a and the diameter D_3 of the neck, and the dimensions of the throat are slightly superior to that difference.

It will also be noted from FIG. 4 that the channel 13 and top portion 4 are so dimensioned that the radially innermost point of contact of the latter with the sealing ring 12 and the outermost point of contact of the ring 12 with the lower part of the channel 13 are spaced from each other by more than 180° of angular measure of the cross-section of the sealing ring, measured from the center of that cross-section radially inwardly toward the axis of the bottleneck. This feature of construction is illustrated in FIG. 4a, where the radially innermost point of contact of the top portion 4 with the sealing ring 12 is identified by reference character 4b and outermost point of contact of the sealing ring 12 with the lower part of the channel 13 is identified by reference character 13a. The angular spacing from each other of the points 4b and 13a, measured from the center of the cross-section of the sealing ring 12, radially inwardly toward the axis of the bottleneck is identified at the arc 12a.

To open the bottle it is only necessary to cut or tear off the cap 6 along the circular weakened band 7 by which it is attached to the body of the stopper. Body 5 then remains in the neck as shown upon FIG. 5 and beneficially assists in pouring the beverage in the way previously stated.

It is understood that changes in shapes, proportions, angles, etc. may be made within reasonable limits, without affecting the new and useful results which the invention affords. In the claims the terms "top," "down-

wardly," etc., refer to the positions of the parts as viewed in the drawing.

We claim:

1. The combination, with a bottle neck flared outwardly and upwardly at its upper end to define an internal inverted frusto-conical surface surmounted by an inwardly curled rim, of a hollow stopper formed to fit said neck and to define an external second inverted frusto-conical surface of lesser generating angle than said first surface and surmounted at its top by an annular outwardly-facing channel, a sealing ring movable along said second surface from a first position about the smaller diameter thereof, to a second position in said channel, said surfaces cooperating in response to insertion of said stopper into said neck, into a final sealing position therein, to cam said ring from first to second position wherein the same makes sealing contact with said rim, said channel and rim being so dimensioned that the radially innermost point of contact of said rim with said sealing ring and the outermost point of contact of said sealing ring with the lower part of said channel are spaced from each other by more than 180° of angular measure of the cross-section of said sealing ring measured from the center of said cross-section radially inwardly toward the axis of the bottle neck.

2. The combination of claim 1, said channel being surmounted by a radially- and outwardly-extending yielding flange, said flange sealingly pressing down on said rim when said stopper is in said final sealing position.

3. The combination of claim 1, the lower part of said neck being generally cylindrical internally, the juncture between said cylindrical neck part and first surface forming an annular ridge, said ridge sealingly engaging said rim when said stopper is in said final sealing position.

4. The combination of claim 1, in which the generating angles of said first-named and second-named frusto-conical surfaces are about 60° and 30°, respectively.

5. The combination of claim 1, said channel being semicircular in transverse section, said ring being an O-ring having a radius about the same as that of said channel.

6. The combination of claim 5, the interior lower surface of said neck being cylindrical, said ring having a diametral cross section of diameter about two-thirds the difference between the diameter of said rim and that of said cylindrical surface.

7. The combination of claim 1, an erect third frusto-conical surface integral with and extending coaxially downwardly from said second and inverted frusto-conical surface, said second and third surfaces defining at their juncture a constriction retaining said ring releasably in said first position.

8. The combination of claim 7, said constriction being annular and having a diameter less than the internal diameter of the lower cylindrical portion of said neck.

9. The combination of claim 7, said stopper being hollow, the larger and lower end of said third surface forming a yielding annular edge sealingly engaging the lower internal surface of the neck when said stopper is in said final sealing position.

10. The combination of claim 9, said channel being surmounted by a radially outwardly extending yielding integral flange, said flange pressing down on said rim when said stopper is in said final sealing position, a cap surmounting said flange and closing the top end of said stopper, and a weakened band integrally uniting said stopper and cap.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,874,541

DATED : April 1, 1975

INVENTOR(S) : Jean Lagneaux and Leon Roger Vermeerbergen

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 9, for "then" substitute --the--;
line 35, for "the" substitute --to--.

Column 6, line 28, for "in" (first occurrence)
substitute --is--;
line 34, for "said rim" substitute --said
second surface--; insert --is-- before "in".

Signed and Sealed this

nineteenth Day of August 1975

[SEAL]

Attest:

RUTH C. MASON

Attesting Officer

C. MARSHALL DANN

Commissioner of Patents and Trademarks