Dec. 15, 1953 M. B. BEAUBAIRE ET AL 2,662,656

RECEPTACLE CLOSURE

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Fig. 1.

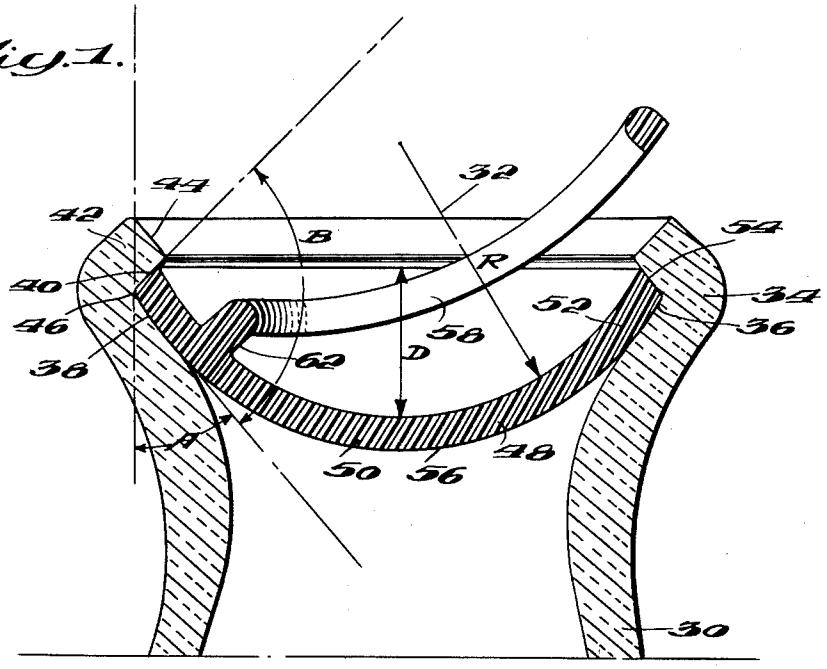


Fig. 2.

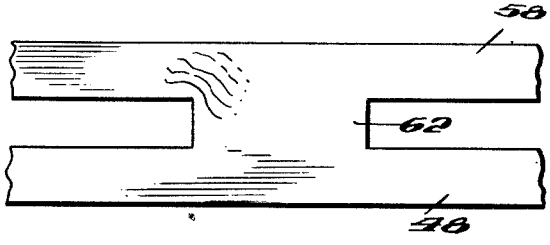
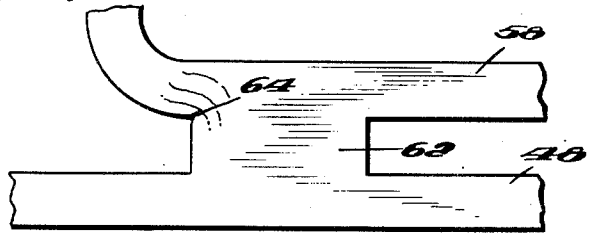


Fig. 3.



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Fig. 4.

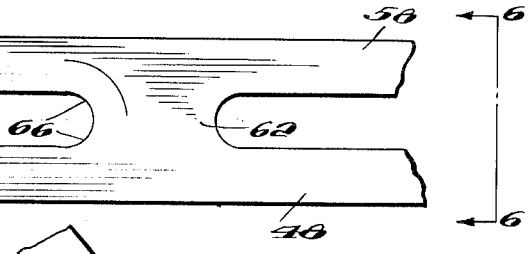


Fig. 5.

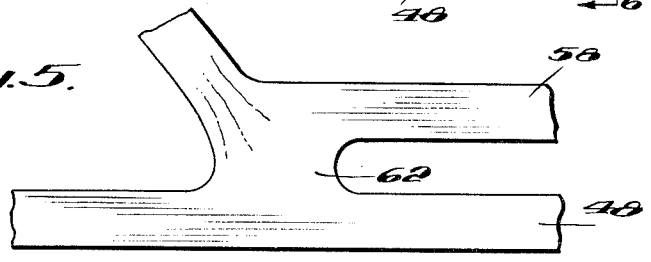


Fig. 7.

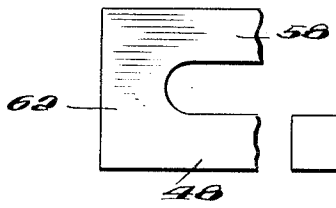


Fig. 6.

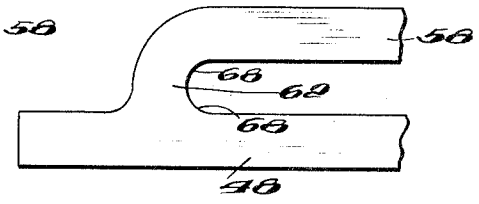


Fig. 8

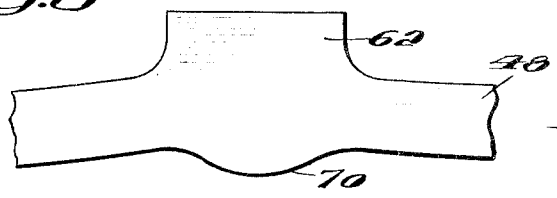


Fig. 18.

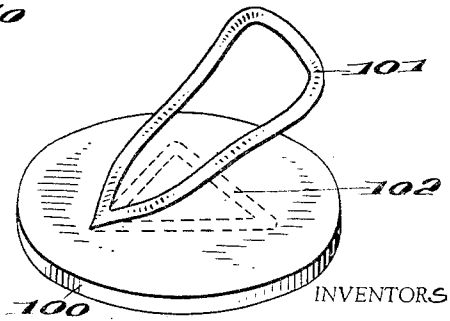
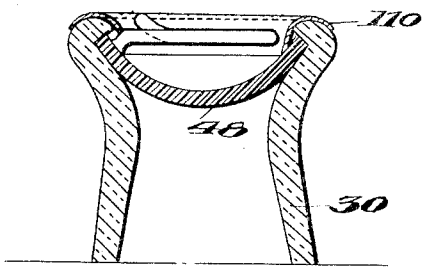


Fig. 19.



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Fig. 9.

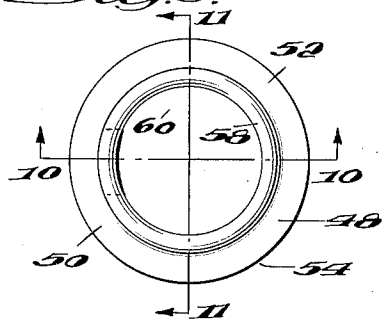


Fig. 10.

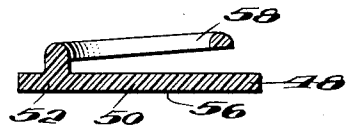


Fig. 11.

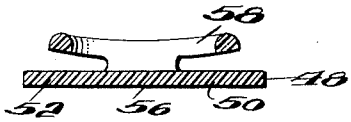


Fig. 12.

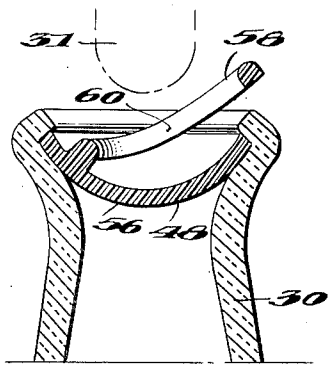


Fig. 17.

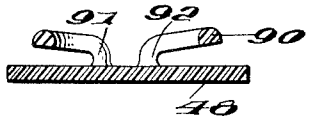


Fig. 13.

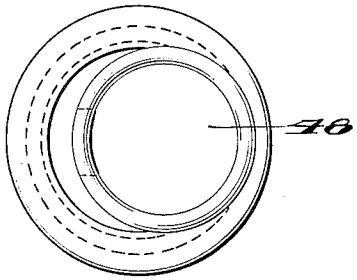


Fig. 14.

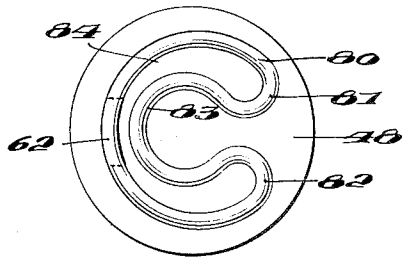


Fig. 15.

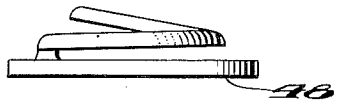
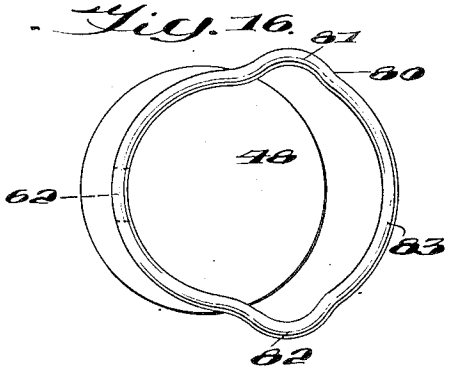


Fig. 16.



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UNITED STATES PATENT OFFICE

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RECEPTACLE CLOSURE

Marshall B. Beaubaire and Martin E. Strand, Minneapolis, Minn.

Application April 14, 1953, Serial No. 348,714

8 Claims. (Cl. 215—51)

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This invention relates to closure means and more particularly to closure means for receptacles for beverages for human consumption. The closure means in accordance with the invention is admirably suited for bottles for carbonated beverages, beer, and the like, which are maintained under pressure.

At the present time, great use is made of closures known as crown caps. These, from the standpoint of durability and cost have proved quite satisfactory. However, because the pressure of the gases within the receptacles is consantly exerting its force in the direction of removal of the cap, crown caps seldom prevent leakage of the gases and a consequent diminishing of the pressure within. Moreover, their structure is such that, if once removed to permit a portion of the contents of the receptacle to be withdrawn, they cannot, when replaced, provide a leakproof closure as will prevent escape of the gases. Accordingly, the beverages soon become "flat."

The present invention approaches the problem from the standpoint that a satisfactory closure could well make use of the pressure of the gases within the receptacle in assisting to maintain the closure in sealing position. With this desideratum in view, the invention as applied to a beer bottle, for example, makes use of a comparatively thin flexible disk which is forced into an annular, angular groove in the inner surface of the neck of the bottle near the mouth, the disk being of greater diameter than the groove so that the disk, when in position in the groove, is dished inwardly. In that position, the pressure within tends to force the peripheral edge of the disk tightly against the surface of the groove.

While the general idea of such a disk stopper has been known for many years, their use has never proved satisfactory in practice for a number of reasons. The requirements of a satisfactory disk stopper of that general type are many and, until our present invention, no such stopper has been known or proposed which will meet them.

As relating to closures for bottled beer, for example, the disk stopper first must be strong enough and stiff enough, and be so lodged within the neck of the bottle, as to resist the internal pressures caused by the beer tending to force out the stopper. These internal pressures are often as high as 8 to 9 atmospheres (as when heated during pasteurization to 150° F. and to 15 atmospheres with carbonated beverages).

While resisting such pressures, the stopper, on

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the other hand, must be sufficiently flexible to be readily inserted in the groove in the neck of the bottle and to be readily removable from the groove by the user. Moreover, the disk stopper must be capable of resisting considerable bending in order to permit its insertion and removal, while not cracking or tearing from the stress thus imposed.

Carbonated beverages are often subjected to temperatures ranging from below zero Fahrenheit to pasteurization temperatures, or higher. The disk stopper and its relationship to the groove in the bottle neck must be such that the characteristics mentioned will not be adversely affected by such temperature changes. The disk not only should not become brittle or soft when subjected to various temperatures normally encountered, but its important physical characteristics and dimensions should not vary more than minutely.

Still further, the material of which the stopper is made should not contaminate or affect the flavor of the beverage contained in the bottle, and conversely, the beverage should not affect the stopper material either chemically or physically upon either brief or continued contact.

In addition to these important considerations, there are those of simplicity of construction and easy and low expense of manufacture. These and the cost of the material employed must be very low to compete with the low cost of known closures, such as the crown cap.

Apropos of the commercial aspects, a stopper, preferably should be capable of being produced in various colors, and it should be possible to imprint or mold or otherwise place a trade-mark thereon. Also the stopper should preferably be free from sharp edges which might cut the user's hand.

While these and other requirements have been known, no combination of means has, prior to now, been devised which would supply the need.

The present invention has for a general object, the provision of such means. The invention makes use of a disk stopper comprised of certain materials having critical characteristics and dimensions which are such that, when combined with a groove having dimensions and angles specifically related to the characteristics and dimensions of the disk, a closure answering the above requirements results.

This and other objects will become apparent from a consideration of the description of the invention in conjunction with the drawings in which:

Fig. 1 is a cross sectional view showing the

upper portion of a bottle having the stopper inserted;

Figs. 2 through 8 are enlarged fragmentary elevational views of the connection between the tab and disk;

Fig. 9 is a top plan view of the stopper shown in Fig. 1;

Fig. 10 is a vertical sectional view taken on lines 10—10 of Fig. 9;

Fig. 11 is a vertical sectional view taken on lines 11—11 of Fig. 9;

Fig. 12 is a longitudinal sectional view of the neck of a bottle showing the stopper of Fig. 1 applied thereto;

Fig. 13 is a top plan view of the bottle closure shown in Fig. 12;

Fig. 14 is a top plan view of a modification of the invention;

Fig. 15 is a side elevational view of the stopper shown in Fig. 14;

Fig. 16 is a top plan view of the stopper of Fig. 14 showing the ring extended;

Fig. 17 is a view similar to Fig. 11 of a modification of the invention;

Fig. 18 is a perspective view of a further modification of the invention; and

Fig. 19 is a vertical sectional view showing a sanitary covering for said bottle.

The preferred structure shown in the drawings consists of a bottle of glass or the like, the neck of which is illustrated and which is formed with an internal groove providing an outwardly flaring shoulder and an inwardly turned abutment. Cooperating with the bottle is a stopper constructed from a flexible material having a flat plane disk form and of a larger diameter than the maximum diameter of the internal groove. The disk is adapted to be cupped and forced into the groove to bring the lower marginal portion of said disk into engagement with the shoulder and the edge of the disk into engagement with the abutment.

Overlying the disk is a pull tab in the form of a ring, also constructed of flexible material, which tab is spaced from the disk proper throughout the greater portion of its extent and which may be attached to said disk in any one of several ways. The preferred manner of attaching the tab is by means of a connector integral with the disk and with the tab and of the same material as both. The tab is readily accessible and, when a finger is inserted in the same and the tab is pulled, the stopper may be withdrawn from the groove in the bottle to open the bottle. This arrangement and modifications thereof will be described below.

A sectional view of a bottle having such a stopper inserted therein is shown in Fig. 1 of the drawings. The bottle has a neck **30** which is formed with the usual opening **32** by which access to the interior of the bottle may be had. It is to be understood that the invention is believed to have its greatest use as a closure for bottles and cans, but it is conceivable that the stopper would have application in other passageways, the ingress-egress portions of which must be blocked with a stopper of some type.

With the receptacle illustrated the rim **34** of the neck is somewhat enlarged and is formed with an internal groove **36**. This groove is so constructed as to provide an outwardly flaring shoulder **38** and an inturned angular abutment **40**. This construction provides a lip **42** which overlies the shoulder **38**. The lip **42** is formed with an inverted frusto-conical surface **44** which serves as a funnel and directs the stopper into closing position and meets the surface **40** along the annular corner **46**.

The stopper is indicated generally by the reference number **48** and in the preferred embodiment is formed of a disk **50** shown in Figs. 9, 10 and 11. This disk is of a suitable flexible material and is of a larger diameter than the maximum diameter of the groove **46**. It is to be understood that it is within the scope of the invention to have the disk stopper normally cup-shaped, but the preferred embodiment is a plane disk which becomes cup-shaped only when inserted in its groove. The disk stopper has a marginal portion **52** formed with a circular edge **54** at right angles to an undersurface **56**.

Overlying the disk **50** is a pull tab **58** which is also preferably constructed of a resilient material and which, in the preferred embodiment, is spaced parallel from the disk **50** being connected at one point. This tab is in the form of a ring having a hole **60** in the center thereof and so that the finger of the user may be inserted therein during removal of the stopper. The tab **58** may be of any convenient diameter and preferably of a diameter sufficient to permit a finger to be easily inserted into the hole **60**. In the drawing, the tab has been shown as disposed within the confines of the disk when the disk is in its plane configuration. However, a larger tab may be used even of such dimensions as to bring the extent of the tab outwardly of the edge **54** of the disk. In either case, the hole **60** in the tab exposes the center of the disk. Between the disk **50** and the tab **58** is a connector **62** which is also constructed of flexible material and which is integral with both the tab **58** and the disk **50**. As shown in the preferred embodiment of the invention, the tab connector and disk are all of the same material.

The stopper is inserted into its groove in the following manner: After the receptacle has been filled, the disk **50** is laid across the upper end of the neck **30** resting on the lip **42**. A plunger is passed through the hole **60** in tab **58** and pressed downwardly upon the center of the disk **50**. A spheroidal shaped plunger such as illustrated in outline at **31** in Fig. 12 may be employed for this purpose. This downward movement causes the disk to cup and the under surface **56** thereof, at the marginal portion **52**, to ride inwardly along the surface **44** of the lip **42**.

When the edge **54** of the disk clears the inner corner of the lip **42** the marginal portion springs outwardly and the same snaps into groove **46** with the surface **56** of the marginal portion seated on the shoulder **38** and the edge **54** bearing against the abutment **40**. This effects a seal and prevents leakage.

In the removal of the stopper, the tip of a finger is inserted into the hole **60** in the tab **58** and the tab is elevated sufficiently to permit of inserting the finger well into said hole. Where an extremely small closure is desired, and as a result a tab having a small hole is used, a pencil or other similarly shaped article may be used instead of the finger. After insertion, a pull on the tab in a direction away from the connector **62** will quickly disengage the adjoining portion of the edge **54** of the stopper from the abutment **40**, and break the seal formed at the edge of the stopper. The stopper can then be partially removed to permit pouring the contents out of the receptacle, or the receptacle can be inverted so as to let gas pressure force out the liquid contents. When the tab is released, the disk will

either snap back into closing position or can easily be pushed by finger pressure into closing position to thus restore the seal. If desired, the stopper can be completely removed by continuing the pull on the tab.

In the preferred embodiment of the invention, the groove of the bottle neck in which the stopper sits has a particular configuration which has been found to be very satisfactory for retaining a disk of comparatively small dimensions at very high internal pressures. It must also be noted that the surfaces of the groove should be very smooth so that a gas-tight seal will be formed between the groove and the disk. The surface of the shoulder **38** is inclined downwardly and is approximately 45° from the axis of the egress of the bottle. The abutment **40** intersects the shoulder surface **38** at approximately right angles. These angles are shown in the broken lines in the life side of Fig. 1, and are designated by the reference letters A and B respectively.

The angular relationship of the groove surfaces shown in Fig. 1 is preferred, but it is to be understood that the angular relationship can be varied without departing from the scope of the invention. Variance in the angular relationships will necessitate changes in the dimensions of the stopper where it is desired to hold the same pressure in the receptacle. For example, if the angle B is maintained constant and the angle A is increased, it will be easier for the stopper to be forced out by the internal pressure in the bottle. Accordingly, it would be necessary to increase the thickness of the disk **48** in order to increase the strength of the stopper and its resistance to being forced out.

On the other hand, it is possible to maintain angle B constant while decreasing angle A toward 0°. Such a decrease in angle A would permit a disk of less thickness to be used in order to maintain the same pressure in the receptacle. It has been found, however, that a substantial decrease in the angle A will make more difficult the removal of the stopper and, therefore, decreasing that angle to any considerable extent has been regarded as unsatisfactory.

It is to be understood also that angle B can be varied and the same considerations discussed above in connection with angle A will apply. It has been found that angle B can be increased by almost 45° although the thickness of the disk will have to be increased accordingly.

Likewise, the angle B can be decreased by almost 45°, but such a decrease makes the stopper increasingly more difficult to remove from the bottleneck.

It will be observed that, when the disk **50** is seated in its groove as specified above, the internal pressure on the under surface **56** of the disk will cause the edge **54** to be forced tightly against the abutment **40** to form a gas-tight seal. Also the marginal portions of undersurface **56** will form a seal with the shoulder **38**.

The changes in the angles mentioned above will change the radius of curvature of the stopper and also the deflection of the stopper. Knowing these characteristics, it is possible to calculate the necessary dimensions of the disk in order to withhold a predetermined pressure by using the formula to be discussed below.

In Fig. 1 the radius of curvature of the disk is indicated by the letter R. The deflection is the distance a point at the center of the disk moves under internal pressure, when it changes from its normal position in the stopper to a position

in which the disk is just about to reverse its concavity and be forced out of the groove. This deflection is indicated by the letter D. The dimensions of the disk can be calculated for a predetermined internal pressure by the following formula taken from "Machinery's Handbook", 14th Edition, page 414.

$$D=\frac{5PR^4}{6ET^3}$$

In this formula, P equals the internal pressure in pounds per square inch, R is the radius of curvature of the disk in inches in its normal position when inserted in the bottle, D is the deflection of the disk in inches as discussed above, E is the modulus of elasticity of the material used in the disk, and T equals the thickness of the disk in inches.

Referring to Fig. 1 in conjunction with the formula, it will be seen that, if angle A is increased, the deflection will be correspondingly decreased. Referring to the formula, when the deflection is decreased, then the thickness must be increased to maintain a constant relationship among the factors in the formula.

Thus any change in the angular relationships discussed above will require a change in the dimensions of the disk. The change in dimension can be computed by determining the effect that the angular change has on the radius of curvature and deflection, and applying new values of these factors to the formula.

The type of material from which the disk, its connector, and the ring are to be formed is of the greatest importance, since as mentioned, there are a considerable number of factors which must be taken into consideration.

The formula demonstrates the importance of the modulus of elasticity. Depending on the use to which the receptacle is put, the stopper may be subjected to temperatures ranging from —40° F. to at least 150° F. (the approximate temperature for the pasteurization of beer). In the beer industry, however, the range would have at its lower limit 26° F., the freezing point of beer. For a stopper disk one-sixteenth of an inch thick, the modulus of elasticity should not be substantially less than 5,000 p. s. i. for the highest temperature with which the stopper is to be used. It will be seen from the formula, that when a material having a much lower modulus is used (for example, 1–1000 p. s. i.), the thickness of the disk must be increased and will become undesirably large and unwieldy, as well as more expensive.

On the other hand, the stopper must be sufficiently flexible so that it can be relatively easily removed from its bottle neck. This flexibility must be maintained even at temperatures below freezing since it is not unlikely that the beverages with which the stopper is used will undergo a certain amount of refrigeration. The modulus of elasticity at the lowest temperature to which the receptacle will be subjected should not be substantially in excess of 130,000 p. s. i. for a disk having the given thickness of one-sixteenth of an inch. If the modulus is much greater, for example, over 200,000 p. s. i., it will be difficult to remove the stopper from the bottle or the disk will have to be made undesirably thin.

In the process of inserting the stopper into its seat and during its removal from the seat, the stopper undergoes rather severe bending stress. Therefore, the stopper must be capable of resisting a considerable bending without tearing. If

a strip of material .075 inch thick can be folded double on itself without tearing at —40° F., the material should be satisfactory in this respect.

Since it has been found desirable to make the stopper, the tab and the connector between the two of the same material, molded integrally, the material must have a tensile strength sufficient to withstand the removal pull in order to prevent breakage during the pulling of the tab from the bottleneck.

Because stoppers of this type have to undergo large variations in temperature, it is also important that the coefficient of thermal expansion should be low and should not exceed approximately 10×10^{-5} inches per inch per degree Fahrenheit.

The stopper must also resist pasteurization temperatures which with careless controls may run as high as 170° F.

Another most important characteristic of the material is that it must have a smooth texture in order to form a gastight seal where the disk engages its groove seat. Rubber, for example, is wholly unsuitable in this respect because of the grainy texture of its surface which does not permit the stopper to withstand high internal pressures.

The construction of the pull tab is very important to a successful operation of the stopper. In order to place a stopper in a bottle in such a manner as to maintain a comparatively high pressure in the bottle, it is obvious that the stopper must be secured very firmly in the bottle neck. When the stopper is thus applied firmly to the bottle neck, it is naturally rather difficult to remove. This is as it should be since the stopper would not be satisfactory if it could be easily removed. Therefore, considerable tension stress must be placed on the pull tab in order to remove the stopper from its seat in the bottle neck.

As shown in Figs. 2 and 3, if the disk **50**, the connector **62**, and the tab **58** are joined together at substantially right angles, the right angle joints form locations of stress concentration and a pull on the tab will have a tendency to tear the tab away from its connector at those joints. The tear which results is illustrated at **64** in Fig. 3.

A solution to this difficulty is shown in Figs. 4 and 5. Instead of right angle joints, as shown in Fig. 2, the joints are formed with fillets having curved surfaces **66**, as illustrated in Figs. 4 and 5, and these fillets should have an optimum radius equal to the thickness of the ring, but it can be as low as $\frac{1}{32}$ inch for a ring of $\frac{1}{16}$ inch thickness, for example. It will be seen from Fig. 5 that pulling on the tab, having such fillets, results in no undesirable stress concentrations. Fig. 6 shows the ring and disk connection in a different view taken in the direction of lines **6—6** of Fig. 4. Fig. 6 shows similar fillets **68**.

In the removal of the stopper from the bottle neck, it will be appreciated that the greatest leverage would result from placing connector **62** out as far toward the edge of the disk as possible. Such a connection is shown in Fig. 7. While, at first blush, this would appear to be the most desirable arrangement, it is actually so disadvantageous as to render a stopper so constructed almost completely useless if pressures much greater than one atmosphere are to be retained in the receptacle. The additional mass of material caused by the connector **62** at the edge of the disk causes a distortion or deformation of the disk at its edge. This deformation results in the wavy lines **70** in the edge portion of the disk as shown in Fig. 8. These wavy lines make it impossible to form a seal which will withstand the pressures encountered, for example, in the beer bottling or carbonated beverage industry.

In accordance with the invention, therefore, the connector **62** is located in a specially chosen position which is spaced from the edge of the disk but which is also spaced as far as possible from the center of the disk so as to provide good leverage in the removal of the stopper. Thus, the connector should be spaced from the edge of the disk far enough to prevent distortion but as far from the center as possible as to provide good leverage. Spacing the connector from the center at least two-thirds of the radius of the disk is preferred.

These are the mechanical characteristics and are most important to a successful stopper. However, in order to be a commercially successful item, the stopper must meet additional standards. For example, the material must be such that it will not contaminate the food or beverage contained in the receptacle and, in turn, it must not be adversely affected by the material in the receptacle. It has been found that, if the material can withstand the effects of weak acids and bases, the material will be satisfactory.

In order to have high speed production, it is very desirable to use a plastic which can be injection molded. By so forming the stopper it has been found that a substantial number can be formed in a short time.

As has been indicated, in order to go into competition with existing closures, it is necessary to have a closure which can be produced at very low cost. For this reason materials which presently cost several dollars per pound and might be satisfactory in all other respects would be out of the question on a cost basis.

Additionally, where materials are equal in all respects including cost per pound but have widely differing specific gravities, the material with the lowest specific gravity will be preferred for it will provide the most stoppers per pound.

These physical and chemical characteristics which have been discussed above rather limit the material which can be used. The inventors have experimented with a considerable number of materials, including rubber and many plastics, and have found polyethylene to be the material which meets all of the standards. They have also found among the vinyl resins an improved Vinylite which, while being 50% heavier than polyethylene, nevertheless would be satisfactory. The vinyls, however, are subject to the difficulty that they must be compound with plasticizers. Initially the product is satisfactory but after a period of time, the plasticizer leaches out and the material becomes brittle.

Other materials which are acceptable from the standpoint of their physical characteristics are nylons 10001, 3001 and 6501, Teflon and Kel-F. The latter two are polytetrafluoroethylene and polymonochlorotrifluoroethylene respectively. At present the cost of these materials is considerably higher than polyethylene.

Polyethylene, in addition to having the desirable characteristics mentioned above, is also advantageous in the manufacture of a commercially salable product in that color can be added to the material without its losing any of its necessary properties. Further, it is possible to mold a trade-mark in the material, thus avoiding the printing of a trade-mark as is done on present-day crown caps.

It is realized that, particularly with the great development work now going on in plastics, additional materials probably will become available in future years. Accordingly, the inventors wish it to be understood that they do not want to be limited to polyethylene or the other listed plastics, rather, the invention covers those materials which fall within the scope of the above described physical and chemical characteristics.

The applicants have constructed a bottle and closure arrangement which has been completely satisfactory and has the following dimensions: diameter of the disk, $\frac{1}{16}$ of an inch; thickness of the disk, $\frac{1}{16}$ of an inch; shortest radial distance from outer edge to connector, $\frac{1}{8}$ of an inch; bottle neck dimension—maximum groove diameter, $\frac{13}{16}$ of an inch, angle A, 45°; angle B, 90°.

The stopper placed in a bottle neck of the above configuration has a radius of curvature of approximately $\frac{7}{16}$ of an inch and a deflection of approximately $\frac{3}{32}$ of an inch.

The stopper is made from polyethylene whose physical and chemical characteristics as well as the cost of the material make it satisfactory in every respect.

While the preferred embodiment of the invention has been described, it is to be understood that modifications can be made in the preferred embodiment without departing from the scope of the invention. Certain additional embodiments will be described in connection with Figs. 13 to 19.

Where a small stopper is desired, difficulty may be occasioned in inserting the finger into the hole of the ring for the purpose of withdrawing the stopper. To eliminate this objection, a modified form of stopper, as shown in Figs. 14, 15 and 16, may be employed. This stopper is similar to the stopper originally described, the construction shown in Figs. 14 to 16 differing solely in the ring 89. This ring is constructed with two return bends 81 and 82 opposite the connector 62 which terminate in a loop 83 located within the confines of ring 89. The loop 83 may project somewhat above the major portion of the ring 89 as shown in Fig. 15 whereby the same may be readily engaged by the finger. In the use of this form of the invention, the loop 83 is raised and swung upwardly. At the same time, the finger is inserted in the hole 84 and the loop stretched out. The ring would then appear as shown in Fig. 16 giving ample space for the reception of the finger. Withdrawal of the stopper would then be accomplished in the same manner as in the other form of the invention.

In Fig. 17, another form of the invention is illustrated. The construction shown in Fig. 17 is similar to that shown in Fig. 1, the principal difference being in the connection of a pull tab 90 to the disk 48. In this form of the invention, the central portion of the connector and the corresponding portion of the pull tab ring have been dispensed with, forming two smaller connectors 91 and 92 instead of the single connector. These two connectors have the fillets described above in connection with Figs. 2 through 8 which prevent the pull tab from being broken loose from the disk 48 and forming the connecting means of the stopper.

A still further embodiment of the invention is shown in Fig. 18. In this form of the invention, a disk 100 has attached thereto a pull tab 101 of a material different from the material of the disk. For example, the pull tab could be made from some type of fabric. In the molding of the stopper, the pull tab is molded into the plane of the disk 100 as shown by the broken lines indicated at 102.

Still another embodiment of the invention is shown in Fig. 19. In many instances, it may be desirable to have a sanitary shield around the mouth of the receptacle to which the stopper is applied. Such a shield is shown in Fig. 19, applied to a stopper similar to that shown in Fig. 7. The stopper in this figure has molded integrally therewith a thin film 110 which extends all around the marginal portion of the disk 48. In the process of inserting the stopper into the bottle, this film 110 can be disposed around the mouth of the bottle as shown in Fig. 19, thus, forming a sanitary protective covering.

An alternative of the construction shown in Fig. 19 would be a thin film covering completely the stopper and the top of the bottle. This film could be applied very simply by popping a large bubble of fluid plastic material around the top of the receptacle after the stopper has been inserted.

It is to be understood that the stopper according to the present invention can be used for vacuum sealed receptacles by reversing the orientation of the annular groove and by reversing the concavity of the disk to a dome-like position.

Changes in the specific form of the invention as herein described may be made within the scope of what is claimed without departing from the spirit of the invention.

We claim:

1. A stopper for a receptacle for beer, carbonated beverages and the like and having an outlet portion formed with an internal annular groove providing an outwardly flaring shoulder and an inwardly turned abutment; said stopper comprising; a flat circular disk having substantially the same cross sectional configuration through all diameters thereof, said disk adapted to be cupped in the groove of smaller diameter than said disk with the marginal portion thereof seated on the shoulder and with the edge thereof engaging the abutment of the groove to form a seal, and a molded pull tab integrally joined to said disk at a location spaced from the edge thereof a distance sufficient to provide uniform contact of its edge portion when in sealed position and spaced also at least one-half the radial distance from the center of said disk to enable said disk to be opened upon pulling said tab by first raising the edge of said disk away from its groove along a limited arc radially outwardly from said tab, said disk and tab being formed of a synthetic thermoplastic polymer, and said disk having the properties of resilience sufficient to permit its forceable entrance and withdrawal from the receptacle, a stiffness sufficient to prevent its removal due to internal receptacle pressures normally encountered in bottle beer and carbonated beverages, a substantial resistance to liquid absorption, and being substantially inert to beer and carbonated beverages.

2. A stopper according to claim 1, in which the distance of the tab from the edge of said disk is greater than the thickness of said tab, and in which the distance of the tab from the center is at least two-thirds the radius of the disk.

3. A stopper according to claim 1, in which said pull tab comprises a ring, and a connector block attaching said ring to said disk, said block having fillets located at the joints between said block and ring and said block and disk.

4. A stopper for a receptacle having an outlet portion formed with an internal annular groove

providing an outwardly flaring shoulder and an inwardly turned abutment, said stopper comprising a polyethylene disk having substantially the same cross-sectional configuration through all diameters thereof, said disk adapted to be cupped in the groove of smaller diameter than said disk with the marginal portion thereof seated on the shoulder and with the edge thereof engaging the abutment to form a seal, and a molded pull tab integrally joined to said disk at a location spaced from the edge thereof a distance greater than the thickness of said tab to provide uniform contact of its edge portion when in sealed position and also at least two-thirds the radial distance from the center of said disk.

5. A stopper according to claim 4, in which said disk is of uniform thickness.

6. In combinaation, a receptacle for beer, carbonated beverages and the like and having an outlet portion formed with an internal annular groove providing an outwardly flaring shoulder and an inwardly turned abutment, and a stopper, said stopper comprising a flexible disk having substantially the same cross-sectional configuration through all diameters thereof, said disk having a diameter greater than the diameter of said groove and being inwardly dished with the marginal portion thereof seated on said shoulder and with the edge thereof engaging said abutment, and a molded pull tab integrally joined to said disk at a location spaced from the edge thereof a distance sufficient to provide uniform contact of its edge portion when in sealed position and spaced also at least two-thirds the radial distance from the center of said disk, said disk and tab being formed of a synthetic thermoplastic polymer, and said disk having the properties of resilience sufficient to permit its forceable entrance and withdrawal from the receptacle, a stiffness sufficient to prevent its removal due to internal receptacle pressures normally encountered in bottled beer and carbonated beverages, a substantial resistance to liquid absorption, and being substantially inert to beer and carbonated beverages.

7. The combination according to claim 6, in which said abutment is inclined approximately 45° to the axis of said annular groove and in which said shoulder intersects said abutment at approximately 90°.

8. A stopper according to claim 1 in which said synthetic thermoplastic polymer is polyethylene.

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