This invention relates to cap structures for bottles and especially cap structures for pharmaceutical bottles whose contents must be preserved against contamination. Cap structures of this purpose essentially comprise a resilient closure member, preferably formed of rubber, which is pierced by a needle to remove the contents of the bottle, and at least one metallic cap member, preferably formed of aluminum, serving to cover and retain the closure member while having provision for easy access thereto to permit removal of the contents. In any case, it is important (1) that the cap structure shall be capable of creating and maintaining a moisture-proof and air-tight seal, (2) that it shall be capable of giving ready and easy access to the resilient closure member through a tear-off portion of the cover means, and (3) that it shall be as simple and as inexpensive as possible.

A substantial problem has existed in case of bottles in which internal pressures of appreciable magnitude are created in the course of sterilization. For example, in the case of intravenous solutions, the temperatures employed during sterilization are such as to create internal pressures of 15 to 18 pounds per square inch. The problem has been provided to provide a cap structure which will meet all of the above-stated requirements, even though it is subjected to pressures which tend to distort it to such an extent as to destroy the necessary seal.

While it is possible to provide a cap structure for the above-mentioned purpose employing three members in the outer metallic cover assembly, and such a cap structure will meet the first two requirements set forth above, it is unsatisfactory in respect to simplicity and cost. It is also possible to provide a cap structure employing only one metallic cap member in conjunction with the resilient closure member, but, in order to construct the single cap member so as to maintain the necessary seal, it is necessary to sacrifice ease of access to the resilient closure member.

Early attempts to solve the problem by means of a cap structure employing two metallic cap members met with failure. While it was found to be possible to construct a cap structure which would provide the necessary simplicity and economy and also the necessary ease of access to the resilient closure member, the cap structure failed to maintain the necessary seal. The reason for this was that the construction of the metallic cap members so as to provide easy access to the resilient closure member resulted in sacrifice of ability of the metallic cap members to maintain the necessary seal. This was due primarily to the fact that the tear-off portion of the outer cap member had to be made easily removable to overcome the objection to the single-member cap, and when this was done it sacrificed strength and resistance to pressure.

The principal object of the present invention is to provide a cap structure which solves the above-mentioned problem. By this invention, there is provided a novel cap structure employing a reinforcing member in conjunction with a metallic cap having a tear-off portion. The cap structure provided by this invention has been found to meet all of the requirements set forth above. The invention may be fully understood from the following detailed description with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of the cap structure applied to the top of a bottle; Fig. 2 is a similar view with the tear-off portion of the cap member torn back; Fig. 3 is a similar view with the tear-off portion completely removed, showing removal of the special disk or reinforcing member to gain access to the resilient closure member; Fig. 4 is a relatively large-scale plan view of the cap structure and bottle, as in Fig. 1; Fig. 5 is a sectional view, on a relatively large scale, taken along line 5—5 of Fig. 4; and Fig. 6 is a plan view of the reinforcing member which is employed.

Referring more particularly to the drawing, there is shown a bottle 10 to which the cap structure is applied. As shown in Fig. 5, the bottle shown is of the type having a screw thread 11 at the top and also having a relatively large annular projection 12 below the thread 11. We are not here concerned with the thread 11, as the only reason for its presence is to enable use of a screw cap on the particular type of bottle whenever desired. For use with the type of bottle shown, the cap structure may be adapted to be secured to the bottle through the medium of the annular projection 12, as heretofore described.

The cap structure provided by the invention comprises a resilient closure member 13, preferably formed of rubber, a reinforcing member 14 overlying the closure member, and a cap member 15 adapted to fit over the aforesaid members and to be secured to the bottle. The members 14 and 15 are preferably formed of aluminum. The closure member 13 may be of any conventional form, such as shown, adapted to engage the top of the bottle. In the particular form shown, the closure member has a stopper portion 16 insertable in the mouth of the bottle and recessed to provide a central portion 17 to be pierced by a needle, and said member also has a flange portion 18 which engages the top of the bottle.

The reinforcing member 14, as best shown in Fig. 6, has a body portion 19, preferably of circular disk-like form, and a plurality of angularly-spaced outwardly projecting portions 20, each preferably having an arcuate outer edge and side edges which lie substantially along radii from the center of the circular portion 19. In the form shown, there are three of the projecting portions 20, and each of these portions occupies a substantial part of the periphery of the circular portion 19. In any case, it is desirable that the projecting portions shall be of substantial angular width and not so wide as to render difficult the removal of the reinforcing member in the manner hereinafter described. As may be seen in Fig. 5, the projecting portions 20 may extend substantially to the periphery of the closure member 13, and the circular portion 19 of the reinforcing member may be substantially coextensive with the mouth of the bottle and with the stopper portion 16 of the closure member. As best shown in Fig. 6, the reinforcing member 14 is preferably provided with raised or embossed arcuate ribs 21 at the outer parts of the projecting portions 20, and also with a circular raised or embossed rib 22 at the peripheral part of the circular portion 19. The purpose of this construction will be described presently.

The cap member 15 is shaped to fit over the above-described members and the bottle top, and in the particular form shown, the cap has an enlarged securing portion 23 to accommodate the annular projection 12 and to be secured to the latter by turning the lower edge portion of the cap inwardly beneath said projection. It is common practice thus to secure a metal cap member permanently to the top or head of a bottle. Prior to application of the cap structure, the lower part of the metal cap member is structure to enable application of the bottle, and pressure is applied to the cap structure and the lower part of the outer cap member is turned inwardly.

The cap member 15 has a tear-off portion 24, preferably of circular form, which overlies the reinforcing member 14, and which preferably is of larger area than said body portion. In the form shown, the tear-off portion 24 is separated from the rest of the cap except at diametrically opposed bridge connections 25 and at hinge connection 26. As may be clearly seen in Fig. 1, the hinge connection 26 is preferably defined
by score lines 27 which extend into the side of the cap member 15 and converge downwardly. The tear-off portion 24 is preferably provided with raised or embossed strengthened ribs 28 which serve to rigidize the circular rib 22 and provide a direction substantially at right angles to a diameter extending between the bridge connections 25.

Cap member 15 is also preferably provided with a raised or embossed circular rib 29 which surrounds the tear-off portion 24 and which provides a recess into which the ribs 21 of the reinforcing member 14 may seat.

In use, the component members of the cap structure are applied to the bottle as shown in the drawing, particularly Fig. 5, and preferably a thin rubber diaphragm 30 is interposed between the top of the resilient closure member 13 and the reinforcing member 14, although this diaphragm is not absolutely necessary. When the sealed bottle, with contents therein, is subjected to substantial temperatures to sterilize the contents, the cap structure maintains the required tight seal despite pressures created within the bottle. The projecting portions 26 of the reinforcing member 14 are securely held by the outer part of the cap 15, particularly with the interlocking elements 21 and 29 provided as described. These elements serve both to strengthen and to interlock the reinforcing member 14 and the cap member 15.

The reinforcing member 14 and the bottle tend to distort the reinforcing member 14 and the top of the cap member 15, and such distortion as takes place is actually put to advantage. Not only does the circular rib 22 serve to strengthen and rigidify the reinforcing member 14, but it also slightly raises the tear-off portion 24, making it easier to remove said portion later. Moreover, the distorted reinforcing member 14 slightly raises the portion of cap member 15 surrounding the tear-off portion 24.

When it is desired to gain access to the contents of the bottle, the first removes the tear-off portion 24 by exerting upward force at the edge of said portion opposite the hinge connection 25. Such force shears the bridge connections 25, and the user raises the portion 24 and pulls it over the side of the bottle, as shown in Fig. 2, causing the hinge connection 26 to tear along the score lines 27. The convergent arrangement of the score lines causes tearing along a line 10, and inward removal of the tear-off portion without removal of the retaining part of the cap member, as may be seen in Fig. 3. It should be noted also that the shoulder provided by the enlarged portion 23 of the cap member 15 also resists tearing beyond the shoulder.

As may be seen in Fig. 2, with the tear-off portion 24 removed from the top of the bottle, the circular body portion of the cap member 14 is exposed, and the member 14 may be readily removed. Removal of this member is effected most easily by grasping the edge thereof at the V-shaped opening in cap member 15, as shown at 31, beneath the edge of member 14 to pry it outward and then grasping the edge portion between the same finger and another finger, shown at 32, the user is enabled to pull the reinforcing member free from the cap member to completely remove the reinforcing member and thus gain access to the resilient closure member 13. The slight distortion of the reinforcing member and the cap member, as mentioned above, facilitates the removal of the reinforcing member.

From the foregoing description it will be seen that the invention provides a simple and inexpensive cap structure which is capable of maintaining the required seal despite pressures created within the bottle, and which enables easy access to the resilient closure member 13 without the danger of distorting the bottle. While a specific form of the cap structure has been illustrated and described, the invention is not limited thereto but contemplates such modifications and other embodiments as may occur to those skilled in the art.

I claim:

1. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion overlying the body portion of said reinforcing member, whereby removal of said tear-off portion exposes said body portion and enables removal of said reinforcing member, said reinforcing member having arcuate locking elements on said projecting portions and said cap member having a circular locking element surrounding said tear-off portion and interengageable with said first elements to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

2. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion connected by a hinge portion defined by score lines extending into the side of the cap member, said tear-off portion overlying the body portion of said reinforcing member, whereby removal of said tear-off portion exposes said body portion and provides an opening extending into the side of the bottle, said reinforcing member having a circular locking element surrounding said tear-off portion and interengageable with said first elements to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

3. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion overlying the body portion of said reinforcing member, whereby removal of said tear-off portion exposes said body portion and enables removal of said reinforcing member, said reinforcing member having arcuate locking elements on said projecting portions and said cap member having a circular locking element surrounding said tear-off portion and interengageable with said first elements to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

4. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion overlying the body portion of said reinforcing member, whereby removal of said tear-off portion exposes said body portion and enables removal of said reinforcing member, said reinforcing member having arcuate locking elements on said projecting portions and said cap member having a circular locking element surrounding said tear-off portion and interengageable with said first elements to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

5. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions extending substantially to the periphery of said closure member, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion connected by a hinge portion defined by score lines extending into the side of the cap member, said tear-off portion overlying the body portion of said reinforcing member and of larger area than said body portion.
portion, whereby removal of said tear-off portion exposes said body portion and provides an opening extending into the side of the cap member, enabling removal of said reinforcing member, said reinforcing member having arcuate locking elements on said projecting portions and said cap member having a circular locking element surrounding said tear-off portion and interengageable with said first elements to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

6. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions extending substantially to the periphery of said closure member, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion overlying the body portion of said reinforcing member and of larger area than said body portion, whereby removal of said tear-off portion exposes said body portion and enables removal of said reinforcing member, said reinforcing member having raised arcuate ribs on said projecting portions and said cap member having a circular recess surrounding said tear-off portion and into which said ribs extend to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

7. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of spaced outwardly projecting portions extending substantially to the periphery of said closure member, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion overlying the body portion of said reinforcing member and of larger area than said body portion, whereby removal of said tear-off portion exposes said body portion and enables removal of said reinforcing member, said reinforcing member having arcuate locking elements on said projecting portions and said cap member having a circular locking element surrounding said tear-off portion and interengageable with said first elements to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

8. A cap structure for a bottle in which substantial internal pressures are likely to be created, comprising a resilient closure member adapted to engage the top of the bottle, a reinforcing member overlying said closure member and having a body portion and a plurality of outwardly projecting portions extending substantially to the periphery of said closure member, and a cap member adapted to fit over the aforesaid members and to be secured to the bottle, said cap member having a tear-off portion overlying the body portion of said reinforcing member and of larger area than said body portion, whereby removal of said tear-off portion exposes said body portion and enables removal of said reinforcing member, said reinforcing member having raised arcuate ribs on said projecting portions and said cap member having a circular recess surrounding said tear-off portion and into which said ribs extend to strengthen and interlock the reinforcing and cap members until such time as said tear-off portion and the reinforcing member are removed.

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