United States Patent [19]

Ellis

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[54] **STOPPERS**

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[73] Assignee: **Surgical Equipment Supplies Limited,** London, England

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[52] **U.S. Cl.** **215/320,** 215/341, 215/358, 215/DIG. 1, 215/DIG. 3

[51] **Int. Cl.** **B65d 41/28**

[58] **Field of Search** ..... 215/41, 52, DIG. 1, 320, 215/341, 343, 344, 358

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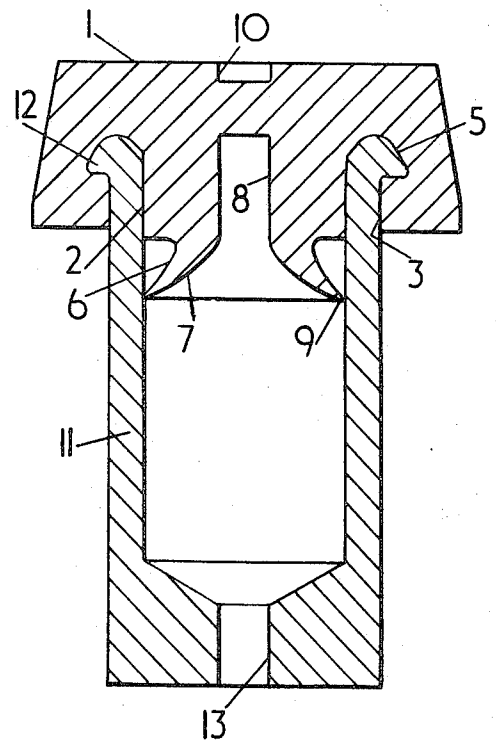
[57] **ABSTRACT**

A stopper having a body with a sealing surface to engage the inside of a bottle neck, and an integral flexible lip extending from the body to an edge which is to engage the inside of the neck in substantial line contact, the outer surface of the lip being concave when unstressed.

4 Claims, 3 Drawing Figures



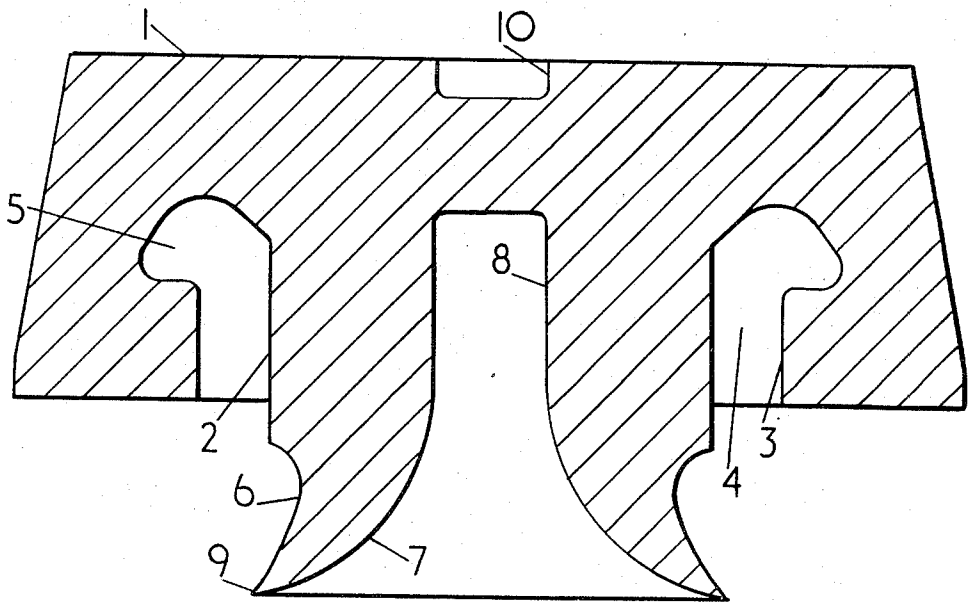


FIG. 1.

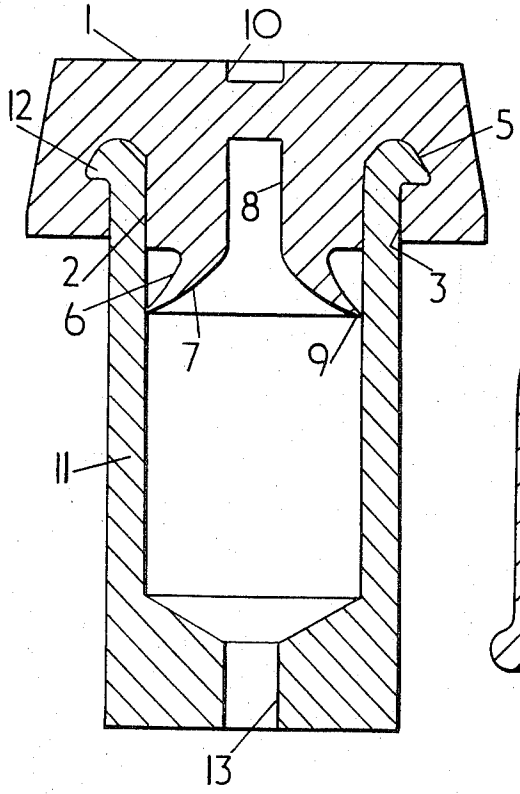


FIG. 2.

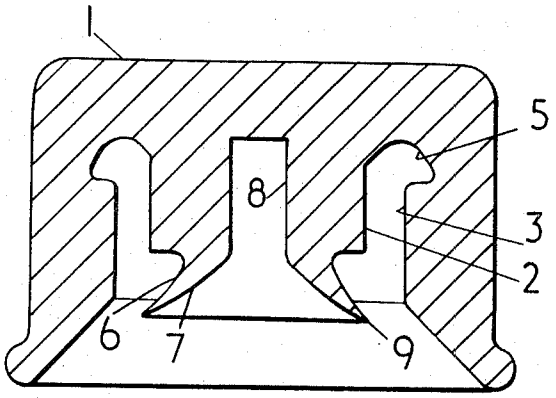


FIG. 3.

STOPPERS

This invention relates to stoppers.

In the preparation of many liquids for use with medical, surgical and pharmaceutical fields, resort is had to in-bottle sterilization, in which a liquid is sealed in a bottle, heated and then held at a sterilization temperature, and subsequently recooled. The heating is usually by saturated steam and cooling by spraying on of cooling water. During the heating stage of the cycle, very considerable pressure may be generated in the bottle, particularly if some air is also present. Thus, if there is any weakness in the sealing, there will be a tendency for the seal to be broken at this stage, so that in the cooling stage there will be sub-atmospheric pressure in the bottle and non-sterile air or water may be drawn in through the weakness. The contents of the bottle thus become contaminated.

Efforts are being directed towards improving the seal by increasing the mechanical strength thereof, but these efforts are to some extent self-defeating, since the additional mechanical forces involved in tightening them may damage the sealing surfaces.

The present invention provides a stopper comprising a body with a surface for engaging the inside of the neck of a bottle or the like, an integral flexible lip extending from the body of the stopper to an edge substantially coaxial with the said surface for engaging the inside of the neck in substantial line contact and having a concave outer surface in the unstressed state.

When the inner surface of the lip is pressurised, the outer surface tends to be moved towards the bottle neck, i.e., it moves toward a convex form and the line contact broadens into a sealing area which is urged by the pressure in the bottle neck into sealing engagement with the inner surface thereof.

Preferably the stopper is adapted to receive the open end of a bottle neck between the sealing surface and a complementary cylindrical surface defining a deep annular groove in the sealing surface. The deep annular groove may terminate in a re-entrant cavity to receive and mechanically grip a flange on the open end of the bottle neck.

The invention further consists in a bottle having a stopper according to the invention as set forth above, in a neck thereof.

The invention will be further described with reference to the accompanying drawings in which:

FIG. 1 is a sectional view of a form of stopper constituting a preferred form of the invention;

FIG. 2 is a sectional view of a stopper similar to that of FIG. 1, in position on a simulated bottle neck; and

FIG. 3 is a sectional view, similar to FIG. 1, of a further form of stopper constituting a second form of the invention.

As illustrated in the drawings, a stopper 1 has a body comprising a sealing surface 2 adapted to fit within the neck of a bottle. Opposite the sealing surface is a second surface 3, which defines with the sealing surface 2 a deep groove 4 to receive the end of the bottle neck, and which itself ends in a re-entrant cavity 5 to receive a flange or lip formed on the bottle neck and provide a snap closure therefor.

Below the surface 2 there is a concave section 6 which constitutes the outer surface of a lip starting at the surface 2, the inner surface 7 of this lip being continued into an axial bore 8 forming a cavity in the stopper. As can be seen from the drawing, the lip tapers away from the body of the stopper to a tip 9 spaced downwardly and outwardly from the surface 2. Opposite the co-axial bore 8 there is provided a depression 10 which indicates the point at which a cannula can be inserted axially of the bottle to go through the thinnest part of the stopper and into the axial bore 8 for withdrawal of liquid from within a bottle closed by the stopper.

The stopper is of a non-toxic rubber or rubber-like composition of a suitable hardness and flexibility.

Referring now particularly to FIG. 2, the stopper 1 can be seen in position on an experimental test rig simulating a bottle neck. The shape of section 6 in the stopper illustrated is slightly different from that of FIG. 1. The test rig consists of a cylinder 11 open at one end and terminating at that end in a flange 12 nesting in the cavity 5. The opposite end of the cylinder is provided with a union 13 whereby pressures at varying levels may be introduced to test the stopper. It can be seen from FIG. 2 that the tip 9 is in substantial line contact with the interior of the cylinder 11, and the sealing surface 2 forms a seal with the interior surface of the cylinder 11, as would happen in a bottle neck. In the unstressed state illustrated, the flexible lip is such that its outer surface 6 is concave, and its inner surface 7 is convex, but when pressure is applied against the lip, it tends to roll about the tip 9 so that the surface 6 becomes convex and surface 7 concave. This means that the line contact at the tip 9 becomes a sealing contact over a very considerable area, which substantially improves the operation of the stopper as the pressure increases. Further, this additional seal is urged against the neck of the bottle (or the cylinder 11) so as to provide additional frictional resistance to movement.

It will thus be realised that the stopper uses the internal pressure in the bottle to increase its own efficiency of sealing, rather than needing to be tightened mechanically to the bottle to provide such additional sealing against this pressure.

As can be seen from FIG. 2, the stopper will extend outwardly from the neck of the bottle so that once the pressure is low within the bottle the stopper can be fairly easily removed, as required, e.g., by a thumb action or by a simple tool.

Various modifications may be made within the scope of the invention. For instance, in certain circumstances the provision of the extension of the stopper outside the neck of the bottle may not be necessary. The stopper can then be used with a standard bottle without the flange 12. It is also envisaged that a screw cap could be used instead of a snap cap. Furthermore, arrangements may be made to "pilfer-proof" the stoppered bottle, for example, by means of a heat-shrinkable PVC bond which would shrink during the sterilization process and would snap at a fault line or line of weakness during removal. In this way, the possibility that the contents of the bottle might be pilfered and the stopper replaced so that the pilfering would not be detected can be eliminated.

I claim:

1. A stopper of rubber or rubber-like material suitable for use in in-bottle sterilization, comprising a body having an external generally cylindrical sealing surface for engaging the inside of the neck of a bottle, the body having an internal cavity extending inside the sealing surface and adapted to be exposed in use to the pres-

sure within the bottle; and an integral flexible lip extending from said body to an edge substantially co-axial with said sealing surface for engaging the inside of the neck in substantial line contact, the configuration of said stopper being such that, in the unstressed state, the edge is of greater diameter than the sealing surface, and the lip has an outer surface which is concave and an inner surface which merges into the cavity.

2. A stopper as claimed in claim **1,** wherein the body has a further sealing surface for engaging the outer surface of a bottle neck, the said sealing surfaces together defining a deep annular groove in the body for receiving the wall of the bottle neck.

3. A stopper as claimed in claim **2,** wherein said groove terminates in an annular cavity for receiving a flange on the rim of the bottle neck.

4. The combination of a bottle having a neck, and a stopper of rubber or rubber-like material suitable for use in in-bottle sterilization, the stopper comprising a body having an external generally cylindrical sealing surface for engaging the inside of said neck, the body having an internal cavity extending inside the sealing surface and adapted to be exposed in use to the pressure within the bottle, and an integral flexible lip extending from said body to an edge substantially co-axial with said sealing surface for engaging the inside of said neck in substantial line contact, the configuration of said stopper being such that, in the unstressed state, the edge is of greater diameter than the sealing surface, and the lip has an outer surface which is concave and an inner surface which merges into the cavity.

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