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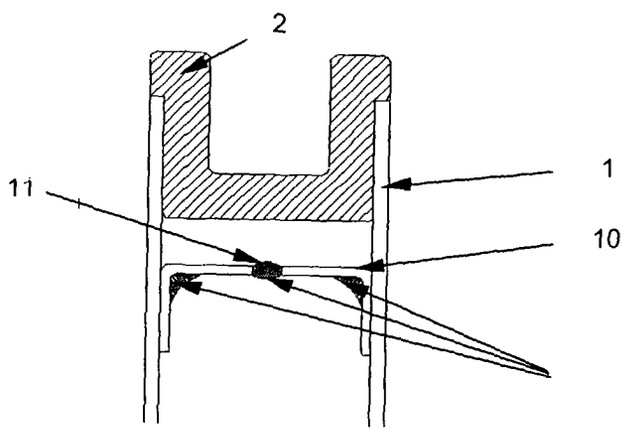
(54) Liquid storage

(57) A liquid retaining member for insertion, in use, into the neck of a liquid sample container. The member comprises: a membrane arranged to be retained within the container in use and having a hole formed therein.

The size of the hole is such that, in use, it is small enough to allow the formation of a plug of sample liquid across it such that the sample liquid cannot readily come into contact with a cap attached to the container, in use.

Figure 4



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Description

[0001] This invention relates to the storage of liquids.

[0002] In a number of differing applications, and, in particular, in the pharmaceutical industry, there is a requirement to store liquids in sealed vessels, the liquids being used in analysing and testing procedures. It is often necessary to obtain samples of liquids from the vessel at intervals for testing or for use as reagents, and a number of different approaches have been proposed to enable such access. For example, the liquid vessel may be provided with a cap which can be pierced by a cannula or syringe. Alternatively, the cap may be readily removable. In this latter case, the cap is removed, an aliquot taken from the vessel, and the vessel resealed either using the original cap or a fresh replacement.

[0003] In many applications the cost of the liquid being contained can be extremely high, and there is a growing trend to employ in many applications smaller and smaller amounts of liquid for testing or for use as a reagent. Typically, a few hundred microlitres of material will be stored in the container, and only a few microlitres removed at any one time. Because of this it has become extremely important to minimise liquid wastage.

[0004] The usual approach to liquid storage has been to store liquid samples in tube-shaped containers which are then kept in a substantially upright position in a rack, drawer or tray. In these circumstances there is little opportunity for the liquid content of each container to come into contact with individual container caps. However, as handling speeds have increased, and as attempts have been made to automate the handling of liquid containers, there has been a growing demand to be able to select a single tube from a store and deliver it as rapidly as possible to point the of use. This demand for high speed transportation and remote delivery can lead to the contents of containers being agitated during movement of the container, resulting in splashing and wetting of the internal surface of the container caps. If the cap is subsequently removed liquid remains adhered to the cap because of surface tension. This results in loss of liquid through evaporation or spillage or, indeed, by disposal of the cap if the cap is replaced as part of the sample obtaining process.

[0005] The present invention seeks to overcome some of these problems.

[0006] According to the present invention there is provided a liquid retaining member for insertion, in use, into the neck of a liquid sample container, the member comprising: a membrane arranged to be retained within the container in use and having a hole formed therein;

> the size of the hole being such that, in use, it is small enough to allow the formation of a plug of sample liquid across it such that the sample liquid cannot readily come into contact with a cap attached to the container, in use.

[0007] Examples of the present invention will now be described with reference to the accompanying drawings, in which:

> Figures 1 and 2 are schematic cross-sectional views of examples of the prior art;
> Figure 3 is a graph showing characteristics of the prior art shown in figures 1 and 2;
> Figure 4 is a schematic side cross-sectional view of a first example of the present invention; and
> Figure 5 are schematic side cross-sectional views of a second example of the present invention in closed and accessible configurations.

[0008] Figure 1 shows an example prior art container 1, which comprises a tube 1 usually formed from a polymer. The container has a single open end 3 which is sealed by a cap 2. The container 1 comes in one of a range of sizes, and a typical example might have a maximum volume of 1.4 ml, with a working volume of 1 ml. This means that there is usually a head space 4 between the top surface of the contents 5 of the container 1 and a lower face of the cap 2. If the container 1 is inverted or agitated it is possible for the contents 5 to contact the lower face of the cap 2. Whilst the bulk of the contents 5 will drain back away from the cap 2, surface tension will tend to ensure that at least some liquid remains attached to the cap 3, especially in the interface 6 between the cap 2 and the wall of the container 1. This is shown in figure 2.

[0009] Whilst in practice it may be possible to exercise care when removing the cap 2 such that much of the retained content 4 will remain attached to the inner wall of the container 1 and will drain back into it, tests have shown that some material will always remain attached to the cap 2.

[0010] Figures 3 shows the results of a test with a known container of the tubular type supplied by Metrix Technologies Corporation and employing a standard elastomeric cap. As can be seen from figure 3, more than 2% of the original contents were lost over nine cycles. This corresponds to an average loss per cap removal of 3.5 microlitres. It will be appreciated that for applications where only a few microlitres are required for testing this loss would soon diminish available stock.

[0011] Figure 4 shows a first example of the present invention, in which components corresponding to those in figures 1 and 2 are numbered identically. In this example a container 1 again has a tubular configuration and employs a cap 2 of a configuration similar to that shown in figures 1 and 2. In the present invention, however, there is provided an insert member 10 which, in use, is positioned within the container 1 beneath the cap 2. The insert member 10 has a cup shape, the walls of which are designed to engage, in use, with the inner walls of the container 1 and retain the insert 10 within the container 1 such that it is resistant to shock and vibration. The insert member may be formed from a pol-

ymeric material, such as polypropylene or polycarbonate. It may be formed to be integral with the container 1 as part of the container manufacturing process, but is preferably configured simply to insert into a standard container. It may be that the inner wall of the container 1 has a circumferential ridge formed thereon to prevent the insert member 10 passing too far into the container 1 in use.

[0012] Positioned in the base of the insert member 10 is a hole 11. The hole 11 is of a size such that a sampling syringe or cannula can pass there through to obtain access to contents 5 in the container 1. It is, however, sufficiently small to ensure that surface tension in the liquid contents 5 being stored prevents passage of store liquid through the hole 11, as shown in figure 4.

[0013] As can be seen from figure 4, in use, when the cap 2 is in place on the container 1 any liquid contents 5 that are agitated within the container 1 will not contact the inner surface of the cap 2, but will be retained by the insert member 10 and its own surface tension within the hole 11. Additional liquid 12 may collect in the corners of the insert member 10, but upon removal of the cap 2 this liquid 12 will not be wasted.

[0014] Figure 5 shows a second example of the invention, in which the insert member 10 still has a central hole 11 but which is defined by cylindrical or frusto-conical side walls 13. This configuration has the benefit that a greater pool of liquid contents 5 is retained in the hole 11, such that the retained liquid contents 5 may be sufficient for a sample to be obtained by a syringe or cannula 14 without needing to have a syringe or cannula 14 of a depth that is sufficient to pass through the hole 11 and down into the main body of the liquid contents 5.

Claims

1. A liquid retaining member for insertion, in use, into the neck of a liquid sample container, the member comprising: a membrane arranged to be retained within the container in use and having a hole formed therein;

   the size of the hole being such that, in use, it is small enough to allow the formation of a plug of sample liquid across it such that the sample liquid cannot readily come into contact with a cap attached to the container, in use.

2. A member according to claim 1, wherein the hole is in the centre of the membrane.

3. A member according to claim 1 or 2, wherein the membrane is attached to a circumferential member.

4. A member according to any of the preceding claims, wherein the circumferential member may extend beyond the rim of the container and form a circumferential lip.

5. A member according to any of the preceding claims, wherein the member is attached, in use, to the container by means of surface friction between the member and the internal wall of the container.

6. A member according to any of the preceding claims, made from a polymeric material.

7. A member according to any of the preceding claims, wherein the hole in the membrane has conical or cylindrical side walls.

8. A liquid sample container comprising a member according to any of the preceding claims.

9. A liquid sample container comprising a circumferential ridge to support a member according to any of claims 1 to 7.

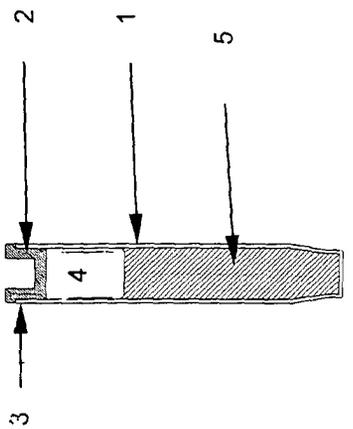

Figure 1

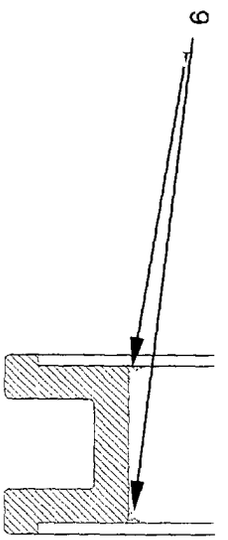

Figure 2

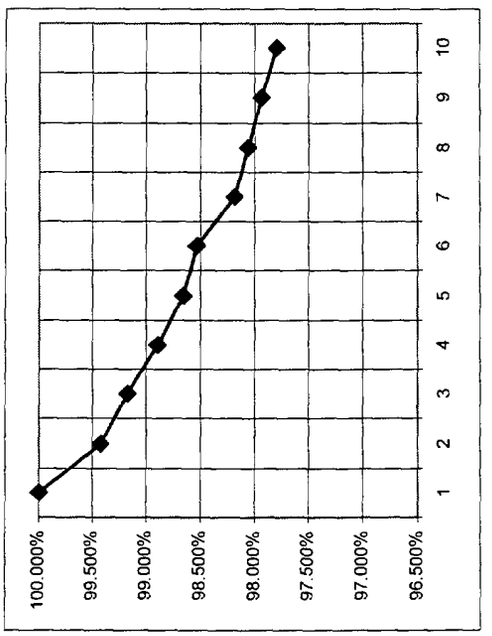
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Figure 3

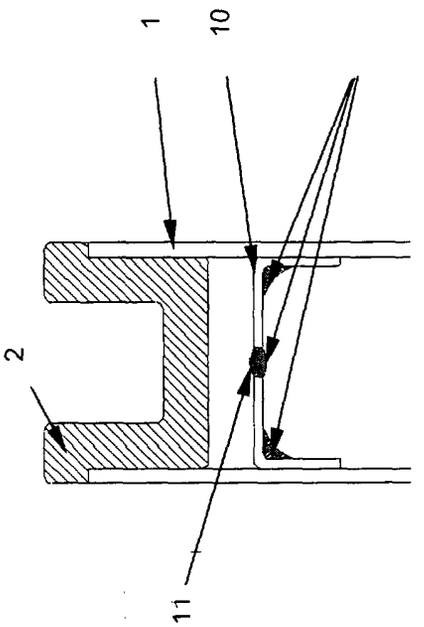

Figure 4

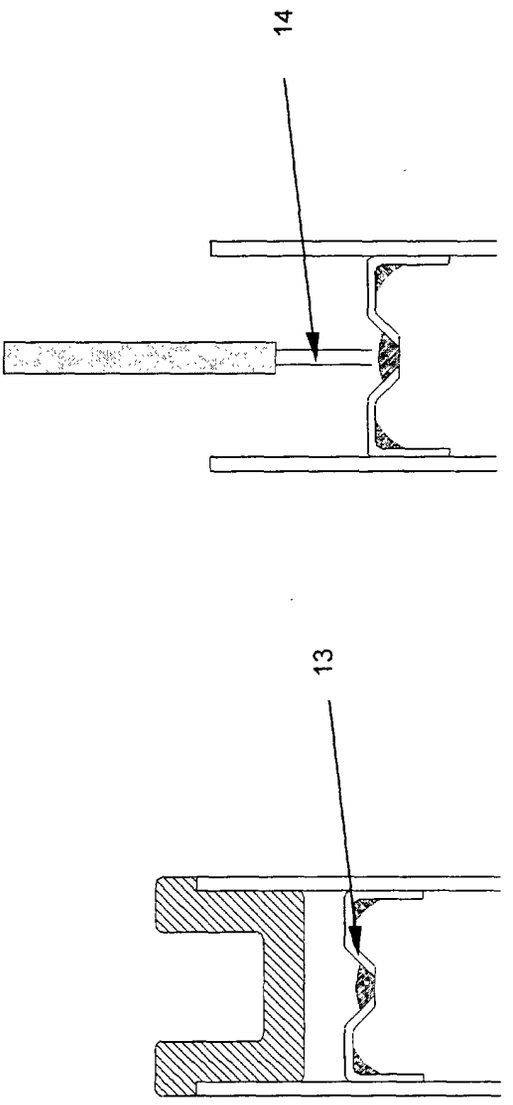

Figure 5

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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 7319

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 196 06 274 A (GLASTECHNIK GRAEFENRODA GMBH) 5 December 1996 (1996-12-05) * abstract; figure 1 * * column 2, line 45 - column 2, line 63 *	1-9	B01L3/14 B01L3/00
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A	US 4 134 512 A (NUGENT EDWARD L) 16 January 1979 (1979-01-16) * abstract; figures 1,2 * * column 2, line 66 - column 3, line 51 *	1-9	
A	US 5 202 093 A (CLOYD WILLLIAM C) 13 April 1993 (1993-04-13) * abstract; figures 1-7 * * column 2, line 55 - column 5, line 11 *	1-9	
A	EP 0 081 976 A (STERILIN LTD) 22 June 1983 (1983-06-22) * abstract; figures 1,2 * * page 6, line 3 - page 7, line 14 *	1-9	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 January 2001	Runser, C

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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