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(56) Documents Cited:
GB 1556082 A
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UK CL (Edition X) **G1B**
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Other: **WPI, EPODOC**

(54) Abstract Title: **Hand-held liquid tester**

(57) A hand-held liquid tester comprising a test chamber 2 and reagent introduction mechanism 12, 18 arranged to introduce a reagent into said test chamber upon manual actuation by a user, wherein said reagent introduction mechanism 12, 18 is removable to allow liquid to be put into said test chamber 2 and replaceable to close the test chamber 2. Methods using the hand-held liquid tester and kits comprising the hand-held liquid tester are also described.

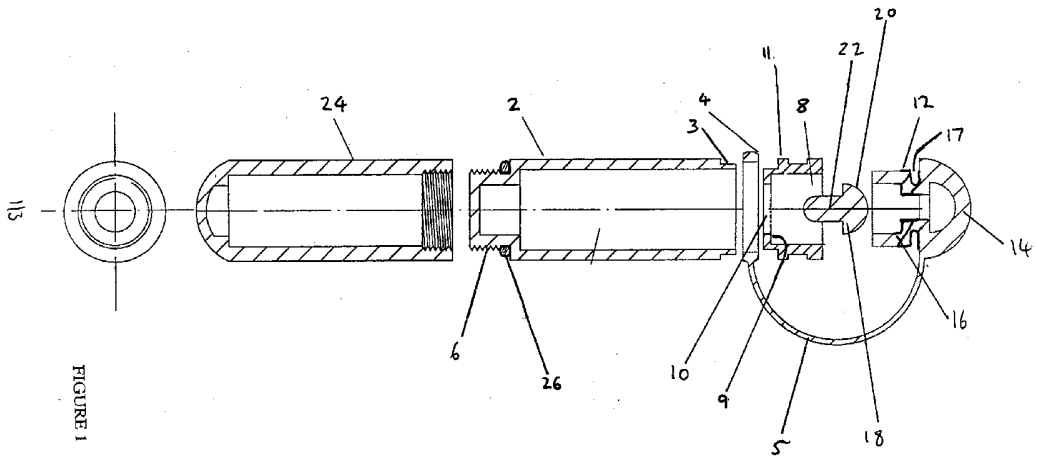

FIGURE 1

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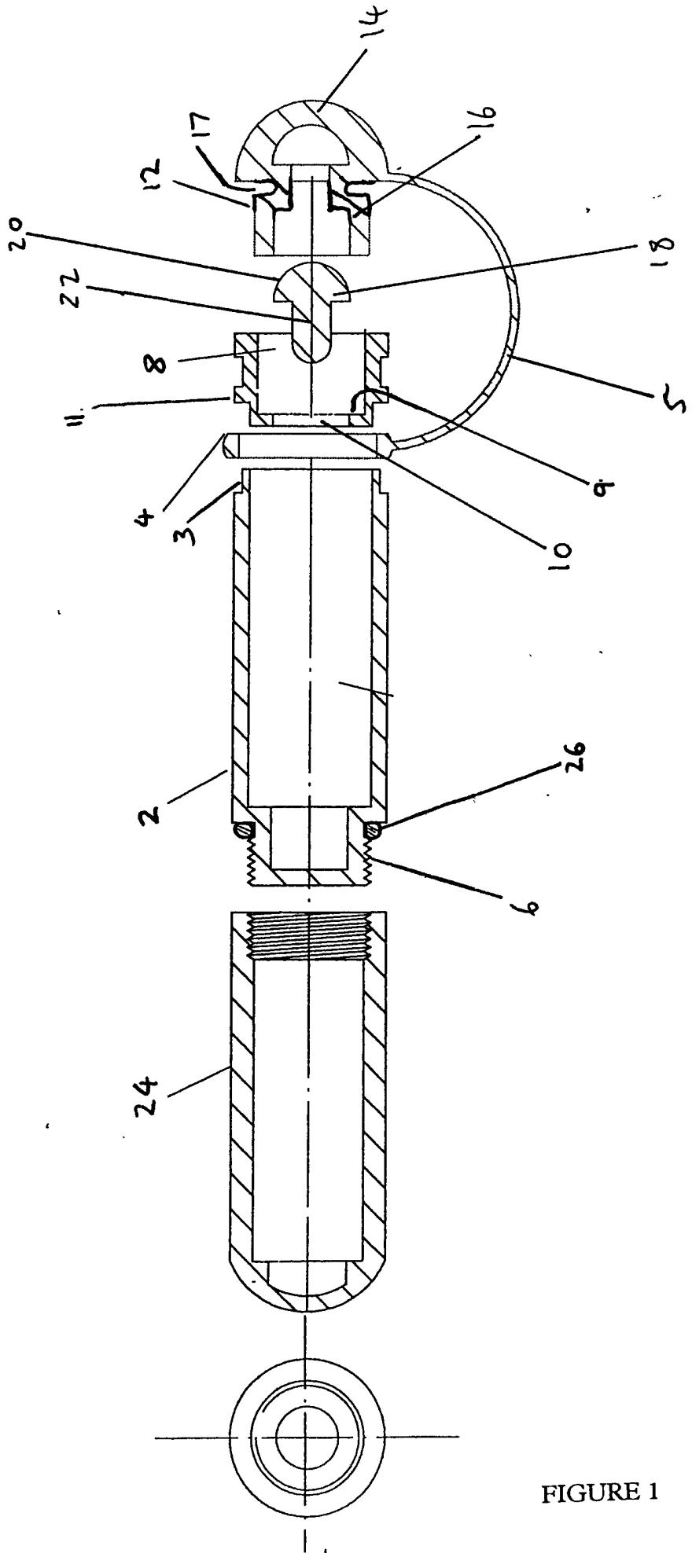

FIGURE 1

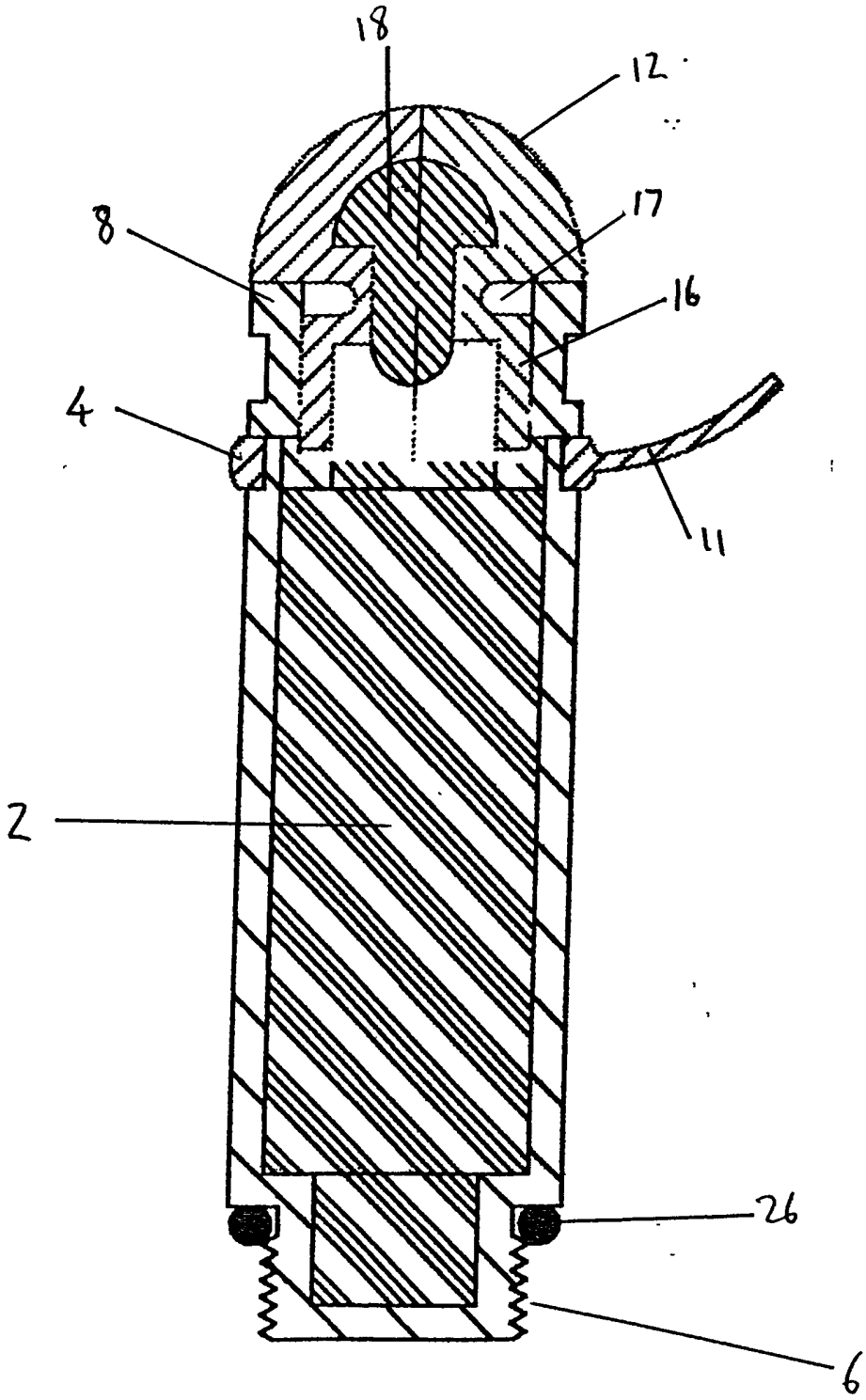

FIGURE 2

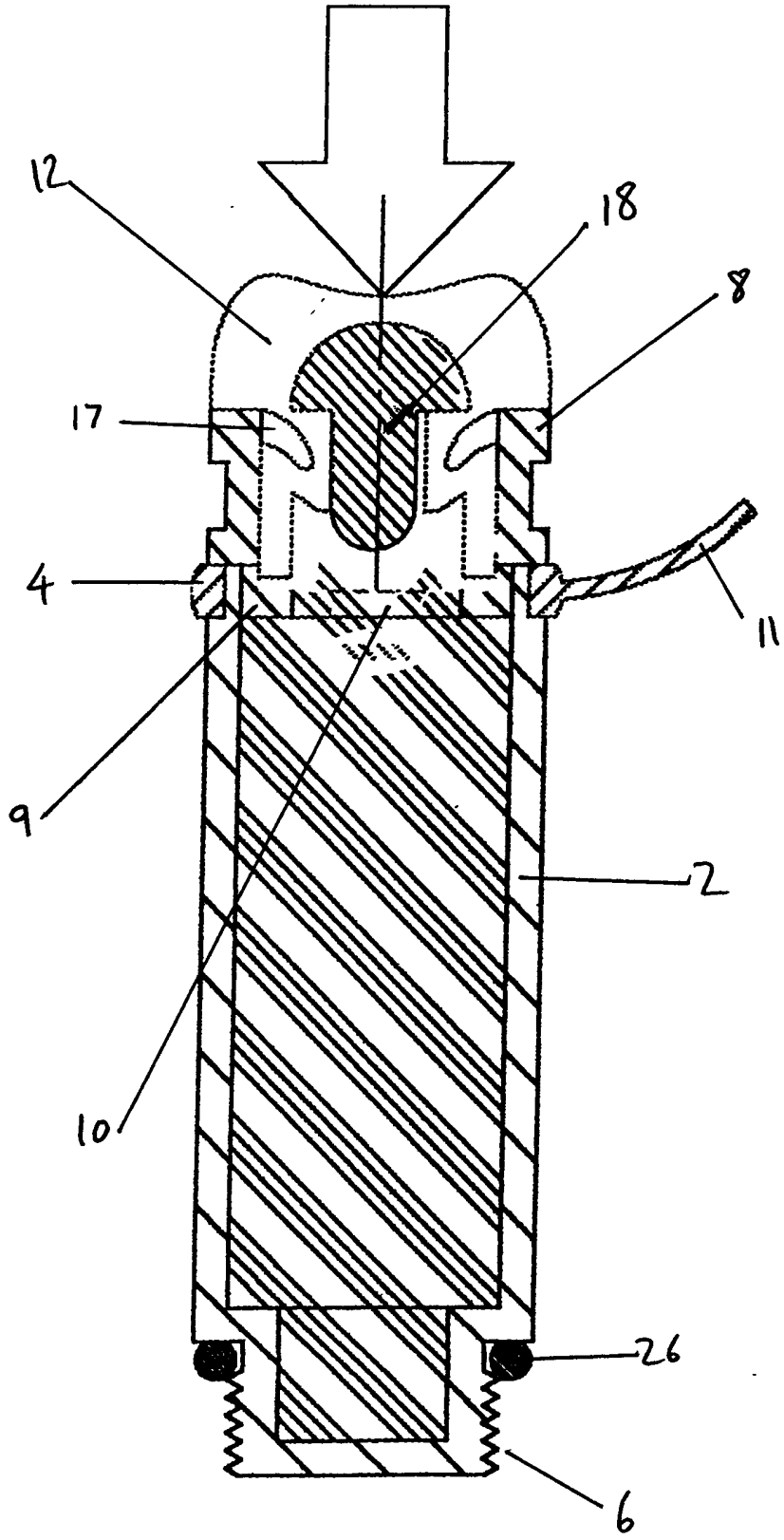

FIGURE 3

LIQUID TESTER

The invention relates to the field of assaying analytes in liquids utilising observable characteristics when specific test reagents are contacted with the liquid. Non-limiting examples of such analytes may include the pH of the liquid, the chlorine bleach concentration of the liquid and the level of biological or chemical contaminants in the liquid. Specifically but not exclusively this invention relates to the assaying of water based liquids, in particular swimming pool water.

Apparatus for assaying liquids in which observable characteristics are measured when specific test reagents are contacted with the liquid are known in the field of swimming pool water testing. It is usual in such contexts to test for pH and chlorine bleach levels. These are important in order to prevent the spread of infection via the water - particularly in communal pools and particularly in hot weather when bacteria can multiply rapidly.

Currently testing is carried out periodically by someone responsible for the pool using a commercially available water testing kit. The water is placed in a receptacle to which the test reagent is added by hand. The test reagent is often supplied in tablet form. The tablets are sensitive to moisture and handling and thus are supplied in blister packs containing a plurality of tablets. The user must manipulate the blister pack such that the tablet is ejected from the pack and into the liquid in the receptacle. This normally requires the receptacle to be placed on a level surface as both hands are need to dispense the tablet.

The water is agitated until the tablet is dissolved and

the observable characteristic is developed. This is normally a colour change. A colourmetric calibration chart is supplied with the test reagent which shows the expected colour dependent on the level of the analyte in the water. The colour of the liquid is then compared with the colour on the calibration chart to determine the level of the analyte in the sample.

The applicant has recognised that the use of such kits is cumbersome and indiscreet such that they would normally only be used by a person responsible for a pool making routine checks.

The open nature of such apparatus and the need for agitation can result in escape of the sample from the apparatus during use. This may cause staining or damage. Consequently such apparatus are messy to use and not suitable for noxious liquids and/or noxious test reagents.

It is an aim of this invention partially to improve what is currently available.

When viewed from a first aspect the present invention provides a hand-held liquid tester comprising a test chamber and reagent introduction mechanism arranged to introduce a reagent into said test chamber upon manual actuation by a user, the reagent introduction mechanism being removable to allow liquid to be put into said test chamber and replaceable to close the test chamber.

Thus it will be seen that in accordance with the invention a liquid to be tested may be introduced into the test chamber by removing the reagent introduction mechanism. Once replaced the latter may then introduce a reagent into the liquid. This arrangement allows simple discreet operation.

The test reagent is introduced into the liquid sample whilst the tester is in the closed configuration. The closed nature of the test chamber during testing reduces the risk of spillage of the sample/reagent which may be simply inconvenient but might be dangerous if the sample/reagent is noxious. Thus, in comparison with known water testing kits in which a tablet must be dispensed by hand into an open receptacle general usage of the tester of the invention may be simplified, cleaner and more discreet.

The tester may require two handed operation - e.g. one to hold it and one to actuate the reagent introduction mechanism. Preferably however the test chamber is adapted to be gripped in one hand and the reagent introduction mechanism arranged so that it may be operated by finger and/or thumb whilst the test chamber is being gripped. Thus easy one-handed operation, at least for testing, is provided.

All in all the ease of use and cleanliness of testers in accordance with at least preferred embodiments of the invention allow them to be used far more widely than was the case with known water testing kits. For example, the testers make possible frequent individual testing of swimming pool water by consumers - e.g. to assure themselves of its hygiene before use, which was not previously done.

The test reagent may be in any convenient form. Non-limiting examples would include reagents in any of the recognised physical states of matter; a solid reagent in powder, granule, crystal, or emulsion; a solid reagent compressed into tablets with the necessary excipients; a liquid or gel reagent in a capsule; a liquid, gel or solid reagent in pouches or in blister packs; or, preferably, tablets or capsules of reagents as mentioned

above in blister packs.

Where provided, the packaging in which the test reagent is supplied is adapted to provide a suitable environment for long term storage of the test reagent.

The reagent introduction mechanism of the present invention need not sacrifice the integrity of the form of the test reagent for the ability to use it in a closed system. This is because the mechanism may be adapted to allow the test reagent to remain protected in its optimum environment e.g. blister pack or the like, until immediately before it is introduced to the liquid sample. This therefore avoids any degradation in performance by exposure of the test reagent to environmental factors deleterious to it (i.e. moisture, physical damage).

In preferred embodiments the blister pack comprises a single test reagent dosage, most preferably in a single blister.

The mechanism, the manual actuation of which results in the introduction of the test reagent into the test chamber, may take many possible forms. For example where the test reagent is in loose particulate form, it is envisaged that possible mechanisms would include shutter mechanisms whereby opening of the shutter releases a single test reagent dosage (which may be one more particles) from a container to the test chamber. Another possibility would be mechanisms whereby the container is in a two part form comprising an inner chamber and an outer sheath whereby translocation of the sheath and chamber relative to each other aligns a suitable aperture and niche containing a single test reagent dosage and thus exit of the test reagent dosage from the container to the test chamber occurs.

In preferred embodiments however the test reagent is in the form of a tablet contained within a blister pack and the reagent introduction mechanism comprises a pressure applicator such as a plunger adapted to apply pressure to the domed base of the blister pack to force out the tablet through the foil membrane. In such embodiments the liquid tester is preferably adapted to retain the blister pack in a configuration that allows cooperation with the applicator. The structure with the ability to retain the reagent pack may be part of the test chamber or part of the reagent introduction mechanism or it may be a structure formed upon formation of the closed configuration of the liquid tester by replacement of the reagent introduction mechanism onto the test chamber. In an alternative embodiment the blister pack may be inserted into another piece of apparatus which is received as combination by the liquid tester.

The pressure applicator preferably comprises a plunger. The plunger mechanism can take a variety of forms. In one possible embodiment the reagent introduction mechanism could comprise a cap and separate plunger slidingly received therein and adapted to be actuated directly. In an alternative embodiment a cap may be made from a resilient material and is shaped to include a portion which upon closure of the liquid tester by replacement of the mechanism is in close proximity to the blister pack so that subsequent deformation of the cap in the direction of the blister pack can force out the tablet. In a preferred embodiment the cap is resilient and is adapted to press the reagent tablet from the blister pack into the test chamber by means of an intermediate plunger.

The cap may be held on in any suitable way including, but not limited to, a screw thread, snap on arrangement or push-on arrangement. The cap may be fully detachable

but is preferably tethered.

In preferred embodiments the test chamber is at least partially transparent. By partially transparent it is meant that the chamber is constructed of a transparent or translucent material of sufficient clarity to allow visual appreciation of the test sample, or a section of the test chamber is constructed of a transparent or translucent material of sufficient size and clarity to allow visual appreciation of the test sample.

The test chamber may remain vented even when closed by the reagent introduction mechanism. In preferred embodiments however the test chamber is sealed when the liquid tester in the closed configuration i.e. all joins are watertight.

In another preferred feature of the invention the liquid tester further comprises a reagent storage receptacle adapted to receive a plurality of test reagent dosages. It is envisaged that in one embodiment this additional chamber could be identical to the reagent introduction mechanism and thus act as a replacement portion housing the same test reagent or as an alternative portion housing different test reagent. Preferably however, the receptacle simply stores reagent, packaged where appropriate, for subsequent insertion into the introduction mechanism.

In preferred embodiments the storage receptacle is removably attached to the test chamber. It may be attached by any suitable method including, but not limited to, screwing, snapping on or pushing on. The receptacle chamber may be fully detachable or be tethered. The attachment preferably results in a watertight seal.

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is an exploded cross-sectional view of a liquid tester in accordance with the invention;

Fig. 2 is a partial cross-section view showing a reagent tablet about to be dispensed; and

Fig. 3 is a view similar to Fig. 2 showing the tablet being dispensed.

Referring to Fig. 1, the liquid tester has a test chamber 2 of a cylindrical cross section open at one end and with an external shoulder 3 adapted to receive an external annular collar 4. The collar 4 is integrally attached to a cap 12 (described below) by means of a tether 5. The test chamber 2 is constructed of transparent plastic and has colourmetric calibration scales (not shown) dependent on the test reagent being used. The open end of the test chamber 2 receives an approximately cylindrical sleeve 8. The sleeve 8 is fully open at the end opposite the test chamber 2. The end nearest the chamber 2 has an annular lip 9 so that the opening 10 is smaller than the other end. The diameter of the opening is just greater than the width of the intended reagent tablet.

At the opening end the sleeve 8 has an annular external ridge 11 positioned such that upon insertion of the sleeve 8 into the end of the test chamber 2 the collar held between the shoulder 3 on the test chamber and the ridge 11 on the sleeve. As mentioned above, the collar 4 is attached to a cap 12 by means of a tether 5. The cap 12 is generally a hollow mushroom shape with a dome portion 14 and a stem portion 16 of an external diameter

equal to the internal diameter of the open end of the sleeve 8 so as to be a sealing fit thereon. The stem portion 16 has a circumferential groove 17 situated at the boundary between the stem 16 and the dome portion 14.

The cap 12 and collar 4 are moulded from plastics or synthetic rubber so as to be resiliently deformable. The hollow interior of the cap 12 receives a rigid plunger 18. The rigid plunger 18 is also mushroom-shaped with a dome portion 20 which is a tight fit inside the dome portion 14 of the cap and a stem portion 22 which has a rounded free end projecting into the hollow interior of the cap stem portion 16. Together the cap 2 and plunger 18 form a reagent introduction mechanism as will be appreciated from the description below.

At its other end, the test chamber 2 has a threaded spigot 6 which receives a storage cylinder 24 with a mating thread. In use this holds a stack of reagent tablets in single blister packs (not shown). An O-ring seal 26 may be placed over the spigot 6 before attaching the storage cylinder 24 in order to prevent the ingress of moisture.

Use of the liquid tester shown in Fig. 1 will now be described with reference to Figs. 2 and 3. Firstly, the reagent introduction mechanism (cap 12 and plunger 18) are removed from the sleeve 8. The tether 11 ensures that the cap 12 is not lost. The test chamber 2 may then be filled with the liquid to be tested - e.g. by immersing the tester into it.

The liquid tester is held vertically and a test reagent tablet is taken, in its blister pack, from the storage cylinder 24 and placed in the sleeve 8 against the

internal lip 9 with the foil membrane facing the test chamber 2. The cap 12, with the plunger 18 in place, is then replaced, thereby closing the test chamber and preventing spillage therefrom. This may be seen in Fig 2. The storage cylinder is screwed back onto the tester chamber.

The deformable dome portion 14 of the cap is depressed, assisted by the circumferential groove, 17 so as to apply pressure to the tablet in the blister via the plunger 18 and thereby force it through the foil and into the liquid in the test chamber 2. This is shown in Fig. 3. Colour is allowed to develop and compared to the colourmetric calibration chart to determine the levels of the analyte under test. The cap 12 is then removed and the liquid sample is discarded. The cap is replaced to ensure any remaining liquid does not leak out.

Claims

1. A hand-held liquid tester comprising a test chamber and reagent introduction mechanism arranged to introduce a reagent into said test chamber upon manual actuation by a user, wherein said reagent introduction mechanism is removable to allow liquid to be put into said test chamber and replaceable to close the test chamber.

2. The hand-held liquid tester as claimed in claim 1 wherein said test chamber is adapted to be gripped in one hand and the reagent introduction mechanism is arranged so that it may be operated by finger and/or thumb whilst the test chamber is being gripped.

3. The hand-held liquid tester as claimed in claim 1 or claim 2 adapted to receive said reagent in tablet or capsule form.

4. The hand-held liquid tester as claimed in claim 3 adapted to receive said reagent in tablet or capsule form in a blister pack.

5. The hand-held liquid tester as claimed in claim 4 adapted to receive a single test reagent dosage in a single blister.

6. The hand-held liquid tester as claimed in claim 4 or 5 wherein said reagent introduction mechanism comprises a pressure applicator for applying pressure to the blister pack to force out a tablet or capsule.

7. The hand-held liquid tester as claimed in claim 6 wherein said pressure applicator comprises a plunger.

8. The hand-held liquid tester as claimed in claim 6 or 7 wherein said reagent introduction mechanism

comprises a resilient cap adapted to press the reagent from the blister pack into the test chamber by means of an intermediate plunger.

9. The hand-held liquid tester as claimed in any preceding claim wherein said test chamber is at least partially transparent.

10. The hand-held liquid tester as claimed in any preceding claim wherein the test chamber is sealed when the liquid tester is closed.

11. The hand-held liquid tester as claimed in any preceding claim further comprising a reagent storage receptacle adapted to receive a plurality of test reagent dosages.

12. The hand-held liquid tester as claimed in claim 11 wherein said reagent storage receptacle is removably attached to the test chamber.

13. A method of assaying an analyte in a liquid comprising using the hand-held liquid tester as claimed in any preceding claim.

14. The method claimed in claim 13 wherein the liquid is water-based.

15. The method claimed in claim 14, wherein the liquid is swimming pool water.

16. A kit comprising:

a) the hand-held liquid tester as claimed any of claims 1 to 19; and

b) a test reagent.

17. The kit as claimed in claim 16 wherein said reagent is in tablet or capsule form.

18. The kit as claimed in claim 17 wherein said reagent in tablet or capsule form is provided in a blister pack.

19. The kit as claimed in claim 18 wherein said blister pack is adapted to provide a suitable environment for long term storage of the reagent.

20. The kit as claimed in claims 17 to 19 wherein said reagent is a single test reagent dosage in a single blister.

13

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Application No: GB0323460.6 **Examiner:** Dr Jonathan Corden

Claims searched: 1-20 **Date of search:** 17 February 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 2, 7, 9, 10, 13, 16	GB 1542411 A (SECR DEFENCE) see figure and page 1 lines 15-18 especially
A	-	US 3910764 A (TOWER) see figures and whole document
A	-	US 4663126 A (GOULD et al) see figures and whole document
A	-	GB 1556082 A (TINTOMETER) see figures and whole document
A	-	US 3741727 A (US ARMY) see figures and whole document
A	-	US 4235839 A (VESTERBERG) see figures and whole document
A	-	US 4409182 A (MACKLEM) see figures and whole document

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[X] :

G1B

Worldwide search of patent documents classified in the following areas of the IPC[07]

G01N

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC