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(54) Title: DEVICE FOR COLLECTING A SAMPLE AND METHOD OF COLLECTING A SAMPLE

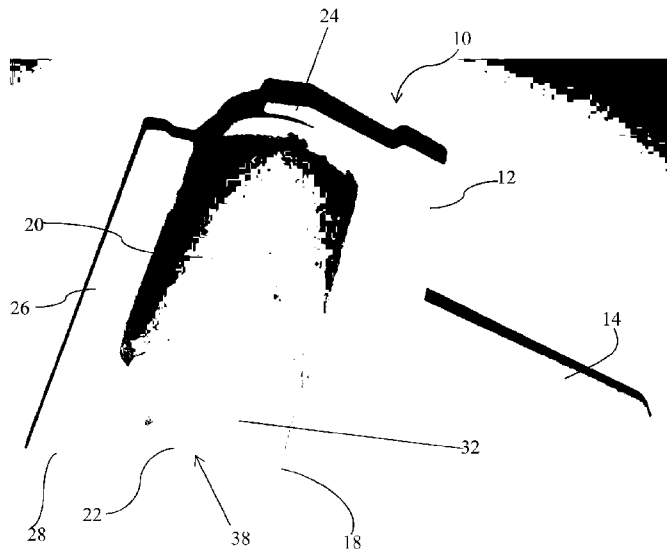


FIGURE 1

(57) Abstract: A device for collecting a sample for an explosive trace detector, wherein the device includes a roller unit having a handle configured to enable a user to move the roller unit across a sample surface, the roller unit including a roller support carried by the handle, and a roller which is rotationally coupled to the roller support to rotate relative to the handle, wherein the roller unit is arranged such that the roller rolls along the sample surface as the roller unit is moved across the sample surface by the handle, the roller being tacky to facilitate adherence of sample material from the sample surface to the roller during rolling along the sample surface.

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DEVICE FOR COLLECTING A SAMPLE AND METHOD OF COLLECTING A SAMPLE

Field of the Invention

The invention relates to a device for collecting a sample and to a method of
5 collecting a sample. More particularly, but not exclusively, the invention relates to a
device for collecting a sample for security testing for traces of explosives, for example on
the clothes and/or hand luggage of passengers arriving for travel at an airport.

Background of the Invention

The applicant has identified that there have been continued terrorist threats to target
10 airlines and that there are shortfalls with existing detection technology at airports. In
particular, it would be desirable for there to be provided improved technology for detecting
inorganic explosives in an effective time frame such as during screening of passengers
prior to boarding aircraft at airports. Existing technologies may not provide adequate
detection of inorganic explosives or may take too long to conduct the analysis necessary
15 for detection.

Examples of the present invention seek to provide an improved device for
collecting a sample for detection of traces of explosives which overcomes or at least
alleviates disadvantages associated with existing systems, such as the sensitivity and
pickup efficiency from fabrics.

20 Summary of the Invention

In accordance with the present invention, there is provided a device for collecting a
sample for an explosive trace detector, wherein the device includes a roller unit having a
handle configured to enable a user to move the roller unit across a sample surface, the
roller unit including a roller support carried by the handle, and a roller which is rotationally
25 coupled to the roller support to rotate relative to the handle, wherein the roller unit is
arranged such that the roller rolls along the sample surface as the roller unit is moved
across the sample surface by the handle, the roller being tacky to facilitate adherence of

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sample material (or target material) from the sample surface to the roller during rolling along the sample surface.

Preferably, the roller is formed of a silicone material. The roller is a composite blend of TPE (Thermoplastic elastomer) and Polydimethylsiloxanes (Silicon oil). The
5 silicon additive provides the material with viscous properties.

Preferably, the roller is cylindrical to provide continuous contact over a large sample area.

In a preferred form, the roller support includes a first pivot to pivotally support one end of the roller and a second pivot to pivotally support a second end of the roller opposite
10 to the first end.

Preferably, the silicone material retains its tackiness after washing in water and drying.

Preferably, the device includes a washing station for washing sample material from the roller into a sample solution for testing by a test unit. More preferably, the washing
15 station is in the form of a cradle to which the roller unit is docked, and the cradle has a cavity shaped to house the roller so as to support the roller unit in position when docked. Even more preferably, using minimum solution volume the cavity is adapted to hold water to wash the roller and the cradle is arranged to support the roller to allow the roller to be rotated through the water held in the cavity.

20 In one form, the cradle includes a scraper edge which extends across a width of the roller when the roller unit is docked at the washing station so as to assist in collecting sample material from the roller into the sample solution by scraping a perimeter surface of the roller as the roller is rotated against the scraper edge. This collects the sample fluid efficiently and minimises residual fluid overflow.

25 This could be done in a number of ways such as:

- Liquid impregnated sponge pad
- Roller to roller transfer

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- Agitation brush
 - Self-spooling web cartridge
 - Ultrasonic interference
 - IPA (Isopropyl alcohol) bath
- 5 • Linear sweeping brush

Preferably, the washing station includes a conduit for supply of water to and/or from the cavity. More preferably, the roller includes a coupling at an end thereof for connection to a driving tool for transmitting rotational drive from the driving tool to the roller to drive rotation of the roller against the scraper edge.

10 In accordance with another aspect of the present invention, there is provided a method of collecting a sample for an explosive trace detector, including the steps of:

using a device for collecting a sample as described above;

holding the handle of the device and moving the device across a sample surface so as to contact the roller on the sample surface and to roll the roller along the contact surface;

15 washing the roller so as to wash sample material from the roller into a sample solution; and

testing the sample solution for traces of explosive material.

Preferably, the step of washing the roller is performed by using a washing station as described above.

20 Eluting (removal of sample) should be done with an elution solution.

Cleaning/washing may be done with a cleaning solution. The cleaning solution may be warm water, Isopropyl Alcohol (IPA) or a different solution.

Also, the elution station and cleaning station could be done in the same bath or station or separate baths or stations.

25 Preferably, the step of washing the roller is performed with a solution of water. The actual system will just use water (or a liquid of some form) to transfer the contaminate particles through to the back-end of the system.

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In a preferred form, the testing of the sample solution includes testing for traces of inorganic explosive material. More preferably, the testing of the sample solution includes testing for nitrate, chlorate and/or perchlorate traces.

Brief Description of the Drawings

5 The invention is described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective top view of a device for collecting a sample in accordance with an example of the present invention, including both a roller unit and a washing station;

10 **Figure 2** shows a top perspective view of the washing station;

Figure 3 shows a front perspective view of the roller unit shown atop the washing station;

Figure 4 shows a side perspective view of the roller unit shown atop the washing station;

15 **Figure 5** shows a perspective view of the washing station including a fluid supply conduit;

Figure 6 shows a perspective view of the roller unit shown docked at the washing station;

20 **Figure 7** shows a side perspective view of the roller unit being rolled across a sample surface; and

Figure 8 shows test results demonstrating effectiveness of sample collection of the roller unit in comparison to a swab.

Detailed Description

The applicant has identified that it would be advantageous to be able to provide improved technology for efficiently detecting trace amounts of inorganic explosives commonly found in homemade explosives, particularly at security checks at airports. With the benefit of explosive detection technology available to the applicant, it has been involved in developing a capillary electrophoresis process which is able to detect trace levels of inorganic explosives within 60 seconds. The accurate, consistent and rapid identification of these explosives is a breakthrough in explosive trace detection systems. Samples for analysis by the system are collected from a surface using a sampling component. For example, the sampling component may be placed into the introduction port from which the device then extracts the sample for testing. The extracted fluid may then be analysed for targeting inorganic explosive anions utilising capillary electrophoresis.

However, the development of this new technology led the applicant to identify that there is a need for an improved apparatus and method for collecting sample material from a sample surface so as to provide a sample which can be tested by the capillary electrophoresis. More specifically, the applicant found that using traditional swab sample collection systems there was a significant target loss (>90%) which occurred when swabbing from a porous surface compared with a non-porous surface. Although swabbing uptake efficiency was significantly improved by pre-dampening the swab compared to using a dry swab, there would be difficulties in using damp swabs on passenger clothes at airports and, moreover, the uptake efficiency of particular materials was still found to be lacking.

With reference to Figures 1 to 8 of the drawings, there is shown a device for collecting a sample for an explosive trace detector. Advantageously, it has been determined by the applicant that the use of a tacky roller facilitates an efficient uptake of sample material without damage to clothes, luggage and other items worn on the person of a passenger at an airport. Moreover, the device is efficient, simple and neat to use, and

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also may include a washing station to improve the process of gathering the sample material into a form which can be used by the explosive trace detector.

More specifically, with reference to Figures 1 to 8, there is shown a device 10 for collecting a sample for an explosive trace detector, wherein the device 10 includes a roller unit 12 having a handle 14 configured to enable a user to move the roller unit 12 across a sample surface 16. The roller unit 12 includes a roller support 18 carried by the handle 14, and a roller 20 which is rotationally coupled to the roller support 18 to rotate relative to the handle 14. The roller unit 12 is arranged such that the roller 20 rolls along the sample surface 16 as the roller unit 12 is moved across the sample surface 16 by the handle 14. The roller 20 is tacky when dry to facilitate adherence of sample material from the sample surface 16 to the roller 20 during rolling along the sample surface 16.

In the preferred form of the roller unit 12 shown in the drawings, the roller 20 is formed of a silicone material (see material description page 2) and is cylindrical, with a circular, cross-sectional shape. As can be seen in Figure 1, the roller support 18 includes a first pivot 22 to pivotally support one end of the roller 20 and a second pivot 24 to pivotally support a second end of the roller 20 opposite to the first end. In this way, the roller support 18 effectively has a forked arrangement to provide the first pivot 22 and the second pivot 24 so as to support the roller 20 between the first pivot 22 and the second pivot 24 in an arrangement wherein the roller 20 is free to rotate relative to the roller support 18 and the handle 14. The roller support 18 and the handle 14 may be formed integrally as a unitary part. Although the rolling surface of the roller 20 is formed of tacky silicone material, that silicone material (see material description page 2) may be formed as a sleeve which fits over a core formed of plastic, with the plastic core protruding at both ends of the sleeve and forming stub axles at either end for mounting in the first pivot 22 and the second pivot 24 of the roller support 18.

The silicone material (see material description page 2) may be chosen to retain and/or restore its tackiness when washed in water and dried. Conveniently, in the event that a negative reading is obtained for a particular passenger, this would enable the roller unit 12 to then be washed and to be re-used so that, potentially, a single roller unit 12 may

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be used until either a positive result is recorded or the roller 20 finally loses its tackiness. Tackiness disappears when wet or clogged with particles; a wash/dry cycle is required to restore tackiness. Roller tackiness life is expected to exceed likelihood of positive sample result (400+ uses have been validated so far).

5 As shown in Figure 2, the device 10 includes a washing station 26 for washing sample material from the roller 20 into a sample solution for testing by a test unit. The washing station 26 is in the form of a cradle 28 to which the roller unit 12 is docked (see Figure 6), and the cradle 28 has a cavity 30 shaped to house the roller 20 so as to support the roller unit 12 in position when docked. The cavity 30 may be shaped to maximise the
10 exposure of the roller 20 along its length while minimising the fluid volume. The cavity 30 may be adapted to hold water to wash the roller 20 and the cradle 28 may be arranged to support the roller 20 to allow the roller 20 to be rotated through the water held in the cavity 30 so as to facilitate washing of the sample material from the roller 20 into a liquid form to be tested by the test unit.

15 As shown in Figures 3 and 4, the cradle 28 may include a scraper edge 34 (see notes page 3 regarding scraper edge) which extends across a width of the roller 20 when the roller unit 12 is docked at the washing station 26 so as to assist in washing sample material from the roller 20 into the sample solution by scaping a perimeter surface of the roller 20 as the roller 20 is rotated against the scraper edge 34. The scraper edge 34 may
20 be in the form of a relatively thin insert mounted as a substantially vertical screen in a floor surface of the cradle 28. The scraper edge 34 may be mounted to be parallel to an axis of the roller 20 when the roller unit 12 is docked at the washing station 26. Furthermore, the scraper edge 34 may be mounted to the cradle at a location which is raised upwardly from a lowest point of the floor surface of the cavity 30.

25 As shown in Figures 5 and 6, the washing station 26 may include a conduit 36 for supply of water to and/or from the cavity 30. The conduit 36 may be fitted to a nipple which is integrally formed in the washing station 26, with the nipple having an opening which extends through a side wall of the washing station 26 to be in fluid communication

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with the interior of the cavity 30. The lowest portion of the floor surface of the cavity 30 may have an indented drain which extends longitudinally of the cylindrical cavity 30.

When a sample yields a positive result, the cavity is removed and replaced with a clean one. This is only required removed on positive samples (or at a determined life cycle
5 ie x number of uses/cycles, or when clogged after multiple uses) as the cavity is then contaminated.

The conduit 36 may facilitate efficient and neat collection of the sample solution from the washing station 26 during washing of the roller 20, as shown in Figure 6. Washing may be achieved by rotating the roller 20 through a bath of water which is then
10 collected, for example by suction, through the conduit 36. To facilitate washing of the roller 20, the roller 20 may be driven in rotation as shown in Figure 6. This may be achieved by providing the roller 20 with a coupling 38 at one or both ends thereof for connection to a driving tool 40 for transmitting rotational drive from the driving tool 40 to the roller 20 to drive rotation of the roller 20 against the scraper edge 34.

15 It will be appreciated that the step of washing the roller 20 in the washing station 26 may be performed by using de-ionized water, possibly in combination with an elution agent. In particular, washing may be performed with a mixture of de-ionized water and ferric sulphate.

Figure 7 shows the roller unit 12 being used in laboratory conditions to remove
20 sample material from a sample surface 16 and Figure 8 shows the results of tests conducted by the applicant in comparing uptake of the roller unit 12 compared to a swab uptake. The uptake of the roller unit 12 is shown at the upper graph indicated with reference numeral 42 and the results of the swab uptake are shown at the lower graph indicated by reference numeral 44. For each of the two graphs, the left-hand result (that is, the left-hand
25 "bump" in the graph) shows a level of Nitrate, the central result (the central "bump") shows a level detected of Chlorate, and the right-hand result (the right-hand "bump") shows a level detected of Perchlorate. As can be seen, using the same sample conditions, the uptake using the roller unit 12 is significantly higher for Nitrate, Chlorate and Perchlorate when compared to the swab uptake.

While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only, and not by way of limitation. It will be apparent to a person skilled in the relevant art that various changes in form and detail can be made therein without departing from the spirit and scope
5 of the invention. Thus, the present invention should not be limited by any of the above described exemplary embodiments.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or
10 information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group
15 of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A device for collecting a sample for an explosive trace detector, wherein the device includes a roller unit having a handle configured to enable a user to move the roller unit across a sample surface, the roller unit including a roller support carried by the handle, and a roller which is rotationally coupled to the roller support to rotate relative to the handle, wherein the roller unit is arranged such that the roller rolls along the sample surface as the roller unit is moved across the sample surface by the handle, the roller being tacky to facilitate adherence of sample material from the sample surface to the roller during rolling along the sample surface.
2. A device as claimed in claim 1, wherein the roller is formed of a silicone material.
3. A device as claimed in claim 1 or claim 2, wherein the roller is cylindrical.
4. A device as claimed in any one of claims 1 to 3, wherein the roller support includes a first pivot to pivotally support one end of the roller and a second pivot to pivotally support a second end of the roller opposite to the first end.
5. A device as claimed in claim 2, wherein the silicone material retains its tackiness when washed in water and dried.
6. A device as claimed in any one of claims 1 to 5, wherein the device includes a washing station for washing sample material from the roller into a sample solution for testing by a test unit.
7. A device as claimed in claim 6, wherein the washing station is in the form of a cradle to which the roller unit is docked, and the cradle has a cavity shaped to house the roller so as to support the roller unit in position when docked.

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8. A device as claimed in claim 7, wherein the cavity is adapted to hold water to wash the roller and the cradle is arranged to support the roller to allow the roller to be rotated through the water held in the cavity.
9. A device as claimed in claim 8, wherein the cradle includes a scraper edge which extends across a width of the roller when the roller unit is docked at the washing station so as to assist in washing sample material from the roller into the sample solution by scraping a perimeter surface of the roller as the roller is rotated against the scraper edge.
10. A device as claimed in claim 9, wherein the washing station includes a conduit for supply of water to and/or from the cavity.
11. A device as claimed in claim 10, wherein the roller includes a coupling at an end thereof for connection to a driving tool for transmitting rotational drive from the driving tool to the roller to drive rotation of the roller against the scraper edge.
12. A method of collecting a sample for an explosive trace detector, including the steps of:
 - using a device for collecting a sample as claimed in claim 1;
 - holding the handle of the device and moving the device across a sample surface so as to contact the roller on the sample surface and to roll the roller along the contact surface;
 - washing the roller so as to wash sample material from the roller into a sample solution; and
 - testing the sample solution for traces of explosive material.
13. A method of collecting a sample as claimed in claim 12, wherein the step of washing the roller is performed by using a washing station as claimed in any one of claims 6 to 11.
14. A method of collecting a sample as claimed in claim 12 or claim 13, wherein the step of washing the roller is performed with water.

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15. A method of collecting a sample as claimed in claim 12 or claim 13, wherein the step of washing the roller is performed with an elution agent.
16. A method of collecting a sample as claimed in claim 12 or claim 13, wherein the step of washing the roller is performed with a solution of water and ferric sulphate.
17. A method of collecting a sample as claimed in claim 16, wherein the step of washing the roller is performed with a solution of water and ferric sulphate, mixed in proportions of 1:1.
18. A method of collecting a sample as claimed in any one of claims 12 to 17, wherein the testing of the sample solution includes testing for traces of inorganic explosive material.
19. A method of collecting a sample as claimed in claim 18, wherein the testing of the sample solution includes testing for nitrate, chlorate and/or perchlorate.
20. A device for collecting a sample for an explosive trace detector substantially as hereinbefore described with reference to the accompanying drawings.
21. A method of collecting a sample for an explosive trace detector substantially as hereinbefore described with reference to the accompanying drawings.

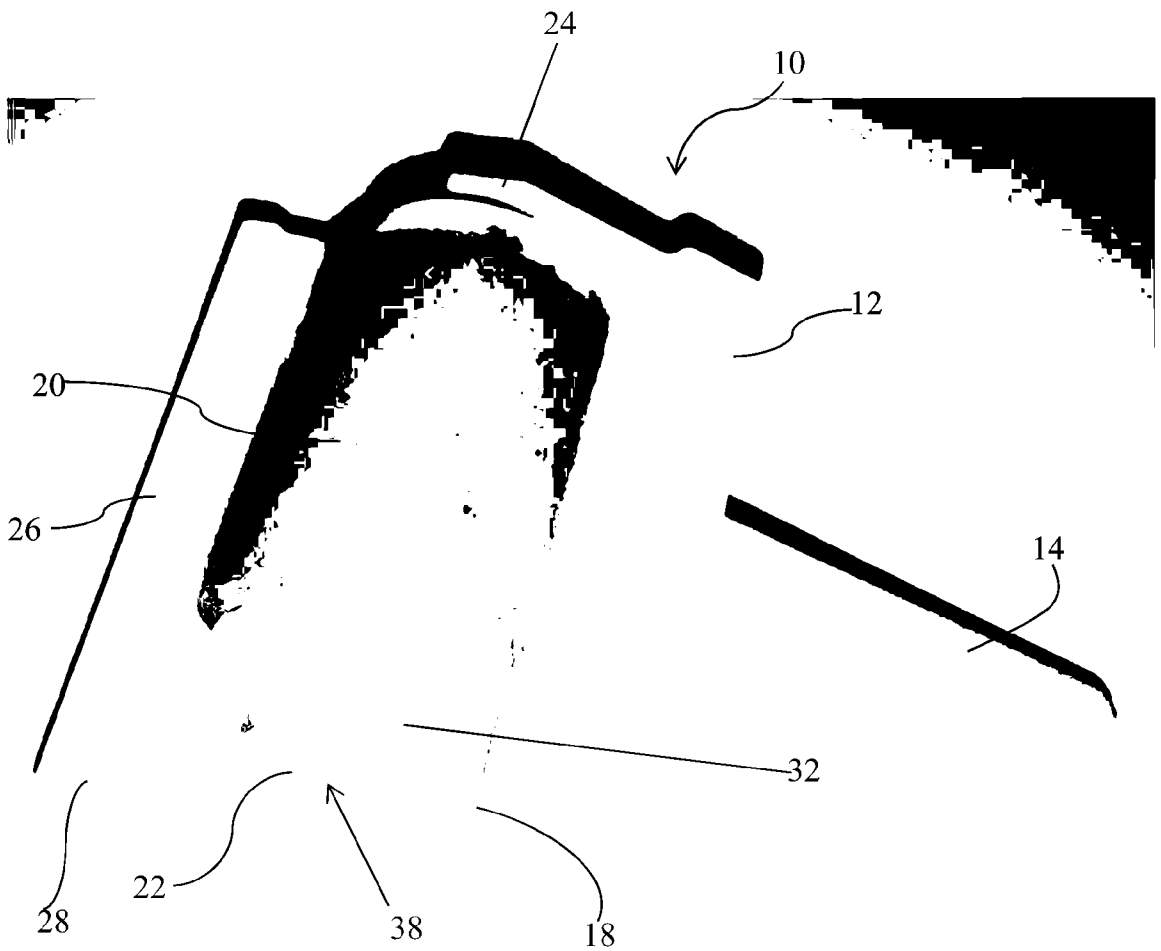


FIGURE 1

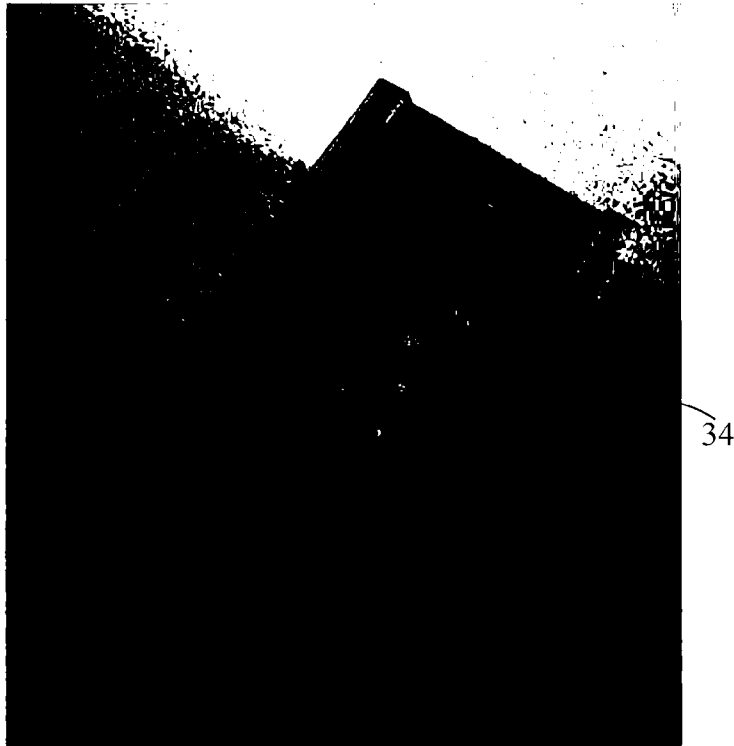


FIGURE 2

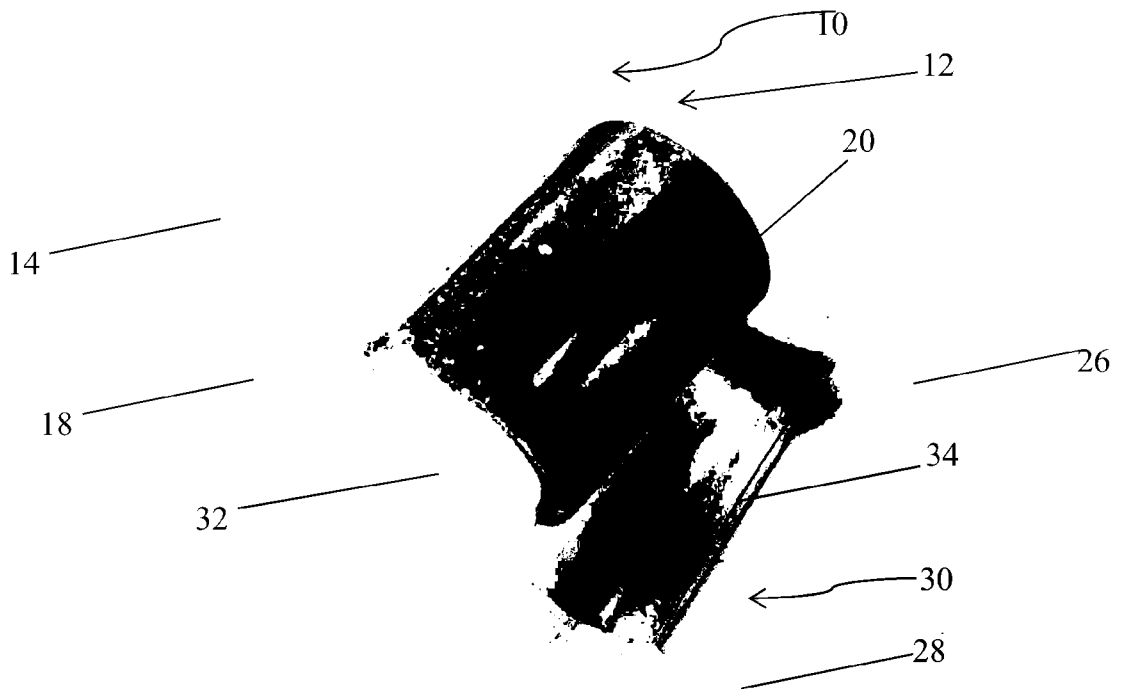


FIGURE 3

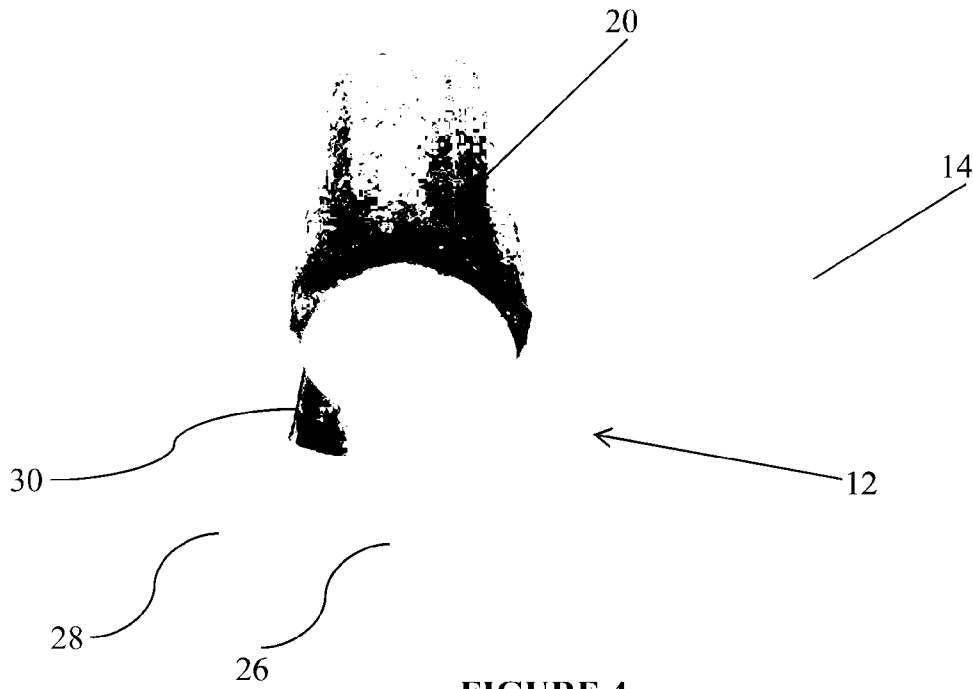


FIGURE 4

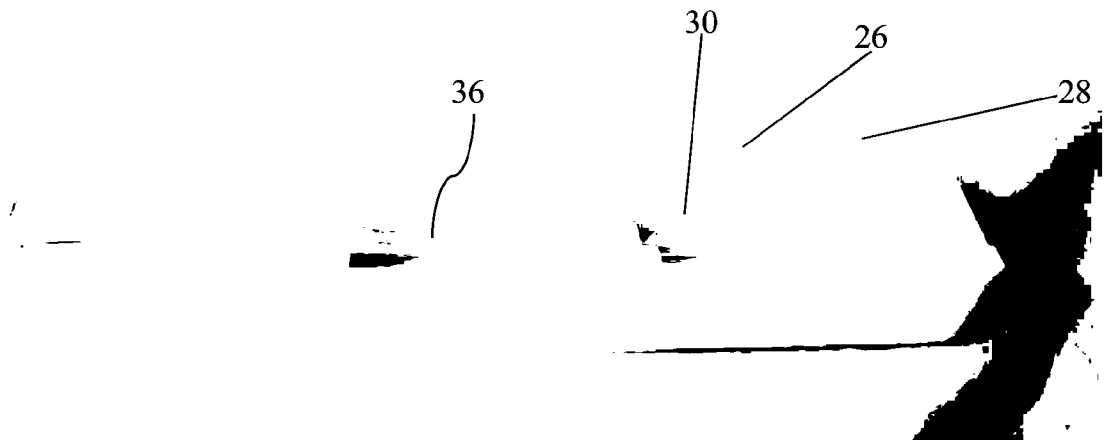


FIGURE 5

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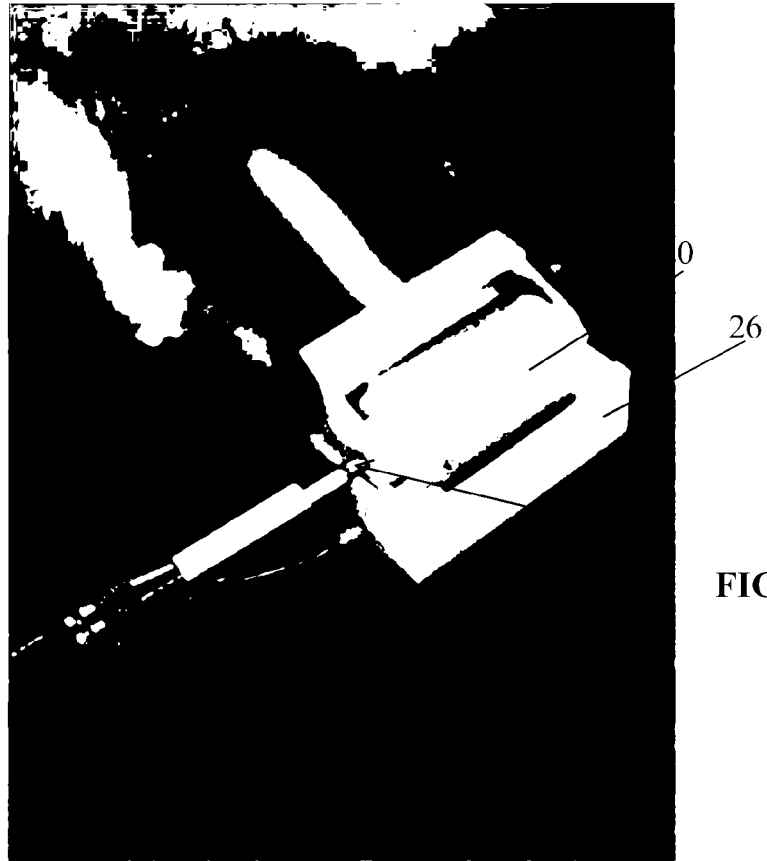


FIGURE 6

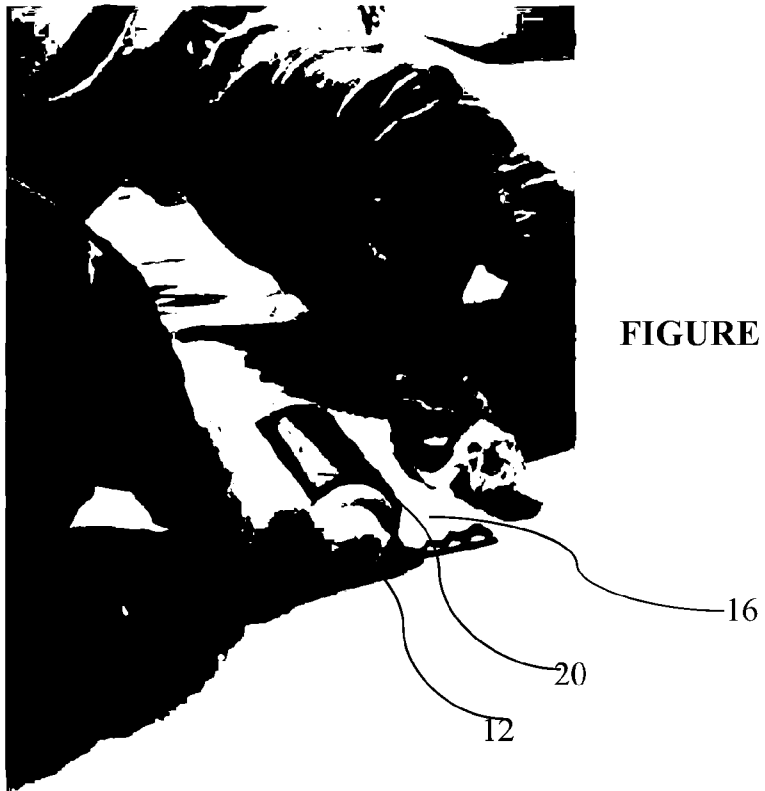


FIGURE 7

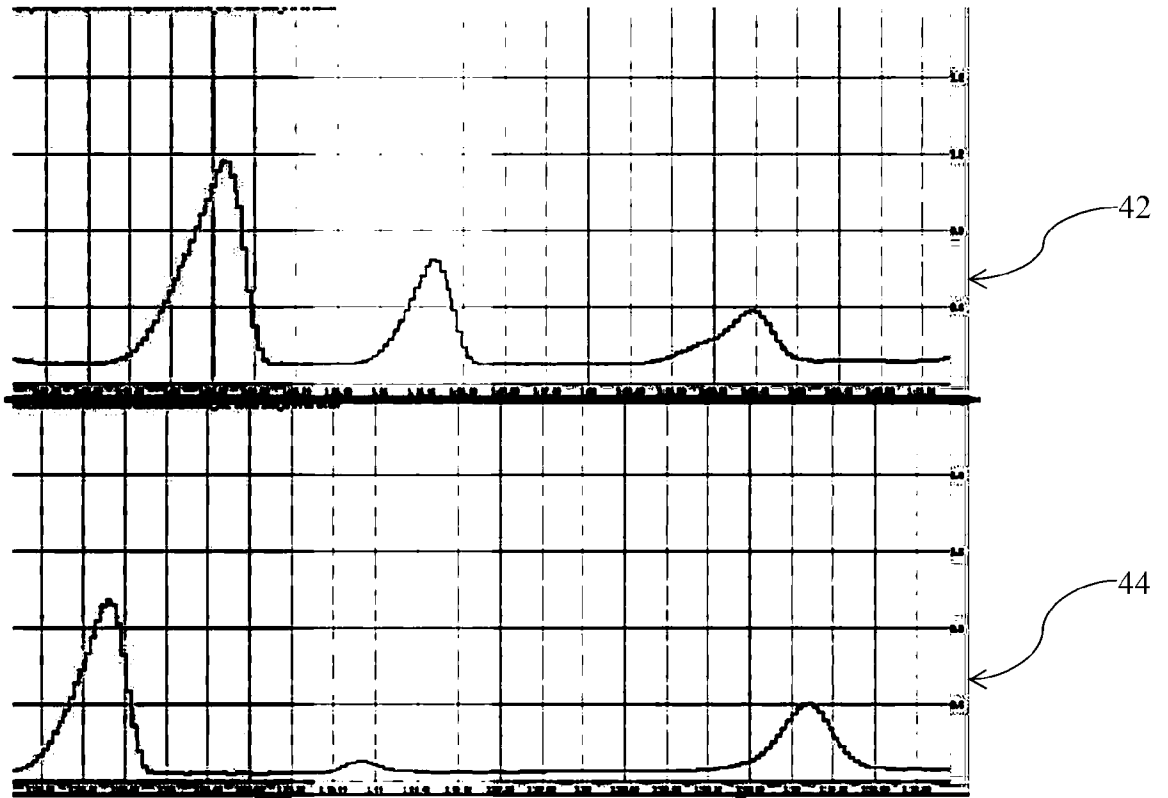


FIGURE 8

A. CLASSIFICATION OF SUBJECT MATTER

G01N 1/28 (2006.01) G01N 33/22 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Applicant(s)/Inventor(s) name searched in internal databases provided by IP Australia

WPIAP, EPODOC: IPC, CPC G01N, G01N1, G01N33, G01N33/22, A47L25/005, G01N2001/2833, G01N2001/022 & Keywords (roller, cylinder, drug, explosive, trace, gunpowder, wash, clean) and like terms; Applicant/Inventor search

Google Patents/Scholar: roller, tacky, trace, substance, explosive, drug, detector, wash, rinse, dock, cradle, station and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Documents are listed in the continuation of Box C		



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:		
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
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"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
4 October 2016Date of mailing of the international search report
04 October 2016

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INTERNATIONAL SEARCH REPORT

International application No.

C (Continuation).

DOCUMENTS CONSIDERED TO BE RELEVANT

PCT/AU2016/050683

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2016/050683

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

Form PCT/ISA/210 (Family Annex)(July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2016/050683

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

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