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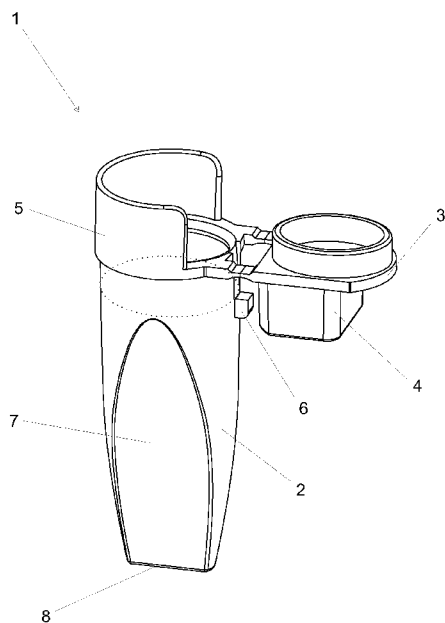


FIG. 1A

(57) Abstract: A sample vessel (1, 11) for transferring and analyzing a sample with analyzer instrument, which sample vessel comprises an elongated vessel body (2, 12) for containing the sample and a hinged cap (3, 13) connected in top end area of the vessel body, and the cross-section of the vessel body (2, 12) on a transversal plane in relation to the lengthwise center axis of the vessel body the inner surface of the vessel body is rotationally asymmetrical in relation to the lengthwise center axis, wherein the sample vessel (1, 11) comprises a surface (5, 15) extending upwards from the vessel body, which surface partially surrounds the edge of the cap (3, 13), when the cap is in closed position.

## Sample vessel

### Field of technology

The present invention relates to a sample vessel used to transfer samples,  
5 such as biological samples, into suitable analyzer instruments and for storing  
the samples during analysis process.

### Technological background

Different kinds of sample vessels, vials and tubes are used for containing  
samples to be analyzed with analyzer equipment. These samples vessels may  
10 contain separate or hinged caps for closing the vessel, and are generally made  
from plastic or glass. Examples include Thermo Scientific™ Capitol Vial prod-  
uct family.

Other examples of known plastic sample vessels used widely in laboratory  
work include so-called microcentrifuge tubes, for example from Eppendorf, and  
15 various PCR (Polymerase Chain Reaction) reaction tubes.

These kinds of sample vessels are disposable in order to prevent possible  
sample contamination and other problems related to reusable sample vessels  
in sample handling and analyzing processes. However, the similarity of these  
kinds of sample vessels makes them easily mixable, since they are usually  
20 identical except for markings identifying the sample, e.g. a hand written or  
printed label or a barcode requiring machine reading and interpretation, which  
may cause human derived errors for the analyzing processes.

Known sample vessels also include sample vessels compatible with laboratory  
automation means and robotic handling. These sample vessels are made of  
25 plastic which enhances their durability and flexibility in the automated handling  
processes. One example of the sample vessels designed for automatic opera-  
tions is disclosed in publication WO 2012/056116.

### Summary of the invention

Both FDA (US Food and Drug Administration) and MDD/IVD standard ISO  
30 13485 require that patient results generated by *in vitro* diagnostic (IVD) instru-

ments must be traceable back to the original patient samples and to all analytically critical components of the analyzer systems including liquid consumables and disposables used in the analyzing processes.

5 In the context of the present invention a microbiology laboratory has several rooms or laboratories for different kinds of sample types. These rooms are also categorized based on biosafety levels (BSL) of the biological agents handled to BSL-1, BSL-2, BSL-3, and BSL-4. Many hazardous microbes, such as mycobacteria for example, are processed in BSL-3 level laboratories and non-hazardous microbes are processed in BSL-1 level laboratories. Samples from  
10 these laboratory rooms are transferred to a separate analyzing room for analysis, which analyzing room is equipped with suitable analyzer instruments and serve several different laboratory rooms.

Generally, the samples to be analyzed are prepared in a sample preparation station located at the BSL room or rooms. The sample preparation station  
15 comprises an instrument to facilitate movement of primary samples (e.g. bacterial colony) from original sample media (e.g. agar plate, blood culture bottle) to a sample vessel in an ergonomic manner which further reduces errors.

As an example, a primary sample in an agar plate is taken to the sample preparation station and identification data of the primary sample, which is stored in  
20 a barcode, radio frequency identification (RFID) tag or other indicia, is read to the sample preparation station with a suitable reader. Once confirmation of the data input is received, for example by a visual or audio signal, a specimen sample is taken from the primary sample with a sampling device, and the primary sample is returned to its storage. Next a sample vessel is taken, and its  
25 identification data is read to the sample preparation station with a suitable reader as was done with the primary sample. Then the sample in the sampling tool is inserted in the sample vessel, and the end of the sampling tool containing the sample is detached inside the sample vessel by twisting the sample tool, for example. The remaining part of the sampling tool is discarded and the  
30 lid or cap of the sample vessel is closed. The sample vessel together with the sample is placed in an empty position of a sample vessel rack located in the sample preparation station in a proper orientation. The sample preparation station detects the location of the newly inserted sample vessel in the sample vessel rack and connects identification data obtained from the primary sample

and the new sample vessel to the location of the sample vessel in the sample vessel rack.

When the sample vessel rack contains the required number of sample vessels, the sample vessel rack is removed from the sample vessel preparation station.

- 5 In one example, the removal action also activates a locking means in the sample vessel rack. The locking means prevent the removal of any of the sample vessels located in the rack when locking is activated. The sample vessel rack is then inserted into an analyzing instrument, which insertion action optionally deactivates the locking means in the sample vessel rack, allowing removal of  
10 the sample vessels from the sample vessel rack for analysis operations.

The obtained analysis results are connected to the identification data of the sample from the sample preparation station, so that each analysis result can be tracked to a single sample.

- 15 The present invention provides a sample vessel, to be used for example in the above described process, that allows for easier and safer sample transfer to the sample vessel and safer and more secure handling and transfer of the sample vessel, including the automated handling of the vessel by an analyzer instrument. The present invention also provides a sample vessel that allows implementation of enhanced traceability through the whole analyzing process.

- 20 The sample vessel of the invention comprises an elongated vessel body for containing the sample and a hinged cap connected in top end area of the vessel body, wherein the cross-section of the vessel body on a transversal plane in relation to the lengthwise center axis of the vessel body the inner surface of the vessel body is rotationally asymmetrical in relation to the lengthwise center  
25 axis. The asymmetrical shape of the inner surface of the vessel body allows for easy and secure insertion of a sample in the sample vessel with a suitable tool by wedging the end of the tool against inner surfaces of the vessel body and by twisting or bending the tool and thus breaking the end portion of the tool together with the sample inside the vessel body. An example of this type of tool  
30 is disclosed in a patent application filed at the same date and by the same applicant as the present application.

The sample vessel of the invention also comprises a surface extending upwards from the vessel body, which surface partially surrounds the edge of the cap, when the cap is in a closed position. This surface prevents the sample

material slashing from the sample vessel when the cap of the sample vessel is opened, for example. The upwards extending surface is preferably situated substantially in 90 degrees angle in relation to the plane of the top of the cap when the cap is in a closed position. The upwards extending surface also provides a gripping surface when the sample vessel is moved robotically in the automated handling of the sample vessel. This can be implemented with a robot gripper sleeve, which is pushed against the outer surface of the vessel's upwards extending surface, i.e. a collar, to such extent that friction between the surfaces keeps the vessel in grip, for example.

10 In an embodiment of the sample vessel of the invention the cross-section of the inner surface of the vessel body is substantially oval-shaped.

In an embodiment of the sample vessel of the invention the outer surface of the vessel body is tapered, which helps in setting the sample vessel in a sample vessel rack. Further, the oval shape of the cross-section of the inner surface of the vessel body preferably also extends to the outer surface of the vessel body, which enhances the proper orientation of the sample vessel when it is placed in a sample vessel rack, for example. This is very important in the automatic handling of the sample vessel, where the proper orientation of the sample vessel is critical for the operation of the analyzing instruments.

20 The oval shape of the sample vessel body allows the vessel to be inserted into e.g. sample rack in two different orientations, which are 180 degrees apart. In an embodiment of the sample vessel of the invention the outer surface of the vessel body is equipped with a protrusion. This protrusion is used for preventing the insertion of the sample vessel in the incorrect one of the two orientations in 180 degrees, preferably together with the form and shape of the outer surface of the vessel body, when placed in a sample vessel rack, so that the cap can be automatically opened, for example. The protrusion may also be used for securing the sample vessel at its place in a sample vessel rack, when the sample vessel rack is equipped with suitable locking means. An example of this kind of sample vessel rack is disclosed in a patent application filed at the same date and by the same applicant as the present application.

In an embodiment of the sample vessel of the invention the cap of the sample vessel comprises a tab extending from the upper surface of the cap, when the cap is in closed position. This tab may be used for automatic opening of the

sample vessel with an analyzing instrument, for example. The tab is preferably formed substantially flat on its upper surface to allow controlled manual opening and closing of the cap without fear of tearing protective gloves and for providing comfortable and ergonomic contact surface against the user's finger.

- 5 The tab is also preferably formed so that it allows the use of suitable opening tools to be used both in automatic and manual opening and closing of the cap. The controlled opening of the cap of the sample vessels is important in order to prevent liquid droplets possibly located on the inner surface of the cap from splashing outside the vessel during the opening process.

- 10 In an embodiment of the sample vessel of the invention the cap comprises a bracket extending from the lower surface of the cap, when the cap is in closed position, which bracket comprises a sealing protrusion on the side surface of the bracket at a distance from the lower surface of the cap. When the cap is in closed position the sealing protrusion sets itself against the inner surface of the
- 15 sample vessel, and thus provides sealing effect for the closed cap. Advantageously the bracket is circular in form, preferably oval-shaped to correspond to the cross-sectional form of the inner surface of the sample vessel, so that the sealing protrusion in the outer surface of the bracket forms a ring.

- In an embodiment of the sample vessel of the invention the outer side surface
- 20 of the vessel body comprises a substantially level area. This level area may be used for printing a bar code on the level area, which allows for better traceability of the analyzing results and of the whole analyzing process.

- In an embodiment of the sample vessel of the invention the vessel body comprises a substantially level bottom surface. This level horizontal bottom surface
- 25 provides better contact with a flat tipped ultrasonic mixing probe and thus enhances the ultrasonic mixing process.

- In an embodiment of the sample vessel of the invention the inner surface of the sample vessel comprises one or more protrusions, preferably at the bottom area of the sample vessel, which protrusion(s) form a narrow slot inside the
- 30 sample vessel. This thus formed slot can be used as an additional support surface(s) for detaching a part of a suitable sample transferring tool, for example.

In an embodiment of the sample vessel of the invention the sample vessel is formed from suitable plastic material, such as PP (Polypropylene), with injection moulding. Further, in an embodiment of the sample vessel of the invention

the sample vessel, especially the vessel body, is essentially rigid and does not allow deformation when squeezed manually. Preferably, the deformation of the sample vessel requires a force exceeding 60 Newtons.

5 The features defining a sample vessel of the invention are more precisely presented in claim 1. Dependent claims present advantageous features and embodiments of the invention.

### Drawings

10 An exemplifying embodiment and its advantages are explained in greater detail below in the sense of an example and with reference to the accompanying figures, where

Figure 1A shows an embodiment of a sample vessel of the invention as a perspective view,

Figure 1B shows the embodiment of figure 1A as a back view,

Figure 1C shows the embodiment of figure 1A as a side view,

15 Figure 1D shows the embodiment of figure 1A as a top view,

Figure 1E shows the embodiment of figure 1A as a bottom view, and

Figures 2A-2B shows an alternative embodiment of a sample vessel of the invention.

### Detailed description of the embodiment

20 In the figures is shown a sample vessel 1, which comprises an elongated vessel body 2 and a cap 3 attached to the upper end of the vessel body with integral hinges. From top surface of the cap 3 extends a tab 4. The outer edge of the cap 3 is partially surrounded with a splash guard 5 connected to the upper end of the vessel body 2.

25 The elongated vessel body 2 has in this embodiment, as can be best seen from figure 1E, an oval cross-section, both for the outer and inner surface of the vessel body. The oval cross-section of the inner surface of the vessel body 2 allows the end of a suitable sample collecting tool to be wedged between inner surfaces of the vessel body 2, so that the end of the sample collecting tool

can be broken off by twisting or turning the sample collecting tool, and the end of the sample collecting tool is left together with the sample inside the vessel body. This guarantees the proper sample transfer to the sample vessel 1 for further analysis. The oval cross-section of the outer surface of the vessel body  
5 2 also enhances the usability of the sample vessel 1 in automated and robotic handling of the sample vessel.

The elongated vessel body 2 is in this embodiment also formed to have tapered shaped, as can be best seen from figures 1B and 1C. This tapered shape helps the setting of the sample vessel 1 in a sample vessel rack, for ex-  
10 ample.

In the outer surface of the vessel body 2 is formed a protrusion 6, which operates as a guiding and locking tab when the sample vessel 1 is inserted in a correspondingly formed slot of a sample vessel rack. During insertion of the sample vessel 1 to the sample vessel rack, the protrusion 6 requires that the  
15 sample vessel is in proper orientation in relation to the sample vessel rack, otherwise the sample vessel may not be inserted properly in the rack. In obtaining the proper orientation for sample vessel 1 when the sample vessel is inserted in a sample vessel rack, the oval cross-section of the outer surface of the vessel body 2 advantageously works together with the protrusion 6 and  
20 helps to guide the sample vessel into correct orientation. The upper edge of the protrusion 6 also allows a suitable locking means, which locking means are preferably part of the sample vessel rack, to be set on top of the protrusion. This prevents the removal and changing of place of the sample vessel 1 once it is placed on the sample vessel rack and locked there.

25 On the outer surface of the vessel body 2 is formed a substantially level area 7. This level area 7 allows suitable identification means, such as bar codes or color codes to be printed or otherwise easily added to the sample vessel 1. The level area 7 also identifies the area from where the suitable identification information can be found on the sample vessel 1.

30 The bottom surface 8 of the vessel body 2 is formed substantially level in horizontal direction. This flat bottom surface 8 allows for better contact with a flat tipped ultrasonic mixing probe, and thus enhances the ultrasonic mixing effect.

The top part of the sample vessel 1 comprises the splash guard 5, which extends upwards from the top end of the vessel body 2, and partially around the

side surface of the cap 3. The splash guard 5 defines surface that prevents possible sample droplets in the interior of the cap 3 or on the inner surface of the opening of the vessel body 2 to get airborne and contaminating the surroundings when the cap is opened.

- 5 From the upper or outer surface of the cap 3 extends upwards the tab 4, which enables both the manual and automatic opening and closing of the cap. The tab 4 is formed to cover, or more precisely encircle in this embodiment, a significant area, over half as can be best seen from figure 1D, of the upper surface of the cap in order to provide suitably large contact area also for a controlled manual opening and closing of the cap.
- 10

Figures 2A-2D shows an alternative embodiment of a sample vessel of the invention, where figure 2A is a back view of the sample vessel, figure 2B is a side view of the sample vessel, figure 2C is a bottom view of the sample vessel, and figure 3D is a top view of the sample vessel. In the figures the sample vessel 11 is shown the cap 13 in open position.

15

In the embodiment of figures 2A-2D, the vessel body 12, the tab 14, the splash guard 15, the substantially level area 17, and the flat bottom surface 18 are the same than in the embodiment of figures 1A-1E.

- In the embodiment of figures 2A-2D, the protrusion 16 has been made a little smaller, and formed substantially V-shaped. This shape of the protrusion 16 allows for better and more robust guidance for the sample vessel 11 to a proper orientation when the sample vessel is inserted in an opening with a slot for the protrusion.
- 20

The cap 13 comprises a bracket 19, which extends downwards from the lower surface of the, when the cap is in closed position. At the lower edge area of the bracket 19, at the side surface of the bracket, there is formed a sealing protrusion 20. The sealing protrusion 20 enhances the sealing effect of the side surface of the bracket 19, which side surface sets itself against the inner surface of the body 12 of the sample vessel 11. As can be best seen from figure 2D, the shape of the bracket 19 is substantially oval-shaped to correspond to the cross-sectional shape of the inner surface of the body 12 of the sample vessel 11, and the sealing protrusion 20 extends around the outer surface of the bracket 19 to form a sealing ring.

25

30

At the bottom portion of the inside of the body 12 of the sample vessel 11 there are formed a plurality of protrusions 21 extending from the inner bottom and side surfaces of the vessel body, which protrusions form a slot at the bottom of the sample vessel. This slot is suitable for receiving a detachable portion of a suitable sample transfer tool, and provides support for detaching the detachable portion of the tool together with the sample inside the sample vessel.

In the present invention the tab 6 and 16 of the above discussed embodiments may be also be implemented with different shapes, sizes and locations, depending on the requirements for different implementations, for example. The key function of the tab, however, remains the same, i.e. guiding the sample vessel in a proper orientation in a sample vessel rack, and/or preventing inserting of the sample vessel in a sample vessel rack in an improper orientation, and/or utilizing locking of the sample vessel in a sample vessel rack.

The specific exemplifying embodiments of the invention shown in figures and discussed above should not be construed as limiting. A person skilled in the art can amend and modify the embodiments in many evident ways within the scope of the attached claims. Thus the invention is not limited merely to the embodiments described above.

## Claims

1. A sample vessel (1, 11) for transferring and analyzing a sample with analyzer instrument, which sample vessel comprises an elongated vessel body (2, 12) for containing the sample and a hinged cap (3, 13) connected in top end area of the vessel body, and the cross-section of the vessel body (2, 12) on a transversal plane in relation to the lengthwise center axis of the vessel body the inner surface of the vessel body is rotationally asymmetrical in relation to the lengthwise center axis, **characterized** in that the sample vessel (1, 11) comprises a surface (5, 15) extending upwards from the vessel body, which surface partially surrounds the edge of the cap (3, 13), when the cap is in closed position.
2. A sample vessel (1, 11) according to claim 1, wherein the cross-section of the inner surface of the vessel body (2, 12) is substantially oval-shaped.
3. A sample vessel (1, 11) according to claim 1 or 2, wherein the shape of the outer surface of the vessel body (2, 12) is tapered.
4. A sample vessel (1, 11) according to any of claims 1-3, wherein the outer surface of the vessel body (2, 12) is equipped with a protrusion (6, 16) for guiding the sample vessel in correct position when placed in a sample vessel rack and/or for securing the sample vessel at its place in a sample vessel rack.
5. A sample vessel (1, 11) according to any of claims 1-4, wherein the cap (3, 13) comprises a tab (4, 14) extending from the upper surface of the cap, when the cap is in closed position.
6. A sample vessel (1, 11) according to any of claims 1-5, wherein the cap (3, 13) comprises a bracket (19) extending from the lower surface of the cap, when the cap is in closed position, the side surface of the bracket comprising a sealing protrusion (20) at a distance from the lower surface of the cap, which sealing protrusion is located against the inner surface of the vessel (1, 11) when the cap is in closed position.
7. A sample vessel (1, 11) according to any of claims 1-6, wherein the outer side surface of the vessel body (2, 12) comprises a substantially level area (7, 17).

8. A sample vessel (1, 11) according to any of claims 1-7, wherein the vessel body (2, 12) comprises a substantially level bottom surface (8, 18).
9. A sample vessel (1, 11) according to any of claims 1-8, wherein the inner surface of the sample vessel (1, 11) comprises at least one protrusion (21) for  
5 forming narrow slot inside the sample vessel.

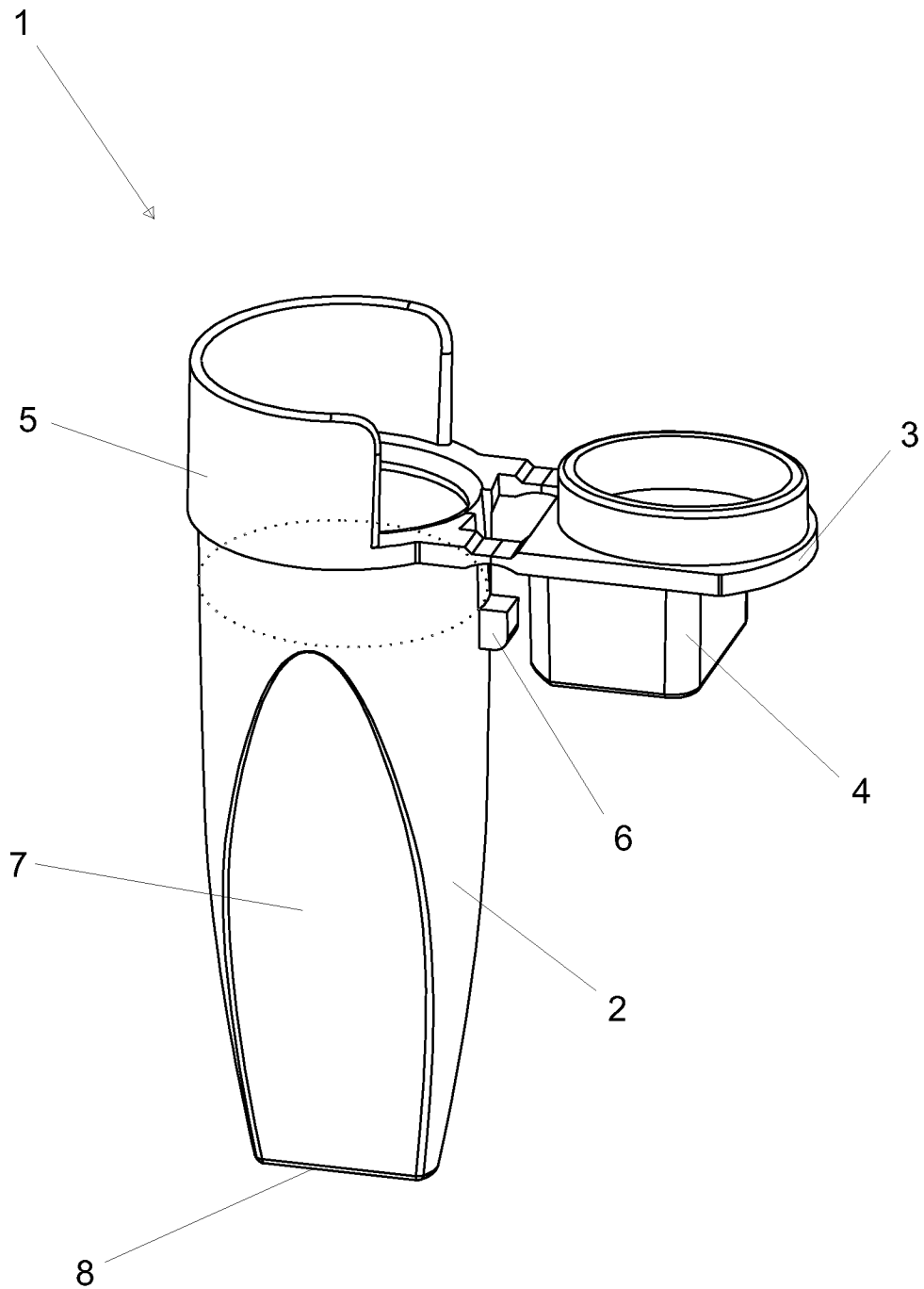


FIG. 1A

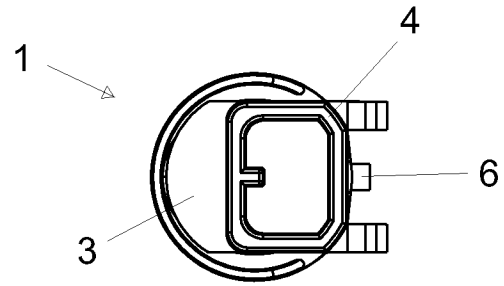


FIG. 1D

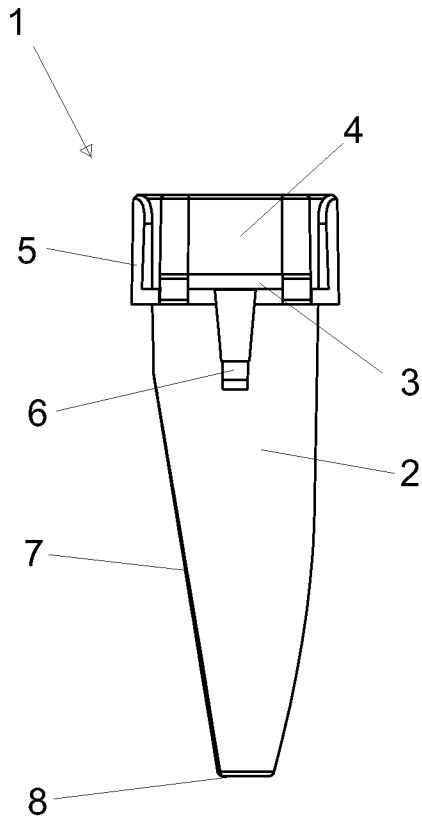


FIG. 1B

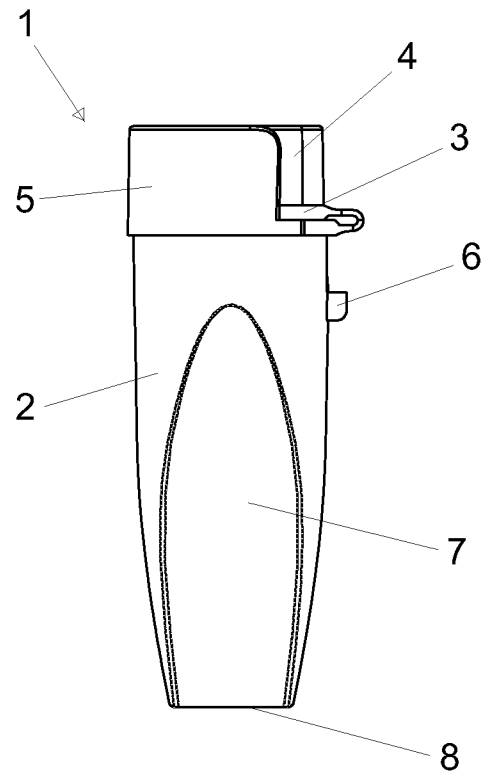


FIG. 1C

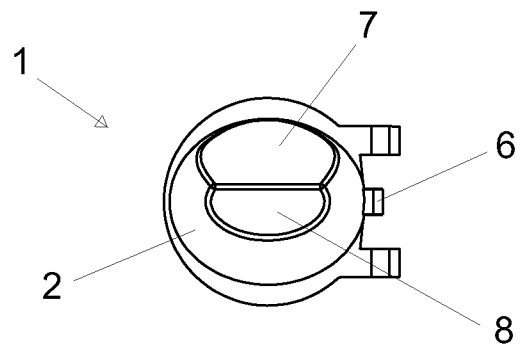


FIG. 1E

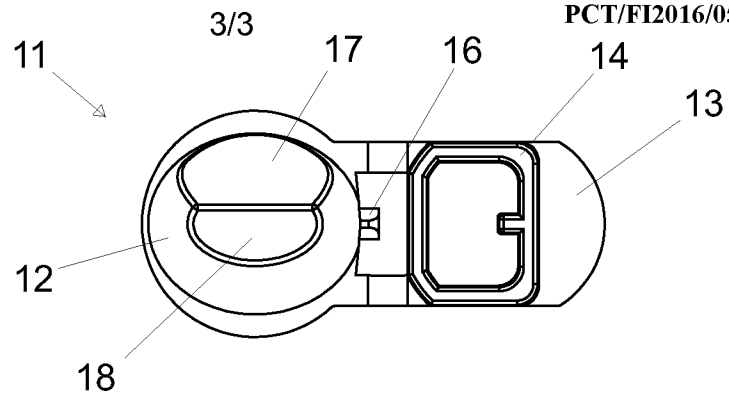


FIG. 2C

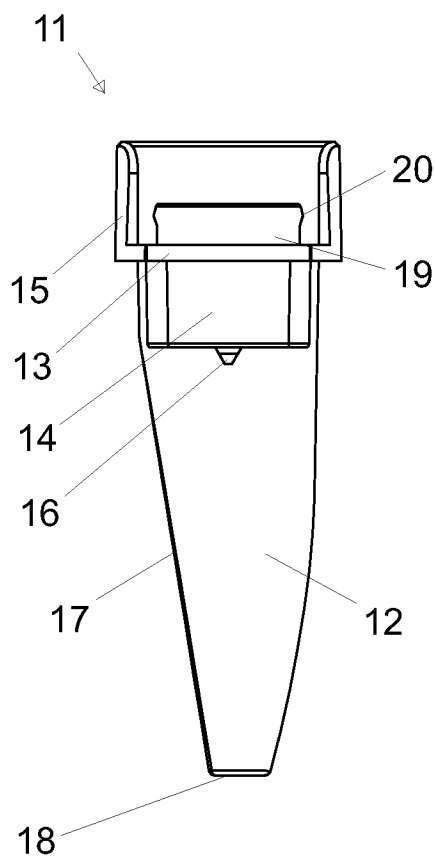


FIG. 2A

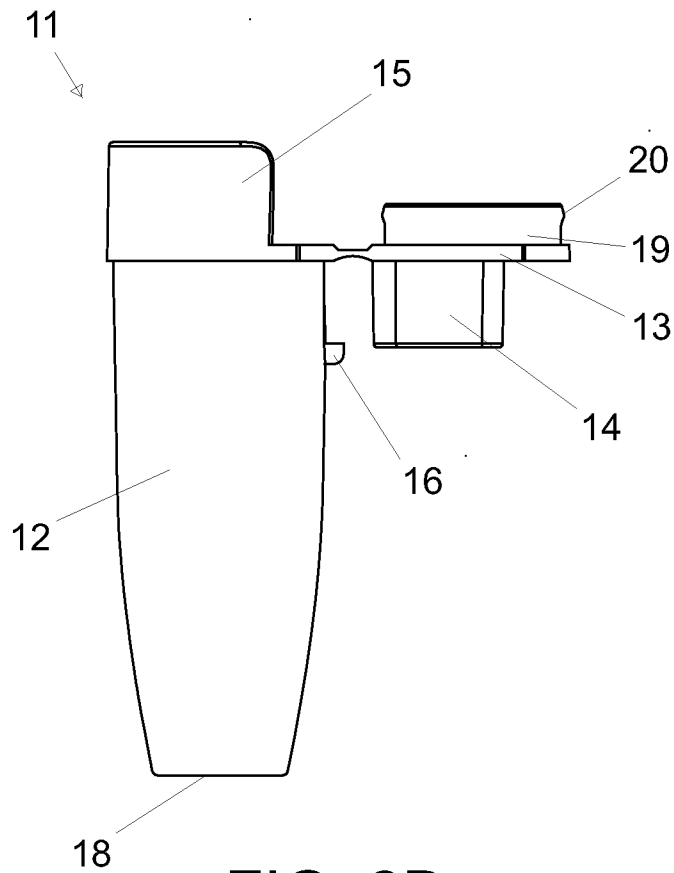


FIG. 2B

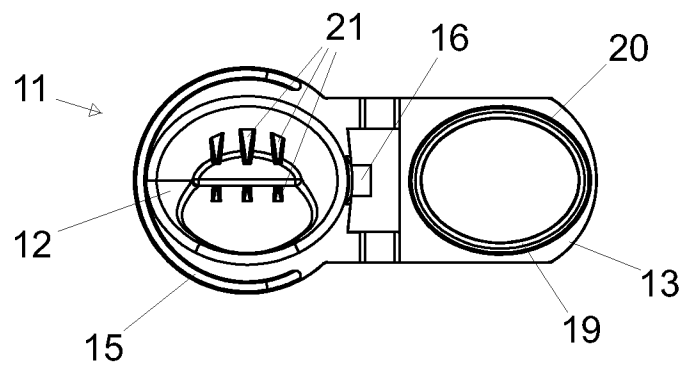


FIG. 2D

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/FI2016/050104

A. CLASSIFICATION OF SUBJECT MATTER  
INV. B01L3/00  
ADD.

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)  
B01L

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)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                         | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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| Y         | US 2012/269703 A1 (VILJOEN HENDRIK J [US]<br>ET AL) 25 October 2012 (2012-10-25)<br>paragraph [0046]; figures 1, 2<br>-----                | 1-3,7,8               |
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| Y         | US 5 295 599 A (SMITH JAMES C [US])<br>22 March 1994 (1994-03-22)<br>column 3, line 40 - line 55; figure 1<br>-----<br>-/--                | 6                     |



Further documents are listed in the continuation of Box C.



See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

29 April 2016

Date of mailing of the international search report

09/05/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
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Fax: (+31-70) 340-3016

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Ueberfeld, Jörn

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/FI2016/050104

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                |                       |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------|
| 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

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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date                                                                                                                                                                                                                                                                                                                |
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