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DESCRIPTION

Field of the Invention

[0001] The invention refers to a stool extracting, diluting and discharging device and, in particular, to a sample transferring device. Furthermore, the invention refers to a method for collecting, diluting, mixing and discharging a stool sample.

Background Art

[0002] Several devices and methods have been used in the past to collect, preserve, transport, dilute and discharge chemical, environmental or biomedical specimens, including in particular fecal samples for later analysis by a laboratory or for clinical studies. One problem with specimen contaminated with germs is in particular the hygienic component of collecting the samples and diluting them in an appropriate tube. EP 1 986 006 A1 discloses a device according to the preamble of claim 1. DE 10 2007 057 760 B3 discloses a device for collecting and dissolving a pastry sample. The sample pin of this device has a hollow end part for collecting the sample. The end part comprises further windows or openings in its side wall. When the sample in the sample pin is dissolved in a solution chamber, the end part of the chamber can be broken off and the dissolved sample can be discharged.

[0003] US 7,048,693 B2, EP 1384442 B1 and US 2006/0210448 A1 show a specimen collection, storage and transport device with a sample pin for collecting the specimen. This sample pin has a handle and an elongated pin with a spiral-shaped end. This end is put into a sample to be probed, pulled out again and shoved into the corresponding tube. The tube is divided into two sections, an upper section and a lower section. The separation wall between these two sections comprises a hole through which the sample pin and in particular the spiral-shaped end is pushed and a certain amount of the collected sample can be brought into the second section. This second section is filled with a solution. By agitating the tube after the sample pin has been closed by screwing it into the tube via complementary threads, the sample is diluted in the solution.

[0004] To discharge such a diluted sample, for example to put a certain amount of the diluted sample on an analytical test strip or a test plate or any other device, the discharge port comprises a breakable closure, which is opened by breaking off the tip of the discharge port. After that, the diluted sample can be discharged through the broken tip by pressing the body of the tube.

[0005] One problem is that the samples are not always of the same structure. That is, the samples can vary from a very liquid state to a very solid state. Thus, with the above-mentioned prior art tubes, or more particular with the sample pins used therewith, it is difficult to take a

predetermined amount of a sample which is either very solid or very liquid. For example, in a very liquid sample the spiral-shaped end of the sample pin is not ideal of keeping the sample on the sample pin, because a liquid sample will drop off the sample pin. Therefore, it is very difficult to get a predetermined amount of such a sample into the tube.

[0006] There are also other solutions, like a spoon-shaped device or circumferential recesses at an end of a sample pin, as can be seen in various other documents.

[0007] However, with the circumferential recess the same problems occur as with the above-mentioned spiral-shaped pin according to the state of the art, whereas a spoon-shaped device makes it very difficult to get a specific amount of a sample, because the sample will adhere at the bottom of the spoon and this bottom cannot be scraped off by a through-hole as can the sample pins of the above-mentioned prior art.

[0008] A further disadvantage of the prior art is that discharging of the diluted sample via the breakable closure is difficult to control. By or after opening the discharge port it may happen that pressure is brought onto the tube and some of the diluted sample is discharged by accident. Finally, once opened, the types of prior art tubes cannot be closed again and, thus, it is very difficult or impossible to store them and use again for a second test and the like.

[0009] Another problem occurs when the diluted sample should be transferred into another tube for further processing, i.e. mixing the already diluted sample with the same or another solution for further diluting (some medical utilizations need highly diluted samples and/or a dilution buffer different from the first buffer or liquid). For this purpose, a pipette is generally used to transfer a predetermined volume of the diluted sample contained in the tube. Thus, the tube has to be opened and the pipette has to be inserted into the tube. However, this is a possible source for contamination of the sample and also hygienically not free of risks. Therefore, the above mentioned devices are even not suitable for near patient testing. Moreover, if the sample has to be further processed, home testing by a patient is impossible with these tubes, because the danger of contaminating the test sample with foreign particles as well as contamination of the environment and the user himself with the test sample is simply too high by untrained persons using a pipette.

Summary of the Invention

[0010] An aspect of the invention is a tube for mixing, diluting, preserving and discharging a sample, the tube comprises a hollow first container for receiving and/or storing a solution, the first container having first and second ends, wherein the first end has a first through-hole suitable for inserting a sample pin having a shape matching to the through-hole, the second end has a discharge port suitable for discharging a diluted sample, wherein the hollow first container comprises locking means for locking a sample pin in a first position located at the first end of the hollow first container. This ensures a safe delivery of a properly closed tube. The tube further comprises second locking means for locking the sample pin in a second position

located further in insertion direction than the first position. The second locking means prevent retraction of the sample pin. In addition to a safe delivery and due to the hygienically aspect, after use the second locking means prohibits that the tube is opened by accident or normal handling.

[0011] The first locking means can comprise a rib or a groove disposed on a circumferential portion of the first end of the first container, preferably not on the complete circumference (although it is possible).

[0012] Also the second locking means can comprise a rib or a groove disposed on the circumference of the accommodating part, preferably around the complete circumference.

[0013] Such a tube can further comprise a sample pin having an elongated pin, a handle located at a proximal end of the elongated pin, and at least one recess with a predetermined volume formed in a distal portion of the elongated pin, wherein the handle comprises at least one locking portion corresponding to the first and/or second locking means.

[0014] The sample pin can further have a gripping portion, particularly formed as pressing portion that serves to deform the handle to unlock the sample pin from the first position. This is a convenient but also secure way to firstly open the tube.

[0015] Furthermore, the hollow first container of the tube may comprise a guide disposed on the first end of the first hollow container which interacts with the sample pin to guide the sample pin in a predetermined position. Such a guide eases handling of the sample pin, in particular after the collection of a sample and can support the opening action for the user. The guide has preferably inclined portions.

[0016] The guide preferably comprises a receiving slot in a predetermined position for receiving the protrusion of the sample pin in the final position. The final position is in particular the second position and improves the control of movement of the sample pin.

[0017] The tube can further comprise a sample pin for collecting a sample, the sample pin comprises an elongated pin, a handle located at a proximal end of the elongated pin, and at least one recess with a predetermined volume formed in a distal portion of the elongated pin, wherein the handle further comprises a protrusion that interacts with the corresponding guide. The protrusion can comprise a tapered or inclined end in insertion direction. This improves the guidance by the guide. However, the protrusion can also have a round shape.

Brief description of the Figures

[0018]

Figure 1a

shows a longitudinal section of a tube comprising a transport-pin, a discharge device, a first and a second container and a sample pin, wherein the transport-pin is in a first or initial position;

Figure 1b

shows the tube of Figure 1a, wherein the transport-pin is in the second or end position in the first container;

Figures 2a-g

show isometric views of exemplary single parts of the embodiment of Fig. Ia;

Figure 3

shows an enlarged view of a part of the second container, in which the cap is fitted to the liquid containing part;

Figure 4

shows an enlarged view of the cap including a guide groove and a sample pin including a protrusion;

Figure 5

shows a discharge device according to an embodiment of the present invention;

Figure 6

shows a sample pin according to one embodiment of the present invention; and

Figures 7a-c

show embodiments of the recesses according to different aspects of the invention.

Figures 8a, 8b

show a discharge device in an exploded view, including the second end of the hollow first container

Figure 9a, 9b

show a sample pin according to an embodiment of the invention

Figure 10

shows a hollow first container according to the invention.

Preferred embodiments of the invention

[0019] Referring now to Figures 1a and 1b, an embodiment of the invention is described in the following. Possible optional embodiments will be described as alternatives when the respective element is explained in the description.

[0020] The embodiment in Figure 1 comprises a first hollow container 10 that is capable of receiving and storing a solution in which a collected sample can be mixed, liquidized and/or homogenized. The first container has a first end 12 and a second end 13, which can both be closed by an end-wall integrally formed on the hollow container 10, or which can be formed by an openable wall, for example a wall that is screwed onto or into the first container 10, or fixed on the container like a plug by shape-fitting.

[0021] In the first end 12, the hollow first container 10 comprises a trough-hole 11. In this through-hole 11 is located a transport-pin 14 that has preferably a shape that closely matches the shape of the through-hole 11. The transport-pin 14 comprises a recess 15 with a predetermined size. This recess 15 can be filled with a sample or a sample that is already diluted with a solution. The recess 15 can comprise a bottom wall and side walls, but can also be formed as a through-hole in the transport-pin 14. The transport-pin 14 can furthermore comprise a plurality of such recesses. In Figure 1a, the entire recess is outside of the first container 10. However, it is sufficient, if the recess 15 is only in part on the outer side of container 10, as long as the recess does not provide a connection between the inner side of the first container 10 and the outer side of the first container 10. I.e. as long as the recess 15 is at least in part on the outside of the container, no particles, no sample or anything else can infiltrate the container through the through-hole 11. In the preferred embodiment shown in Figure 1a, the recess 15 is formed as a through-hole.

[0022] The transport-pin 14 is moveable between an initial position (as show in Figure 1a), which is the position with the recess at least partly outside the first container 10, and an end position (as shown in Figure lb), in which the recess 15 is positioned at least partially on the inner side of the first container 10.

[0023] The transport-pin 14 can be press-fitted into the through-hole 11. However, it is preferred that the transport-pin 14 and/or through-hole 11 comprises at least one seal 17a, 17b for sealing the through-hole 11 when the transport-pin 14 is in its initial position and/or the end-position. The seal 17a, 17b can be disposed at the through-hole 11 and can be made of rubber, silicon, Teflon, ceramic, any kind of plastic or synthetic material or any other suitable material. The seal 17a, 17b can also be disposed at the transport-pin 14. In the example shown in the Figures 1a and 1b, the seal 17a is located at a position that will be in contact with the through-hole 11 in the end position 3 of the transport-pin 14, and the seal 17b is in a position which will be in contact with the through-hole 11, when the transport-pin 14 is in its initial position. However, the whole transport-pin 14 can be covered by a seal 17a, 17b as long as the recess 15 is not covered as well. Also, the transport-pin 14 and the through-hole 11 can comprise both a seal. The seal 17a, 17b at the through-hole 11 and the seal at the transport-pin 14 may then be of different materials, so as to provide an easy movement of the transport-pin 14 within the through-hole 11. However, the material of the seal 17a, 17b at the transport-pin 14 in the region of the initial position and the end position can also be made of a different material than the rest of the seal on the transport-pin 14, e.g. with a very high friction in view of the through-hole 11, to stop the transport-pin 14 if it is in the initial position or the end position.

[0024] Furthermore, the transport-pin 14 and/or the through-hole 11 can comprise at least one latch 16a, 16b that prohibits unforced movement of the transport-pin 14 in its initial position and/or the end position. The latch 16a, 16b can be formed into or onto the sealing 17a, 17b. The latch 16a, 16b is for example a protrusion in a radial direction of the tube 10 (in Figures 1a and 1b in a direction perpendicular to the center axis Z). The transport-pin 14 and/or the through-hole 11 can then comprise a corresponding recess, with which the protrusion will engage and latch. The latch can be made of any kind of silicon, Teflon, ceramic, any kind of

plastic or synthetic material or any other suitable material, but preferably of a rubber or rubber-like material, to provide suitable sealing functions.

[0025] In the embodiment shown in Figures 1a and 1b, the through-hole 11 is formed as a longitudinal cylinder-shaped hole, which is formed into an extension 20 that extends along the center axis Z in an axial direction. However, the hole can be formed in any kind of geometry.

[0026] The transport-pin 14 can be guided in the through-hole 11 by guiding grooves and corresponding guiding protrusions on the transport-pin. These grooves and protrusions (not shown in the Figures) could be formed in an axial direction in the through-hole 11 and in the transport-pin 14. However, it does not make any difference if the grooves are formed in the through-hole 11 or the transport-pin 14.

[0027] Basically, these features are enough to make the tube working for mixing, diluting and preserving a sample. The recess 15 in the transport-pin can be filled with a sample and the transport-pin 14 can then be pushed by, for example, a cap (not shown) with a bigger diameter than the hollow first container 10, into the first container 10. After that, the sample can be mixed and diluted in the solution and stored in the hollow first container 10. This embodiment would then serve as a tube with an integrated sample pin.

[0028] However, the preferred embodiment as shown in Figure 1a and 1b includes a second container 30 for receiving and storing a solution. A solution can mean any liquid. However, it is possible to store a lyophilisate, a powder or other solid particles in one or both containers. To liquidize these particles, liquid like water has to be filled in the container storing the particles, before the sample will be diluted. This can be done for example by an extra valve, or, in case of the second container, through the opening for the sample pin. These liquidized particles are also meant by the term solution. In one embodiment, the second container 30 comprises an outer tube 30a (Figure 2f), an inner tube 30b (Figure 2e) and a proximal tube or cap 30c (Figure 2g). These elements can be single parts, but they can also be formed integrally (in one piece). In the example shown in Figure 1a, the first end of the container 10 is formed as a part of the inner tube 30b, as is the through-hole 11. However, the single elements of the assembly as shown in Figures 2a to 2g, are just one particular possibility to construct the tube 1, and the different parts of the tube 1 can be formed integrally, can be divided into additional single parts or can be divided into different parts than shown in Figures 2a to 2g.

[0029] The second container 30 is located with the distal end 31 on the first end 12 of the first container 10, such that the transport-pin 14 protrudes into the second container 30, and the second container 30 further comprises a proximal end 32 and an opening 34 suitable for inserting a sample pin 50.

[0030] The proximal end 32 of the second container 30, in this case the proximal tube or cap 30c, comprises an accommodating part 38 that is suitable to receive a sample pin 50. This accommodating part 38 can be formed in a way to interact with a sample pin 50, which will be described later.

In the second container 30, in particular in the inner tube 30b, is formed a sediment portion 37, which is preferably formed tapered or in a conical shape. Between the wall of the tube 30b and this sediment portion 37, debris and particles of the sample can settle down after its homogenization. In other embodiments, the sediment portion 37 can be replaced by a filter (not shown) such as a mesh or a fine net. Also fabric or other suitable tissue can be used as a filter that covers at least the recess of the transport-pin 14, but preferably the whole transport-pin 14 in the second container 30.

[0031] The opening 34 of the second container 30 can be formed as a transversal septum 35 having an axial passageway 36 therethrough. Such a transversal septum 35 eases introducing a sample pin 50 into the second container 30 and comprises additional features such as stripping off excess sample material present on such a sample pin.

[0032] The accommodating part 38 of the proximal tube 30c is formed such, that a sample pin 50 is movable into a first position (see Figure 1a), in which the sample can be brought into contact with the solution contained in the second container 30, and to a second position, in which the sample pin 50 pushes the transport-pin 14 from the initial position into its end position (see Figure 1b). The first position of the sample pin can thereby be indicated by, for example, a first rib which protrudes radially inwards in the accommodating part 38 of the proximal tube 30c (or single radial protrusions), and which are breakable to allow the sample pin to move further axially inwards in the second container 30. However, another possibility is to provide in the accommodating part 38 a guide groove 40 for guiding a movement of a sample pin 50. The guide groove 40 then can control the movement along the axis Z by interacting with a protrusion 58 of the sample pin 50. In the preferred embodiment, the guide groove 40 is formed by axially and circumferentially extending grooves 41, 42, 43. These grooves are shown in Figure 4. The accommodating part 38 of the proximal tube or cap 30c can also be formed such, that a sample pin 50 is fixable in the first position and/or a second position such that the sample pin 50 is locked from rejection and/or further forward movement. In the preferred embodiment, this is carried out by the wall 44 of the circumferential guide groove 42 that blocks the protrusion from further axial movement in inserting direction. Additionally, the sample pin can be rotated into a blocked position P1 (Figure 4) after pushing it into the first position. By rotating the sample pin 50, the protrusion is moved in the guide groove 42 away from the axial extension 41 of the groove 40 (in Figure 4 clockwise when seen from a top view), so that the sample pin 50 cannot be pulled back because the protrusion is locked axially in position P1. However, such a fixable first position could also be carried out by protrusions protruding radially inward in the accommodation chamber, and interacting with corresponding recesses or protrusions of the sample pin 50 like a clip. By providing these protrusions around the complete circumference of the sample pin, moving the sample pin 50 backwards can be made impossible.

[0033] In the preferred embodiment, the sample pin 50 is the rotated such that the protrusion moves from position P1 along groove 42 in the opposite direction (in Figure 4 counter-clockwise) into position P2. Then the sample pin can be pushed into the second position until the protrusion 58 reaches position P3. A further axial movement in insertion direction is the

blocked by the end wall 45 of groove 43.

[0034] The sample pin 50 is blocked in the second position (Fig. 1b) from further movement in at least the inserting direction, when the transport-pin 14 is in the end position. This can be done either as mentioned above by the guide groove interacting with a protrusion 58 of the sample pin 50, or by protrusions protruding inwardly radially in the accommodating part 38. Also possible is a simple stopper in the accommodating part 38 and/or the end 32 of the accommodating part 38.
However, it is possible to form this accommodating part 38 on or in the proximal end of a first hollow container, as long as it is not wished to implement a transport pin. I.e. if a tube contains only one hollow container for mixing and diluting a sample, all features of the accommodating part 38 can be applied to such a tube, since the accommodation part serves for accommodation the sample pin which is necessary if the transport pin is not included in an embodiment. In this case the first and second positions can furthermore still be applied. With regard to Figure 10, the accommodation part 38 is disposed on a first hollow container 10, which does not comprise a transport pin. The accommodation part 38 includes a first locking means 81, which is here formed as a groove 81 that interacts with a corresponding protrusion on a sample pin, which will be described later. This groove is preferably formed only on a circumferential portion of the accommodation part 38. A second locking means is provided further downstream relative to the inserting direction of the sample pin 50. This second locking means 82 can also be formed as a groove that interacts possibly also with the same corresponding element on the sample pin as the first locking means 81. The second locking groove is formed preferably around the complete circumference of the accommodation part 38. In this manner, the second locking means can prevent any further movement in axial direction of the sample pin once it is locked in the second locking means 82. Of course, the groove can also be a protrusion like a rib and interacts with a corresponding groove on a sample pin.

[0035] As already described above, the accommodation part 38 can also comprise a guide 85. In Figure 10, this guide 85 is formed as a guide rail 87 which is preferably inclined and serves to guide a corresponding protrusion of a sample pin into a receiving slot 86. The interaction between a sample pin and the accommodation part with the first and second locking means 81, 82 and/or the guide 85 is described later. An accommodation part 38 can accommodate the handle of the sample pin within the accommodation part, but can also be inserted in the handle of the sample pin. In any case, it accommodates the elongated pin 52.
The first container 10 has at its second end 13 a discharge port 18 where it is suitable for discharging a diluted sample. On the second end 13 is furthermore provided a first fitting element 19. On the first container 10 is disposed a discharge device 70 for controlling discharge of the diluted sample via the discharge port 18. The device 70 has a discharge-opening 71, for discharging the diluted sample, and has a second fitting element 73, that cooperates with the first fitting element 19 to mount the discharge device 70 on the first container 10. At least a portion of the discharge device 70 is movable between two or more positions. These positions are preferably a discharge position, in which a diluted sample can be discharged, and a closed position in which the sample cannot be discharged.

[0036] In one embodiment, the discharge device can sealingly cover the discharge port 18 in the closed position; and in the discharge position the discharge-opening 71 is then moved to a position where the discharge-opening 71 is connected with the discharge port 18, but closed towards to the first container 10.

[0037] In another embodiment a volume like a chamber or a small container is provided. This chamber or small container has a predetermined volume 78 and is preferably located in the discharge device 70. In this embodiment, the discharge-opening 71' is relatively not moveable to the discharge port 18 of the hollow first container 10. Such a device is shown in Figures 5, 8a and 8b. It is preferred that in the closed position the volume 78, e.g. the chamber or small container, is connected to the discharge port 18 and is filled with a solution. In this case the discharge port 18 is big enough to not affect the mixing of the sample in the solution, i.e. that a total exchange of solution between the volume and the container 10 is secured. In this way it is also ensured that the volume 78 is filled with a properly diluted sample. Then the moveable portion 77 of the discharge device 70 is moved to the discharge position and the diluted sample is discharged out of the discharge opening 71'. However, the volume can also be initially in the discharge position, although it cannot initially contain sample liquid to be discharged. The moveable portion 77 of discharge device has first to be moved into the closed position to fill the volume 78 with a diluted sample. The volumetric discharge can be done as explained below, for example by a pressure in the hollow first container 10, by a pressure applied to the container 10 or by gravitational force preferably supported by a vent or valve (not shown) disposed somewhere at the first end 12 of the first container 10.

[0038] Additionally, the discharge device can also be moveable between three positions, an initial (closed) position, in which the volume is neither connected to the discharge port 18, nor to the discharge-opening 71', a second position, in which the volume is connected to the second container 10 via the discharge port 18 and is filled with the diluted sample, and an end (discharge) position, in which the sample can be discharged via the discharge-opening 71'.

[0039] The connection between the discharge device 70 and the hollow container 10 can be realized by fixing the discharging device 70 with a recess 73 complementary to the protruding pin 19. In Figures 1a and 1b, the protruding pin 19 is formed with a gap in the middle, to enable the functionality of a clip and engage with step-like portions in the corresponding recess 73. Around this protruding pin 19 the discharge device 70 can be rotated between at least two positions.

[0040] Furthermore the discharge device 70 can also be fixed on the hollow first container 10 by a welding portion 76. Such a welding portion can for example be disposed on a part of the discharge device 70 that does not need to be relatively moveable in view of the first hollow container 10. Then, a corresponding welding portion can be provided on the container as the fixing portion 19 and welded onto the welding portion 76 of the discharge device 70. In Figures 8a and 8b this welding portion 76 is shown as a circumferential ring that protrudes outwardly. In this manner, it is easy to access for welding.

[0041] Furthermore, the moveable portion 77 can be formed as a plate or cylinder including the above mentioned volume 78. A seal 75 can be provided on one or both sides of the moveable portion 77, e.g. a flat sheet made of rubber or silicone or any other suitable sealing material. The moveable portion 77 can comprise ribs on the outer surface to enhance the manual movement of the moveable portion 77. To further improve the handling of the moveable portion 77, a protruding handle 79 or grip can be provided. Furthermore, the movement of the moveable portion 77 can be restricted by stopping means 90a, 90b on the fixed part of the discharge device 70 and/or on the first hollow container 10, in particular at the second end 13 thereof. These stopping means 90a, 90b interact with corresponding abutment portions 92 on the moveable portion 77. In Figure 8a and 8b this is carried out by the circumferential welding portion 19, 76 and the protruding handle 79. In both movement directions the handle 79 abuts with the abutment portions 92 against the stopping means 90a, 90b of the welding portion 19, 76 and is stopped from moving further.
To protect the discharge device and the tube, a cap (not shown) can be provided. This cap covers the discharge device. The cap also prevents movement of the discharge device, either by sufficiently covering the moveable portion 77 (in particular completely), or by blocking the handle 79. Blocking the handle 52 can for example be carried out by a protrusion that protrudes upwards from the cap into the movement path of the handle 79. Such a protrusion can either have a simple recess in which the handle is locked as long as the cap is on the tube, or can be combined with the stopper 90a, 90b if they are formed on the tube.

[0042] Another possibility (not shown in the figures) is to design the second end 13 with rails in which the discharge device 70 can slide. Then, the discharge device could be pushed, for example with a thumb of the user, from the closed position to an open position, in which the discharge port 18 is connected with the discharge-opening 71. In this way, it is possible to ensure that on the one hand discharging the diluted solution is not possible by accident, and, on the other hand, the discharge-opening 71 can be closed again. However, to further avoid accidental opening of the discharge device 70, the discharge device can be connected with breakable connections with the second end 13 of the container 10 when it is in the initial, closed position.

[0043] The discharge device 70 can include a sealing 75, preferably in form of a ring made of rubber, silicon, Teflon, ceramic, any kind of plastic or synthetic material or any other suitable material. This sealing 75 is disposed between the moveable portion of the discharge device 70 and the static part, which is either the second end 13 of the first container 10 or a static part of the discharge device 70 fixed at the second end 13 of the first container 10. The sealing 75 seals the cut between the moveable portion of the discharge device and the static part so that leaking of the diluted sample can be avoided, in particular with regard of a movement of the moveable portion of the discharge device 70.

[0044] The volumetric discharge of the diluted solution can be carried out by pressure, which is increased in the hollow first container 10, for example due to the transport-pin 14 pushed into the first container 10. Another possibility is to define the geometry of the discharge port 18 and/or the discharge-opening 71 to allow a quantitative and predetermined volume transfer of

the liquidized and diluted sample. That is, the opening has a size to enable that a drop with a predetermined size will drop off the opening. In particular, the liquid will be slowly come out of the discharge device 70 until the opening cannot hold the increasing drop at the discharge-opening 71 of the discharge device 70. The force to get the liquid out can be simple gravitational force supported by a vent or valve 74, can be the pressure inside the first hollow container 10 or can also be a pressure applied on the container, for which the container itself should be made of a flexible material.

[0045] In the embodiment with the volume, e.g. a chamber, small container or sleeve having a predetermined volume, the diluted sample filled in the volume is discharged out of the discharge-opening 71' by gravitational force or by another device which pushes the diluted sample out of the chamber. For example, the chamber could be designed of a flexible material in the way of a hose or a sleeve. This hose or sleeve can then be pressed together and the filling can be discharged via the discharge-opening 71, 71'. Another preferred embodiment comprises a vent or valve 74 in the discharge device 70 that connects the volume with the outside of the tube and enables the introduction of air into the volume. This supports the flow of the diluted sample out of the discharge-opening 71, 71'. If a valve 74 is used, preferably a one-way-valve is chosen. Such a one-way-valve can also be disposed on the rotating part and be always in connection with the volume or chamber. The valve 74 restricts the leakage of the solution in the volume and is closed sealingly while the volume is filled with solution of the first container 10. However, the one-way-valve 74 allows air or a gas to enter the volume, when the solution has to be discharged from the chamber. Preferably, such a vent or valve can be activated manually.

[0046] Another aspect of the invention relates to a tube 1 for mixing, diluting, preserving and discharging a sample comprises a hollow first container 10 comprising a solution and a discharge device 70 for discharging the solution and a hollow second container 30 also comprising a solution and an introduction port 34 for introducing a sample pin 50, wherein the first container 10 and the second container 30 are connected by a transfer device 14 that enables at least a sealed transfer of the solution from the second container 30 into the first container 10. Such a tube 1 provides a safe and hygienic transfer of the solution of one container to another. Thus, such a tube is highly practical for home use by a patient, in particular if the diluted sample has to be further processed. In particular, the first container 10 and second container 30 can be fixed together, preferably at their ends opposite to the discharge device 70 (which can be basically also a breakable discharge device of the prior art). The transfer device 14 can be a transport-pin 14 as described in this invention, but can also be for example a (preferably manually driven) sleeve pump (not shown) or hose pump (not shown) combined with one or two one-way-valves disposed at the pump device. The valve(s) enable(s) the solution to flow from the second container 30 to the first container 10, but restricts flowing in the opposite direction. Another embodiment of such a transfer device is a third tube (not shown) that is disposed between the second and the first containers and being adapted to be opened and closed to the second container 30 for being filled with the solution and for stopping the flow connection and being adapted to be opened and closed to the first container 10, to further dilute the sample of the second container 30 therein. However, a direct

flow-connection between the second 30 and the first container 10 should be avoided. Thus, the third container should not be opened to the first and second containers simultaneously.

[0047] Finally, the device comprises a sample pin 50. In connection with the above mentioned tubes, any prior art sample pin with an elongated pin 51 and a handle 52, located at a proximal end of the elongated pin 51 will work properly. A very suitable prior art design comprises one or more circumferential grooves at the elongated pin.

[0048] A further design of a sample pin 50 for collecting a sample comprises an elongated pin 51 including a handle 52 located at a proximal end of the elongated pin 51 and at least one recess 54' with a predetermined volume preferably located at a distal portion of the elongated pin 51, wherein the recess 54' has the shape of a circumferential groove, that has an circumferential angle of maximum 180° degrees (this is shown in Figures 7b, 7c). The circumferential angle can be measured along the edge 59, with respect to the center of the elongated pin 51 and/or with respect to the inside surfaces 53 of the side edges 55' of the recess 54'. In such a sample pin 50, a more liquid sample can be better kept in the recess. The circumferential angle is measured from the center of the preferably cylindrical elongated pin 51 or from the middle of the bottom plane with respect to the top of the cut-out sides of the recess 54'. Additionally, the shape of the recess is highly practical for flushing out the sample contained in the recess 54'. Furthermore, there can be two or more recesses 54' and they can be provided on opposite sides or pointing in different directions of the elongated pin 51. However, preferably two or more of these recesses 54' are facing in the same direction. In another embodiment, the bottom of the recess 54' is completely flat (without the protruding middle as show in Figures 7a, 7b) or has a deepened shape.

[0049] An embodiment of another sample pin for collecting a sample comprises an elongated pin 51, a handle 52, located at a proximal end of the elongated pin 51 and at least one recess 54 with a predetermined volume that is preferably located at a distal portion of the elongated pin 51. This recess 54 is formed into the elongated pin, such that the elongated pin has essentially the same shape over its entire length. This recess 54 comprises only one opening with one edge, wherein the complete edge 55 of the opening is above the bottom of the recess 54 when seen in a side-view and the opening is facing upwards. Thus, the recess 54 is somehow spoon-like, to avoid that a very liquid sample can escape by dripping off the sample pin 50. Preferably, there is a plurality of recesses 54 formed in the elongated pin 51. All these recesses 54 might face in the same direction.

[0050] The distal tip of the pin 51 comprises a tapered portion 57 or a rounded portion. This eases introducing the sample pin 50 into the tube 1, in particular into the transversal septum 35 of the second container 30, resp. the proximal part 30c thereof or, if the transport pin is not used, in the corresponding accommodation part including the transversal septum of the hollow first container. Furthermore the tapered or rounded portion 57 at the distal end of elongated pin 51 eases the introduction of the sample pin 50 into a very solid and/or hard sample.

[0051] The handle 52 of the sample pin 50 comprises a protrusion 58, protruding outwards

from the circumference of the handle 52. This protrusion is in particular useful in connection with the guiding groove 40, 41, 42, 43 of the second container 30.

[0052] Furthermore, a sample pin can also comprise a handle 52 that has special features (see Figures 9a, 9b). Such a handle 52 can be used with any prior art pin or pin 51 as described above. The handle 52 comprises a locking portion 83 corresponding to the locking portions 81, 82 that can be used in the accommodation part 38 of the hollow first container 10. Preferably, there is only provided one single locking means 83 on the handle 52, but it is possible to provide more locking means, e.g. one for each locking means on the accommodation part 38. This might be the case, if the locking means have different diameters. Furthermore, the handle can comprise a gripping means 91, that serves to enable a proper manual hold of the sample pin and that can also be used as a pressing means to release the sample pin out of the first position of the first locking means.

[0053] As stated above, the sample pin can comprise a protrusion 58. In the embodiment according to Figures 9a and 9b, this protrusion is protruding inwards, since in this embodiment the accommodation part 38 is inserted in the inner part of the handle 52. The protruding part extends axially along the handle and can have a tapered tip on the insertion side which eases sliding the sample pin 50 along a guide 85 of the tube.

[0054] Although the locking means and the guide can each be provided alone, it is equally possible to include these features simultaneously. They can provide a synergistic effect, as explained below.

[0055] In the first position, the handle is locked in the first locking means 81. The first locking means are adjusted to hold the sample pin in the first position, but it is possible to retract the sample pin or to push it further without destroying the tube or the sample pin and by using only a relatively small force. This can be done by providing a groove and a corresponding rib which are only slightly engaging each other. Another possibility is to provide the first locking means only on a circumferential portion. The handle can then be pressed on a pressing portion 91 and is thereby deformed to release the locking means 81 of the tube from the locking means 83 of the handle, e. g. the protruding rib from the corresponding groove. Such a deformation can be very small. The first position can therefore be used as a delivery position before use of the tube. The pin 51 seals the hollow container with the solution for diluting the sample and the handle is locked in the first locking means in the first position.

[0056] The second position is for use after the sample has been collected. The sample pin is introduced back into the tube and pushed beyond the first position to the second locking means 82. These locking means are preferably very strong, so that the handle cannot be retracted once the second locking means is reached without using improper force or destroying the tube. In Figure 10, the second locking means is therefore formed as a circumferential groove 82 (or rib) which interacts with the corresponding rib 83 (or groove) on the handle 52. Due to the circumferential shape, the pressing means cannot retract the rib out of the groove. The second position is therefore used to tightly and irreversibly close the tube.

This is particularly useful to enhance the hygiene of the tube.
The guide 85 can have mainly two functions. Firstly, it is used to support opening of the handle. In the first position, the protrusion 58 is only partly (or not at all) in the receiving slot 86. By rotating the handle, the protrusion is pressed against the guide 85 and applies a force in opening direction on the handle. This is enhanced, if both of the guiding members, the guide 85 and the protrusion are formed inclined or tapered. Secondly, when the user of the sample pin is introducing the sample pin after collecting the sample, the guide 85 and the protrusion 58 are guiding the sample pin then in a predetermined position, by sliding the protrusion 58 along the guide. In the second position, the protrusion 58 is accommodated in the receiving slot 86. If so, rotation of the sample pin 50 is blocked by the side walls of the receiving slot 86 which abuts against the protrusion 58. Thus, the opening support of the guide cannot be used to open the tube once the sample pin is fixed in the second position.

[0057] A further method will now be described for use of this tube. The sample pin 50 is introduced into a sample, which can be very liquid, soft, sticky or very hard. Due to the recesses 54, it will require a little bit more pressure to force a very solid sample into the recess 54, but once in the recess 54, the sample will not fall off. Additionally, a very liquid sample is easily collected due to these recesses 54 by capillary force and/or the spoon-like structure of the recesses 54. Then, the sample pin 50 is introduced into the second container 30, thereby removing all superfluous sample adhered on the elongated pin 51 by respectively in the transversal septum 35. The protrusion 58 is guided in the guide groove 40,41, 42, 43 and will be stopped in a first position Then the sample pin 50 is rotated into an intermediate, first locking-position (PI). The recesses 54 are now in the second container 30 and the sample in the recesses 54 can be diluted in the solution in the second container 30. This can be done by shaking the tube or by using a mixing device (e.g. a vortexer). In the preferred embodiment, the sample pin 50 is then rotated in the opposite direction following the guide groove 40, 41, 42, 43 and pressed into the accommodation part 38 of the second container 30, and will be stopped in a second locking position (P3). Thereby, the tapered end 57 of the sample pin 50 presses the transport-pin 14 into the first container 10. The transport-pin 14 comprises in the recess 15 a predetermined amount of diluted sample of the second container 30 and transports it into the first hollow container 10. This predetermined amount transferred into the hollow container 10 is then mixed with the solution contained in the first container 10. After that, the diluted sample in the first container 10 can be discharged as described above.

List of reference signs

[0058]

1
tube
10
first container
11

through-hole

12

first end

13

second end

14

transport-pin (transfer device)

15

recess

16a

latch

16b

latch

17a

sealing

17b

sealing

18

discharge port

19

fitting element

20

extension

30

second container

30a

outer tube

30b

inner tube

30c

proximal tube, cap

31

distal end

32

proximal end

34

opening

35

transversal septum

36

axial passageway

37

sediment portion

38

accommodating part

40 guide grooves

41 axial groove

42 circumferential groove

43 axial groove

44 wall

45 end wall

50 sample pin

51 elongated pin

52 handle

53 inside surface

54 recess

54' recess

55 edge

55' side edge

56 bottom

57 tapered portion

58 protrusion

59 egde

70 discharge device

71 discharge-opening

71' discharge-opening

73

second fitting element

74
vent/(one-way) valve

75
sealing

76
welding portion

77
moveable portion

78
volume

79
handle

81
first locking position

82
second locking position

83
locking portion on the handle

85
guide

86
receiving slot

87
guide rail

90a
stopper

90b
stopper

91
gripping means/pressing portion

92
abutment portion

Z
(center) axis

P1
position of the protrusion

P2
position of the protrusion

P3
position of the protrusion

REFERENCES CITED IN THE DESCRIPTION

Cited references

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PATENTKRAV

1. Rør (1) til blanding, fortynding, bevaring og afgivelse af en prøve, i kombination med en prøve, røret omfatter en hul første beholder (10) til modtagelse og/eller opbevaring af en opløsning, hvor den hule første beholder (10) har en første og en anden ende (12, 13), hvor den første ende (12) har et første gennemgående hul (11), der er egnet til indførelse af en prøvestift (50) med en form, der passer til det gennemgående hul (11), den anden ende (13) har en afgivelsesport (18), der er egnet til afgivelse af en fortyndet prøve, hvor den hule første beholder (10) omfatter et første låsemiddel (81) til låsning af prøvestiften (50) i en første position og et andet låsemiddel (82) til låsning af prøvestiften (50) i en anden position og forebyggelse af tilbagetrækning af prøvestiften,

endvidere omfattende prøvestiften, hvor prøvestiften (50) omfatter en aflang stift (51), et håndtag (52), der er placeret i en proksimal ende af den aflange stift (51), og mindst én fordybning (54) med et forudbestemt volumen, der er dannet i en distal del af den aflange stift (51), hvor håndtaget (52) omfatter mindst én låsedel (83), der svarer til det første og andet låsemiddel (81, 82).

2. Rør (1) ifølge krav 1, hvor det andet låsemiddel er placeret længere nedstrøms end den første låseposition i indføringsretning.

3. Rør (1) ifølge et af kravene 1 eller 2, hvor det første låsemiddel (81) omfatter en ribbe eller en rille, der er disponeret på en periferisk del af den første ende (12) af den hule første beholder (10).

4. Rør (1) ifølge et af kravene 1 til 3, hvor det andet låsemiddel (82) omfatter en ribbe eller en rille, der er disponeret på omkredsen af den af den første ende (12) af den hule første beholder (10).

5. Rør ifølge et af kravene 1 til 4, hvor prøvestiften (50) omfatter trykkende dele (91) der tjener til deformering af håndtaget (52) for at låse prøvestiften (50) op fra det første låsemiddel (81).

6. Rør (1) ifølge et eller flere af de foregående krav, hvor den hule første beholder (10) endvidere omfatter en guide (85), der er disponeret på den første

ende (12) af den første hule beholder (10), som interagerer med prøvestiften (50) for at guide prøvestiften i en foruddefineret position.

7. Rør (1) ifølge krav 6, hvor guiden (85) omfatter hældende dele (87).

8. Rør (1) ifølge krav 6 eller 7, hvor guiden (85) omfatter en modtagelsesåbning (86) der tjener til at definere en forudbestemt position for en prøvestift.

9. Rør (1) ifølge et af kravene 6 til 8, der endvidere omfatter en prøvestift (50) til opsamling af en prøve, hvilken prøvestift omfatter en aflang stift (51), et håndtag (52), der er placeret i en proksimal ende af den aflange stift (51), og mindst én fordybning (54) med et forudbestemt volumen, der er dannet i en distal del af den aflange stift (51), hvor håndtaget (52) endvidere omfatter et fremspring (58), der interagerer med den tilsvarende guide (85).

10. Rør ifølge krav 9, hvor fremspringet (58) af håndtaget (52) er tilspidset i enden i indføringsretning.

DRAWINGS

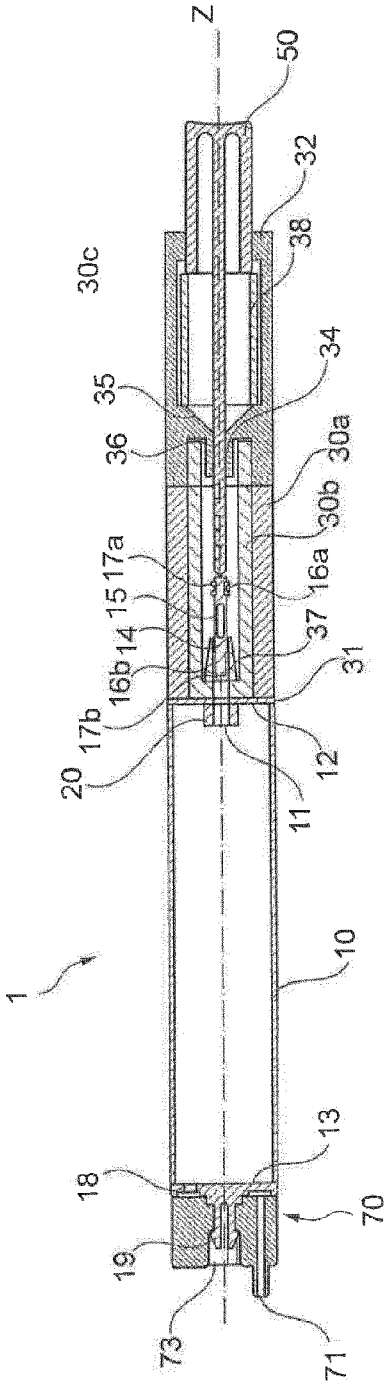


Fig. 1a

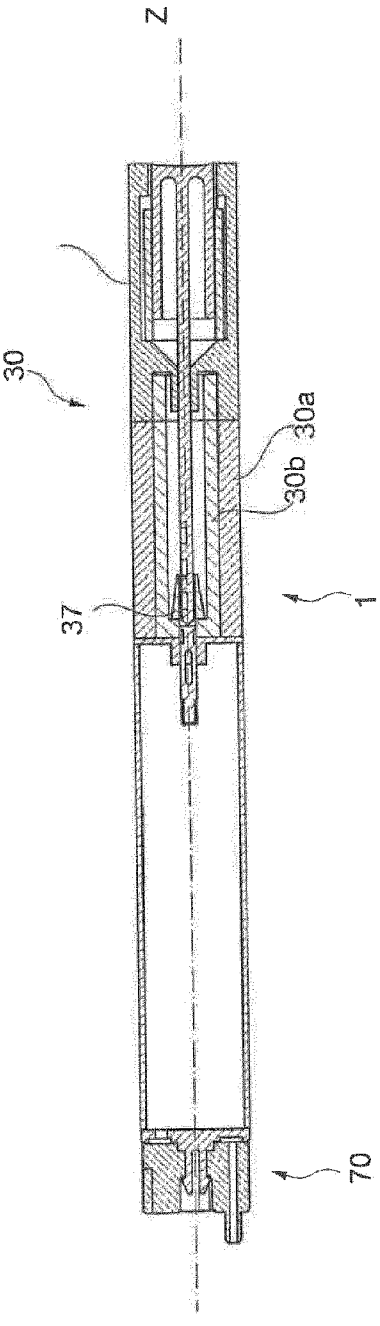


Fig. 1b

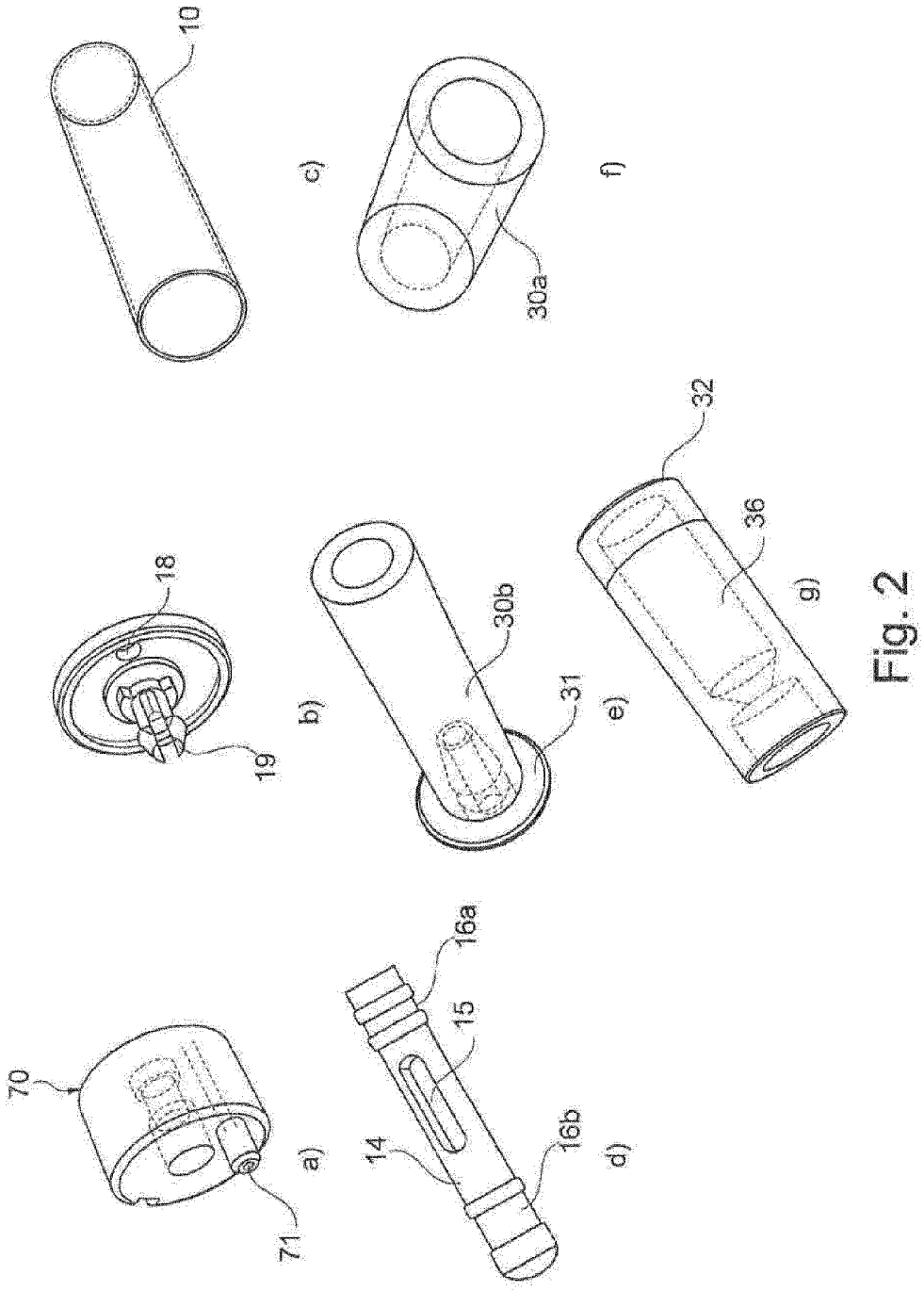


Fig. 2

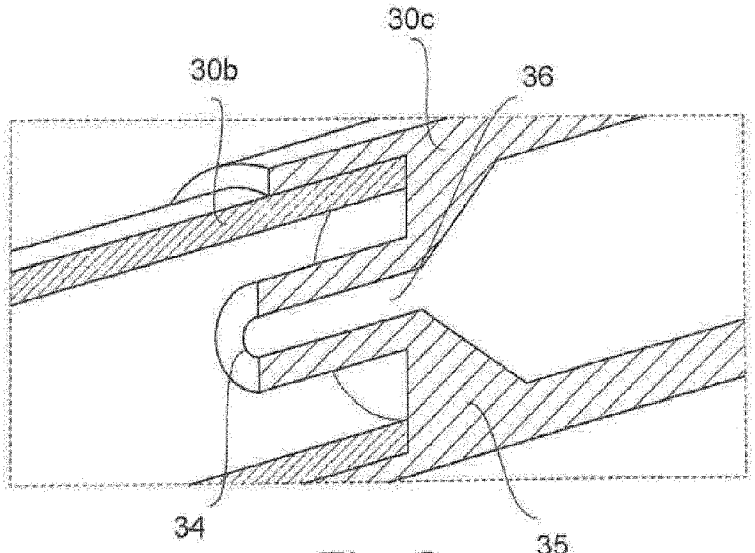


Fig. 3

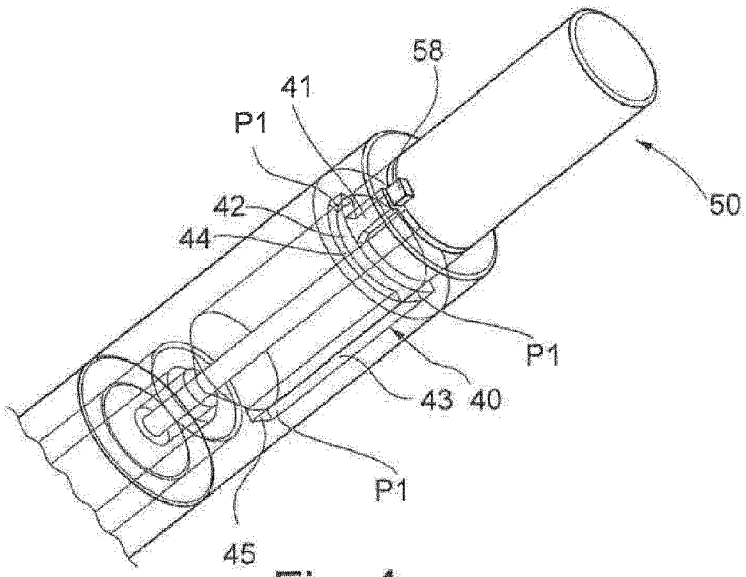


Fig. 4

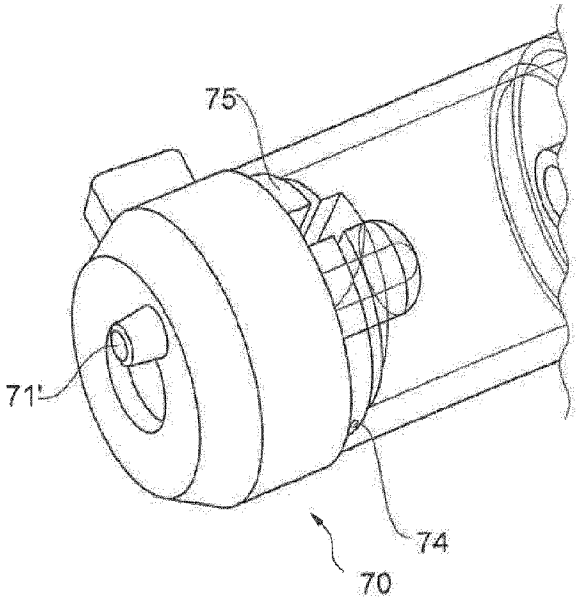


Fig. 5

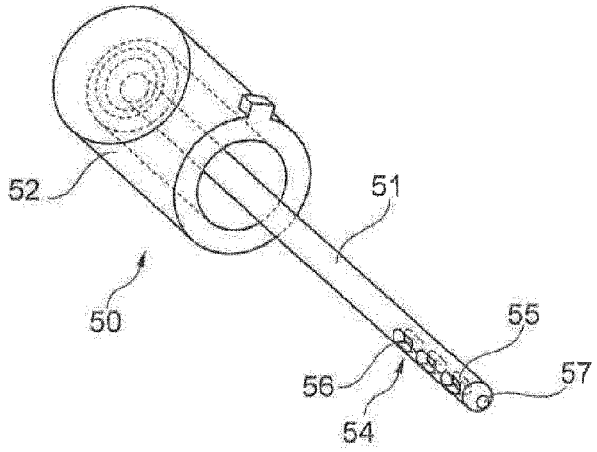


Fig. 6

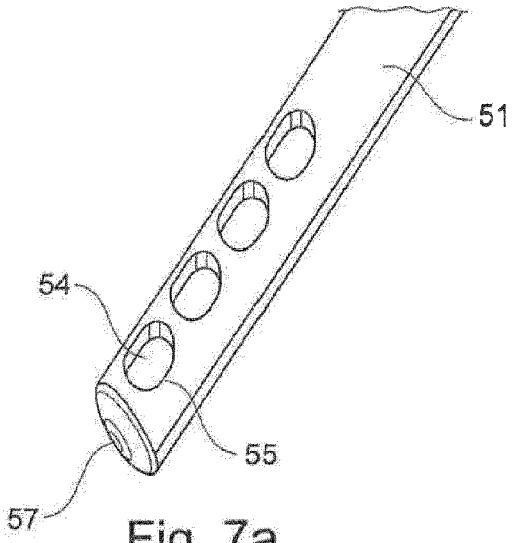


Fig. 7a

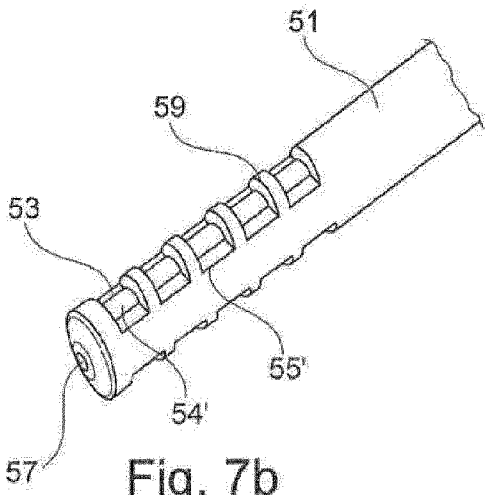


Fig. 7b

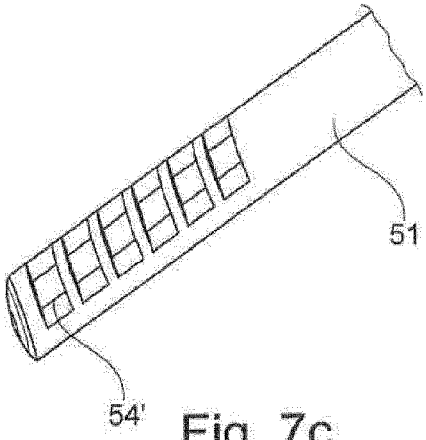


Fig. 7c

Fig. 8a

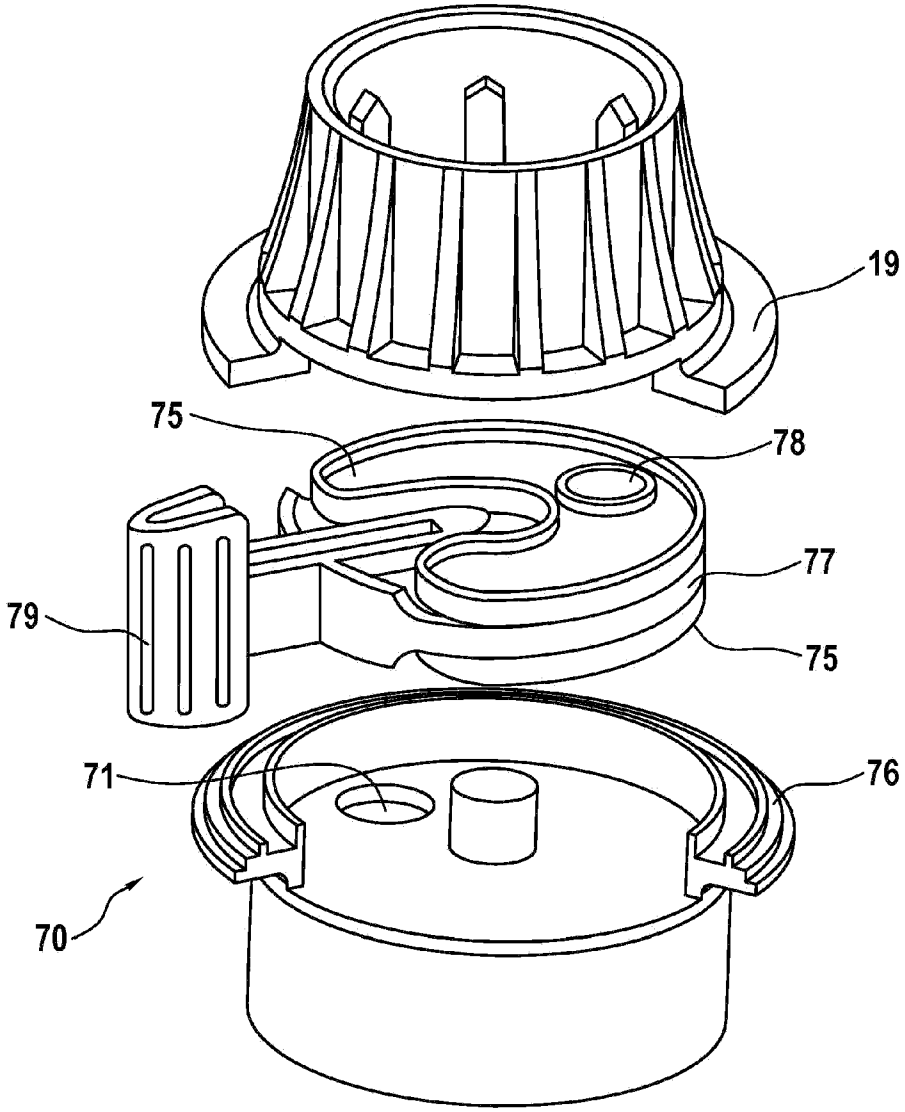


Fig. 8b

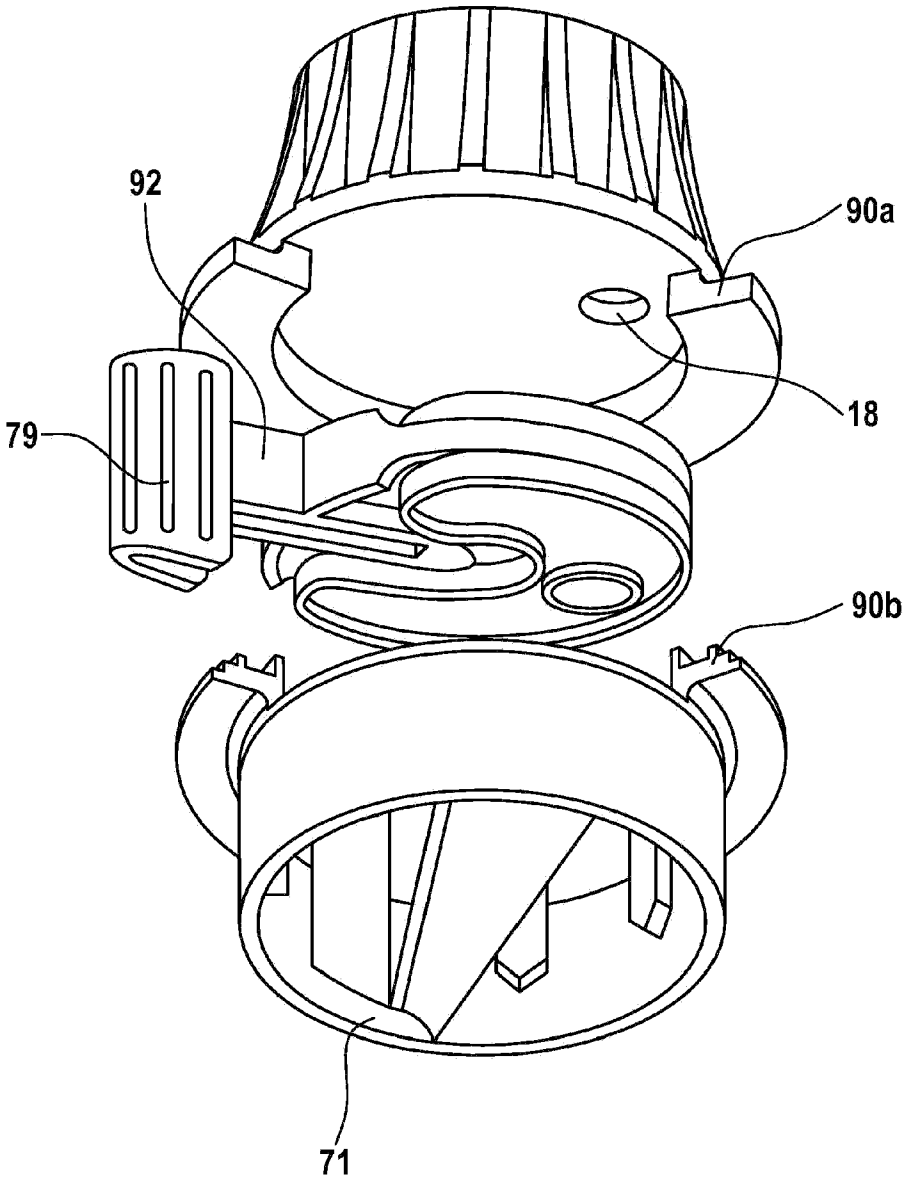


Fig. 9a

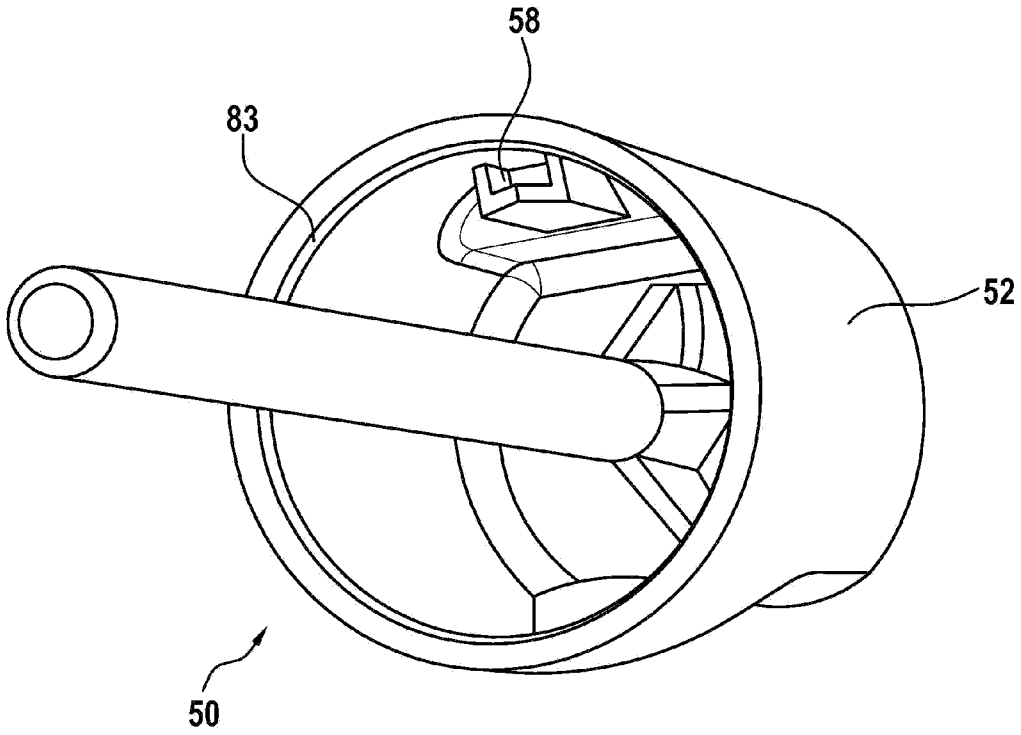
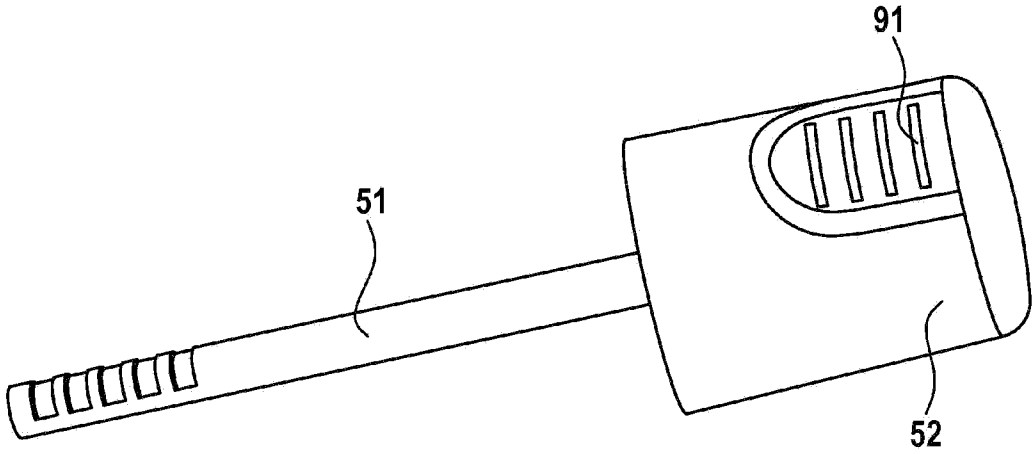


Fig. 9b



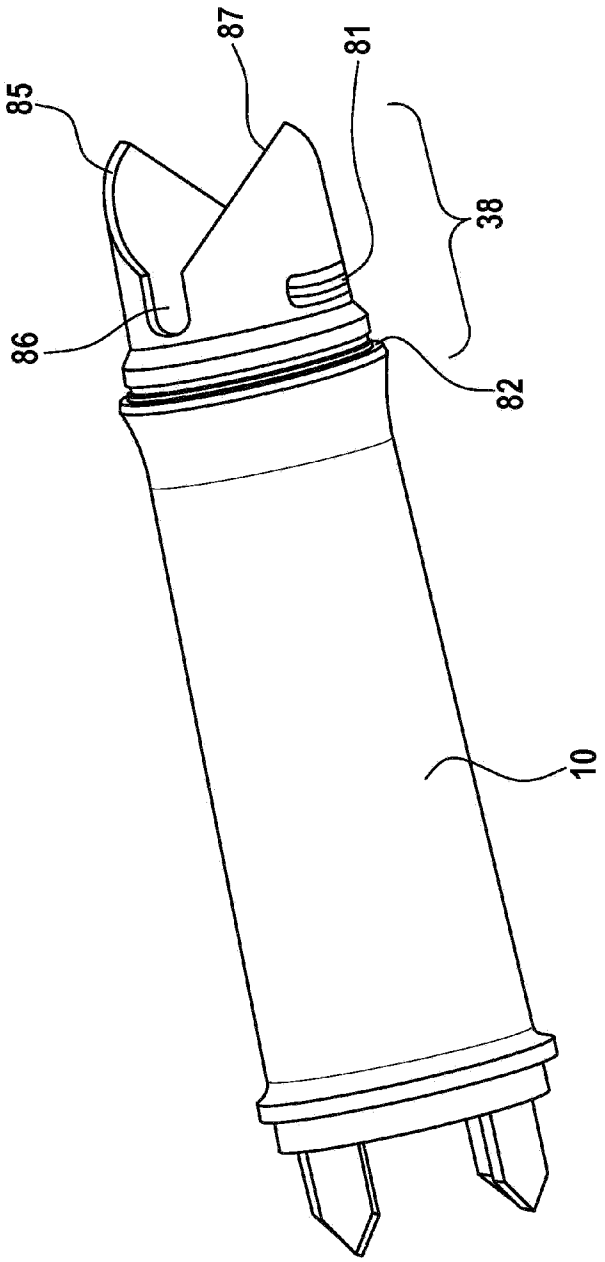


Fig. 10