(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 October 2006 (26.10.2006)

PCT

(10) International Publication Number
WO 2006/111731 A2

(51) International Patent Classification:
A61M 25/06 (2006.01) *A61M 5/32* (2006.01)

(21) International Application Number:
PCT/GB2006/001408

(22) International Filing Date: 19 April 2006 (19.04.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0507969.4 19 April 2005 (19.04.2005) GB
0514766.5 19 July 2005 (19.07.2005) GB

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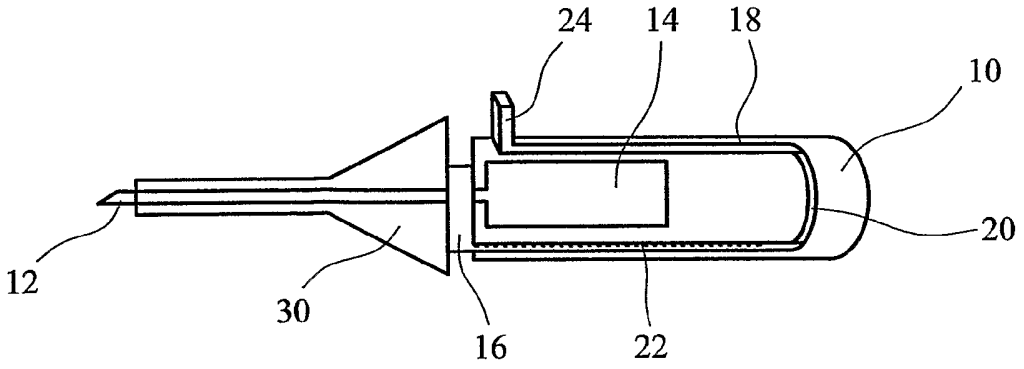
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** CANNULA WITH INTRODUCER, NEEDLE PROTECTING GUARD AND BLOOD COLLECTING SYSTEM



(57) **Abstract:** A cannula introducing device comprises an elongate body (10) having a needle (12) projecting from a front end, an operating element (24) for displacement longitudinally of the body (10) , a plunger (16) disposed at the front end of the body (10) , and a coupling means (18) , such as a flexible wire, coupling the operating element (24) and the plunger (16) , arranged so that retraction of the operating element (24) serves to advance the plunger (16) over the needle (12) and so advance the cannula (30) which is disposed over the needle.

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Cannula with Introducer, Needle Protecting Guard and Blood Collecting System

The present invention relates to medical devices including devices for introducing a cannula into a patient's blood vessel and for collecting a sample of blood or other bodily fluid.

Intravenous cannulation is an important procedure particularly in the management of acutely ill patients. The procedure is carried out using a needle inserted through the cannula, with the tip of the needle projecting from the forward end of the cannula, then inserting the tip of the needle into an artery or vein, and finally advancing the cannula over the tip of the needle to introduce its forward end into the blood vessel, then withdrawing the needle. This procedure requires very fine hand control and considerable practise on the part of the doctor carrying it out. Moreover, cannulation is occasionally complicated and in any event takes time and places the patient under considerable stress.

Cannula introducing devices have hitherto been arranged for user to move the cannula forwardly, over the tip of the needle, using the index finger. This forward movement of the cannula must be performed swiftly once the tip of the needle has entered the lumen of the blood vessel: any slight movement of the tip of the needle in the blood vessel lumen may result in puncture and failed cannulation; any withdrawal of the tip of the needle, prior to cannula placement in the lumen, will also result in failure. US patent No. 5,338,306 is directed to a cannula introducing device which uses either a mechanical spring or a compressed air spring, released by the user once the tip of the needle has been inserted into the blood vessel, to advance the cannula over the needle and into the blood vessel.

I have now devised a cannula introducing device which is reliable to use and does not include any form of spring, at least for initial introduction of the cannula into the blood

vessel.

In accordance with the present invention, there is provided a cannula introducing device which comprises an elongate body having a needle projecting from one end thereof, an operating element mounted to said body for displacement longitudinally thereof, a plunger disposed at said one end of the body, and means coupling said operating element and said plunger and arranged so that displacement of said operating element away from said one end of the body causes displacement of said coupling means to advance said plunger along said needle.

In use, a cannula is slipped over the needle to abut the plunger of the device, with the tip of the needle projecting from the forward end of the cannula. Then the user grips the body of the device and brings the assembly up to the patient to insert the tip of the needle into a blood vessel. The user then retracts the operating element of the device, typically using the index finger, to advance the plunger and so advance the forward end of the cannula over the tip of the needle and into the blood vessel. The device can then be withdrawn, to withdraw the needle, firstly from the blood vessel and then from the cannula, leaving the cannula inserted into the blood vessel: as the device is withdrawn, the retracting movement of the manual operating element may be continued, to continue the advancement of the plunger: preferably the arrangement is such that the plunger will advance far enough to cover the tip of the needle, and so prevent any possible needle stick injuries.

In an alternative embodiment, the plunger is arranged to be advanced an initial distance by the retracting displacement of the operating element (preferably sufficient to advance the tip of the cannula over the tip of the needle and provide initial introduction of the tip of the cannula into the blood vessel), and the device further comprises a spring (either a mechanical spring or a gas spring) which then serves

to advance the plunger through a further distance: preferably the plunger, in its fully-advanced position, covers the tip of the needle, to prevent any possible needle-stick injuries.

Preferably the device includes means for preventing the plunger being retracted after it has been advanced: this prevents the device being re-used, with the risk of spreading infection. Preferably, in order to prevent the plunger being retracted, the coupling means is provided with a series of ratchet serrations which co-operate with a tooth or projection with which the body of the device is provided.

The coupling means may comprise an elongate flexible element extending along a guideway of said body, between the operating element and the cannula-advancing plunger, the elongate flexible element being displaced longitudinally of itself as the operating element is retracted. This elongate flexible element may be arranged to push the plunger forwardly, or it may be arranged to pull on a rearward extension of the plunger to pull the plunger forwardly.

Preferably the guideway comprises a groove or channel formed in the body of the device, the operating element being engaged into and retained by this groove or channel for sliding movement along it. Preferably the operating element comprises a member which projects outwardly from the guide groove or channel, for the user to engage manually, typically with the index finger.

In one embodiment the guideway further comprises a passage having a first portion which extends from the rear end of the guide groove or channel and curves round to a second portion which extends forwardly to the front end of the body. In another embodiment, the guideway has a first portion which extends from the forward end of the guide groove or channel and curves round to a second portion which extends rearwardly of the body. Preferably the latter, second portion of the passage is disposed in or adjacent a surface of the body remote from or opposite the surface in which the guide groove or channel

is formed.

The elongate element which interconnects the operating element and the plunger may comprise a wire, preferably of a flat cross-sectional profile.

Preferably the body of the device is arranged to receive a blood-collecting container for receiving blood which flows along the needle of the device when its tip is inserted into a blood vessel. Preferably the device includes an internal chamber to receive blood through the needle, this chamber being provided with a plunger which is retracted, upon retraction of the operating element of the device, or of a secondary operating element associated therewith, for a piercing needle of this plunger to pierce a membrane closing the end of the blood-collecting container: preferably the blood-collecting container is pre-evacuated or otherwise arranged to provide a vacuum so that the blood is drawn into the container.

Also in accordance with the present invention, there is provided a device for collecting a sample of blood or other fluid, the device comprising an elongate body having a needle projecting from one end thereof, the body having an interior compartment for receiving a fluid-collecting container and having a plunger disposed therein, the device further comprising an operating element arranged for displacement longitudinally of said body away from said one end thereof, in order to displace said plunger and for a piercing needle provided on said plunger to pierce a membrane which closes said container.

The device may be arranged to create a vacuum in the fluid-collecting container, as the container is inserted longitudinally into the device body. For example, the interior compartment of the device body may be provided with an elongate pusher element directed to pierce the membrane of the container as the latter is inserted, and then bear on a piston provided within the container, such that as the container is inserted,

the pusher displaces the piston along the container to create a vacuum in the space between the piston and the membrane.

Further in accordance with the present invention, there is provided a container for collecting a sample of blood or other fluid, the container being of tubular form and having one end closed by a piercable membrane and having an internal piston positioned adjacent said membrane.

Embodiments of the present invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

Figure 1 is a side view, partly in section, of a first embodiment of cannula introducing device in accordance with this invention, shown with a cannula disposed over the needle of the device and the assembly in an initial condition ready for use;

Figure 2 is a top plan view of the assembly shown in Figure 1;

Figure 3 is a side view of the assembly, corresponding to Figure 1, showing the cannula once advanced over the tip of the needle and the device partly withdrawn;

Figure 4 is a similar view of the assembly, once the device has been completely withdrawn from the cannula and the plunger of the device fully advanced to cover the tip of the needle;

Figure 5 is a view, similar to Figure 1, of a second embodiment of device in accordance with the present invention;

Figure 6 is a view, similar to Figure 2, of the assembly shown in Figure 5;

Figure 7 is a view, similar to Figure 5, of a third embodiment of device in accordance with the present invention;

Figure 8 is a view, similar to Figure 6, of the assembly shown in Figure 7;

Figure 9 is a view similar to Figure 1, showing a modified embodiment of cannula introducing device, in an initial condition ready for use;

Figure 10 is a top plan view of the assembly shown in Figure 9;

Figure 11 is a side view of the assembly, corresponding to Figure 9, showing the plunger of the cannula introducing device advanced through an initial distance, to advance the tip of the cannula over the tip of the needle of the device;

Figure 12 is a similar view of the assembly, showing the plunger after it has been advanced its full extent;

Figure 13 is a side view, similar to Figure 1, of a further embodiment of cannula introducing device, shown in an initial condition ready for use;

Figure 14 is a top plan view of the assembly shown in Figure 13;

Figure 15 is a side view of the assembly, corresponding to Figure 13, showing the plunger of the cannula introducing device advanced through an initial distance, to advance the tip of the cannula over the tip of the needle; and

Figure 16 is a similar side view of the assembly, showing the plunger after it has been advanced to its full extent by a spring of the device.

Referring to Figures 1 and 2 of the drawings, there is shown a cannula introducing device which comprises an elongate body 10 having a hollow needle 12 projecting from a forward end thereof, the interior of the needle communicating with a blood collecting chamber 14 within the body 10. The device further comprises a plunger 16, in the form of a flat plate, initially disposed against the front end of the body 10 and having a central aperture through which the needle 12 extends. A guide groove 18 is formed along an upper side of the body 10, the groove 18 extending from a point adjacent the front end of the body 10 to a point adjacent the rear end of the body 10, where it joins a passage 20 which extends though the body 10, firstly curving across the body 10 towards its lower side and then extending longitudinally of the body 10 to its front end. A guide wire 22 extends along the groove 18 and then along the

passage 20, the guide wire 22 having one end attached to an operating knob 24 and its other end attached to the plunger 16: the operating knob 24 is engaged with the groove 18 so as to be slidable along this groove, whilst being retained by it; also, the operating knob 24 projects outwardly from the groove 18, to enable the user to engage it and slide it rearwardly along the groove. The guide wire 22 is resiliently flexible so that, as the operating knob 24 is slid rearwardly of the body 10, the wire will displace along the passage 20 and so advance the plunger 16 along the needle 12.

In use, the plunger 16 is initially in the retracted position shown in Figures 1 and 2, in contact with the front end of the body 10. A cannula 30 is then slipped over the needle 12, for its rear end to abut the plunger 16 and the tip of the needle to project from the forward end of the cannula. It will be noted that the cannula 30 comprises a tubular stem having an enlarged, conical rear end. The user grips the body 10 in one hand and brings the assembly up to the patient to insert the needle 12 carefully into a blood vessel: then the user engages the operating knob 24 with his or her index finger, and moves this rearwardly along its guide groove 18, so displacing the guide wire 22 lengthwise of itself and along the groove 18 and passage 20, to advance the plunger 16; the plunger 16 accordingly pushes the cannula forwardly along the needle, so that the forward end of the cannula passes over the tip of the needle and into the blood vessel.

Once the cannula is in position, and referring to Figures 3 and 4 of the drawings, the body 10 can be withdrawn to withdraw the needle, firstly from the blood vessel and finally from the cannula: throughout this movement, the rearward displacement of the operating knob 24 is continued, so that the plunger 16 continues to advance and, finally, covers the sharp end of the needle 12. Accordingly, the tip of the needle is covered and possible needle stick injuries are prevented.

The guide wire 22 is formed with a series of ratchet serrations 22a which co-operate with a tooth 10a formed on the body 10 of the device, at or adjacent its front end: this prevents the device being re-used, with the risk of spreading infection.

It will be appreciated that the device which has been described is of relatively simple construction yet easy to use, whilst minimising the risk of movement of the needle tip as the cannula is advanced over the needle and into the blood vessel. The device avoids the use of springs and, moreover, provides for the sharp tip of the needle to become covered at the end of the cannulation procedure.

Figures 5 and 6 show a device similar to that shown in Figures 1 to 4, like parts being denoted by like reference numerals. The device shown in Figures 5 and 6 differs, from that shown in Figures 1 to 4, in that the body 10 is formed with a pair of interior compartments side-by-side, open to the rear of the body, to receive respective elongate, blood-collecting containers of a unit or cartridge 40. The needle 12 of the device communicates, at its inner end, with an internal chamber 41 of the body 10, in which a plunger 42 is disposed, the plunger 42 being formed with a pair of piercing needles 43 for puncturing membranes 44 which close the ends of the blood-collecting containers of the cartridge 40. Typically, the blood-collecting containers will be pre-evacuated.

In use of the device shown in Figures 5 and 6, the cartridge 40 is inserted into the body 10 of the device before the device is brought up to the patient. When the tip of the needle 12 of the device is inserted into the patient's blood vessel, blood will pass along the needle and into the chamber 41 at the forward end of the body 10. When the user sees the presence of the blood in this chamber 41 (the wall of body 10 being transparent), the operating knob 24 is retracted slightly: this operating knob is coupled to the plunger 42 to

corresponding retract this plunger and so cause its piercing needles 43 to pierce the membrane 44 at the ends of the blood-collecting containers. The vacuum within these containers causes the blood to be drawn into them, through the needle 12 of the device, its internal chamber 41 and the piercing needles 43 of the plunger 42. The operating knob is arranged so that, upon further retraction, it advances the plunger 16 of the device and so displaces the cannula 30 over the tip of the needle and into the blood vessel, as above-described with reference to Figures 1 to 4 of the drawings. In a modification, the operating knob 24 serves only for displacing the plunger 16 and a secondary operating knob is provided, for example alongside or forwardly of the operating knob 24, for retracting the internal plunger 42. Further, the device body 10 may be formed with an internal membrane which closes the chamber 41, the piercing needles 43 of the plunger 42 firstly piercing this membrane and then the membranes 44 of the cartridge 40 when the plunger 42 is retracted.

Figures 7 and 8 show a similar device to that shown in Figures 5 and 6, like parts being denoted by like reference numerals. The device of Figures 7 and 8 differs in that it is arranged to create a vacuum in each of the blood-collecting containers of the cartridge 40. Each of these containers is provided with an internal piston 45, initially positioned adjacent the membrane 44 which closes its forward end. The device body 10 is formed internally with a pair of rearwardly-directed posts 46 arranged so that, as the cartridge 40 is inserted into the body 10, the posts 46 pierce the membranes 44 of the two containers and abut the pistons 45, and push these pistons rearwardly along the respective containers of the cartridge 40, so creating a vacuum within the containers, forwardly of the pistons 45. It will be appreciated that the rear ends of the containers are formed with openings to allow air to be expelled from the spaces to the rear of the pistons 45: also, the membranes 44 maintain a seal around the posts 46

during the forward movement of the cartridge 40.

Figures 9 to 12 show a modification applicable to each of the devices which have been described above. In this device, the elongate flexible element 22 extends from the forward end of the groove or channel in which the operating knob 24 is retained, and round in a curve to a passage extending lengthwise of the body 10 adjacent the side or edge of the body 10, opposite the side in which the groove for the operating knob 24 is formed. The plunger 16 has a rearwards extension 17 to the end of which the element 22 is coupled. Thus, as the operating knob 24 is displaced rearwardly, the element 22 is displaced longitudinally of itself to pull on the extension 17 of the plunger 16 and so pull the plunger forwardly.

Figures 13 to 16 show a further embodiment which corresponds generally to the embodiment of Figures 1 to 4 and incorporating the modification of Figures 9 to 12, but also incorporating an additional modification. Thus, retraction of the operating knob 24 serves to pull the plunger 16 forwardly through an initial distance, sufficient to advance the tip of the cannula 30 over the tip of the needle 12 and so introduce the tip of the cannula 30 into the blood vessel (see Figure 15). The device further includes a compression spring 50, or alternatively a compressed air spring, positioned around the blood collecting chamber 14: at the end of its retracting movement for advancing the plunger 16 over its initial distance as just described, the operating knob 24 serves to actuate or release the spring 50, which then acts on sliding mounting elements 19 of the plunger 16 to advance this fully, until the plunger 16 covers the tip of the needle 12. This final advancement of the plunger 16 is swift and serves to advance the cannula the required distance into the blood vessel, the plunger protecting the tip of the needle 12 (Figure 16). It will also be noted that the mounting elements 19 of the plunger are elongate in form and extend parallel to the needle 12 and

are spaced apart around it, so as to enclose the needle 12 and provide further protection for it, in the extended condition of the plunger.

Claims

1. A cannula introducing device which comprises an elongate body having a needle projecting from one end thereof, an operating element mounted to said body for displacement longitudinally thereof, a plunger disposed at said one end of said body, and means coupling said operating element and said plunger and arranged so that displacement of said operating element away from said one end of said body causes displacement of said coupling means to advance said plunger along said needle.

2. A device as claimed in claim 1, arranged for said plunger to be displaceable, by displacement of said operating element, far enough to cover the tip of said needle.

3. A device as claimed in claim 1, arranged for said plunger to be advanced an initial distance by said displacement of said operating element, the device further comprising a spring serving to advance said plunger through a further distance.

4. A device as claimed in any preceding claim, including means for preventing said plunger being retracted after having been advanced along said needle.

5. A device as claimed in any preceding claim, in which said coupling means comprises an elongate flexible element which extends along a guideway of said body, between said operating element and said plunger, and arranged to be displaced longitudinally of itself as said operating element is displaced.

6. A device as claimed in claim 5, in which said flexible element is arranged to push said plunger forwardly along said

needle.

7. A device as claimed in claim 5, in which said flexible element is arranged to pull said plunger forwardly along said needle.

8. A device as claimed in claim 6, in which said guideway comprises a groove or channel formed in said body, said operating element being engaged into said groove or channel for sliding movement along it.

9. A device as claimed in claim 8, in which said operating element comprises a member which projects outwardly from said groove or channel, for the user to engage manually.

10. A device as claimed in any one of claims 5, 6, 8 or 9, in which said guideway further comprises a passage having a first portion which extends from the rear end of said groove or channel and curves round to a second portion which extends forwardly to said one end of said body.

11. A device as claimed in claim 10, in which said second portion of said guideway is disposed in or adjacent a surface of said body remote from or opposite a surface in which said guide groove or channel is formed.

12. A device as claimed in any one of claims 5 to 11, in which said coupling means comprises a wire.

13. A device as claimed in claim 12, in which said wire is of a flat cross-sectional profile.

14. A device as claimed in any preceding claim, in which said body is arranged to receive a fluid-collecting container for receiving blood or other fluid through said needle.

15. A device as claimed in claim 14, in which said body includes an internal chamber to receive blood or other fluid through said needle, said chamber being provided with a plunger which is displaced upon retraction of said operating element, or of a secondary operating element, for a piercing needle of said plunger to pierce a membrane closing the end of said fluid-collecting container.

16. A device as claimed in claim 14 or 15, in which said body is formed with an elongate compartment for the longitudinal insertion of a said container of tubular form, said compartment being provided with a longitudinal member for piercing said membrane of said container and to bear on and displace an internal piston of said container, as said container is inserted into said compartment.

17. A device as claimed in any one of claims 14 to 16, in combination with a said fluid-collecting container inserted into or for insertion into said body.

18. A device as claimed in any preceding claim, in combination with a cannula received over said needle.

19. A device for collecting a sample of blood or other fluid, the device comprising an elongate body having a needle projecting from one end thereof, the body having an interior compartment for receiving a fluid-collecting container and having a plunger disposed therein, the device further comprising an operating element arranged for displacement longitudinally of said body away from said one end thereof, in order to displace said plunger and for a piercing needle provided on said plunger to pierce a membrane which closes said container.

20. A device as claimed in claim 19, in combination with a

fluid collecting container received or for receiving within said body.

21. A container for collecting a sample of blood or other fluid, the container being of tubular form and having one end closed by a piercable membrane and having an internal piston positioned adjacent said membrane.

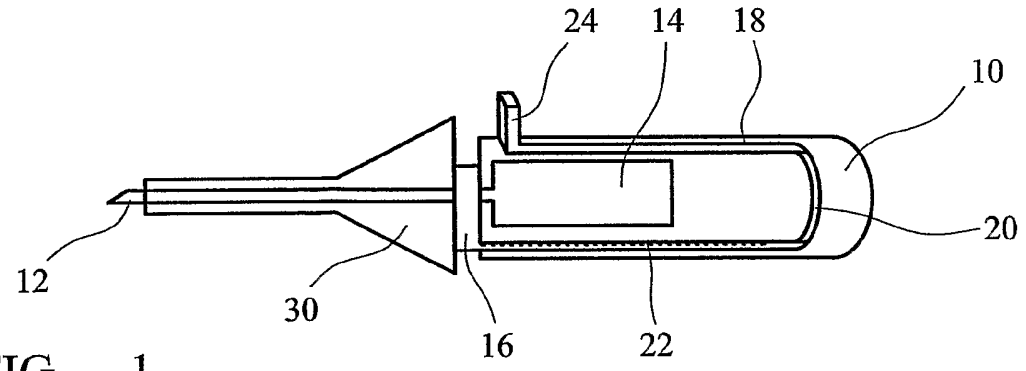

FIG. 1

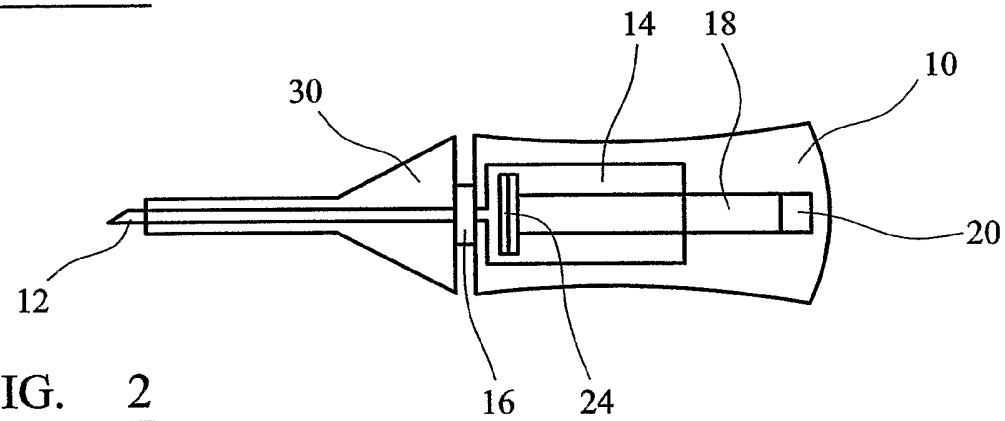

FIG. 2

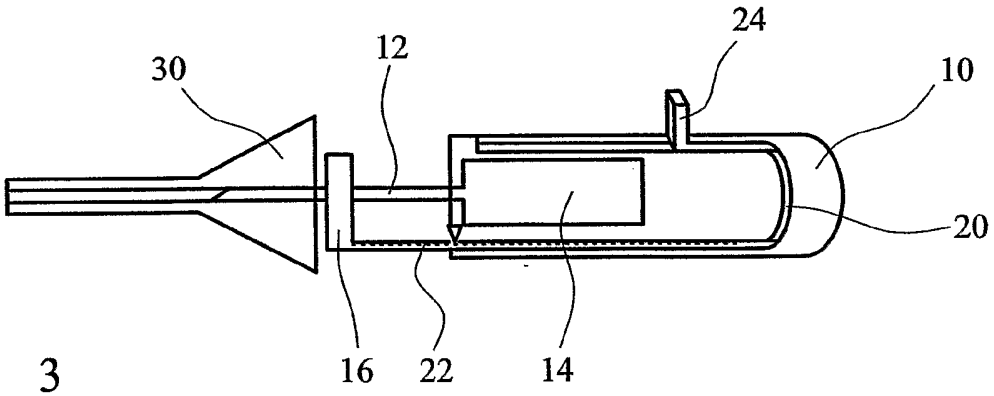

FIG. 3

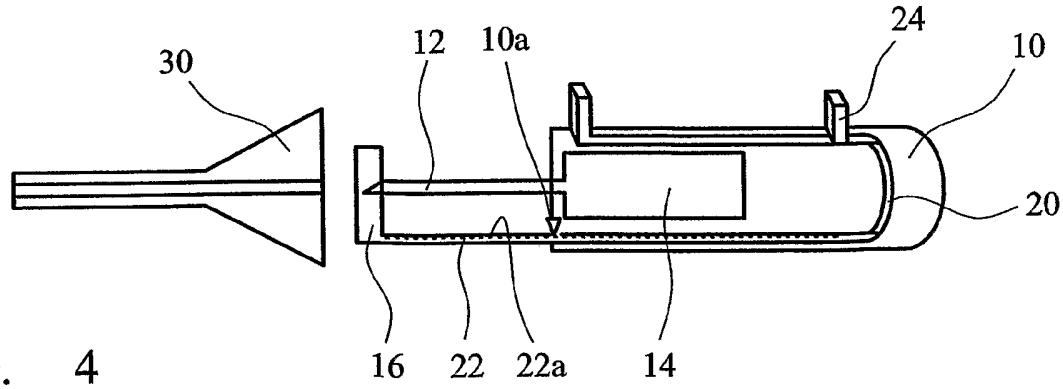

FIG. 4

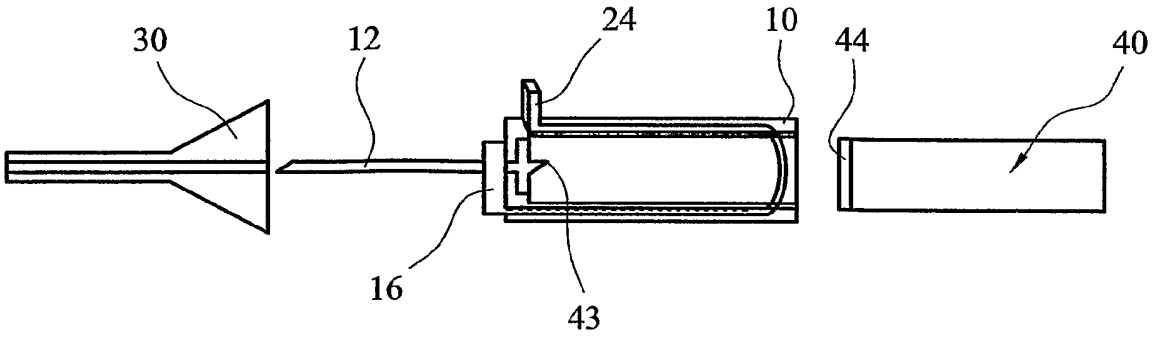

FIG. 5

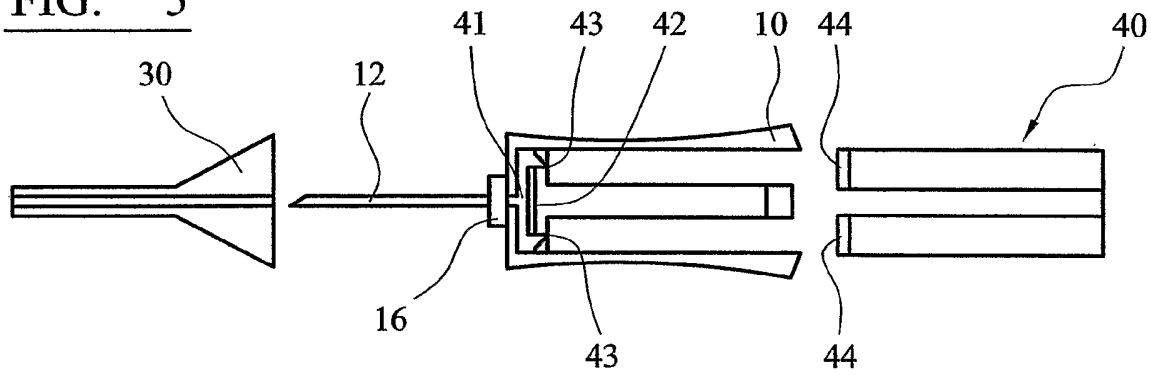

FIG. 6

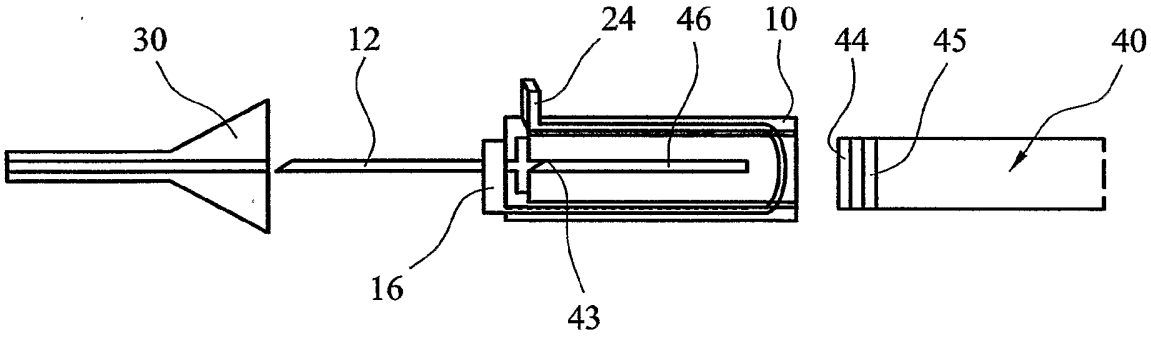

FIG. 7

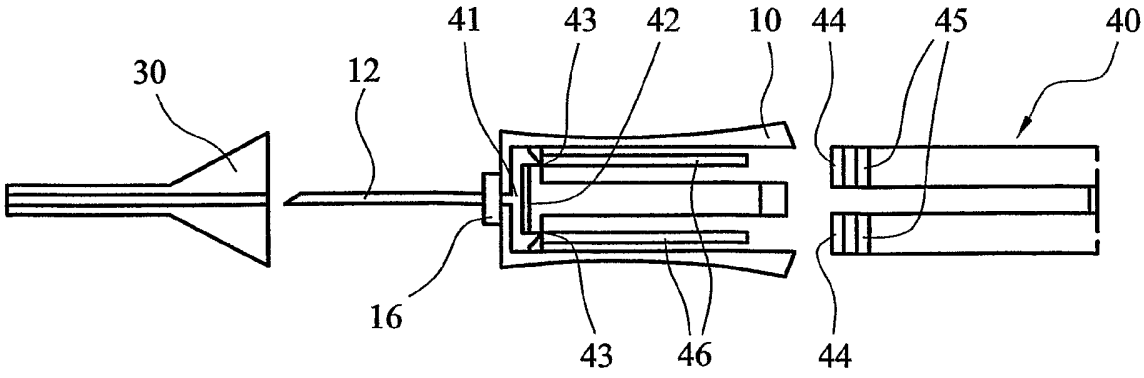

FIG. 8

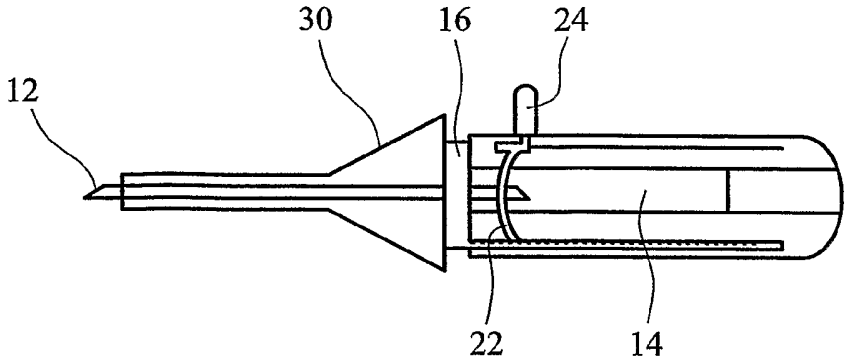

FIG. 9

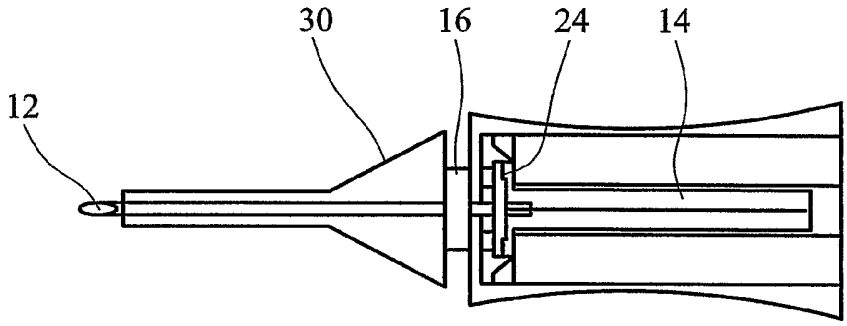

FIG. 10

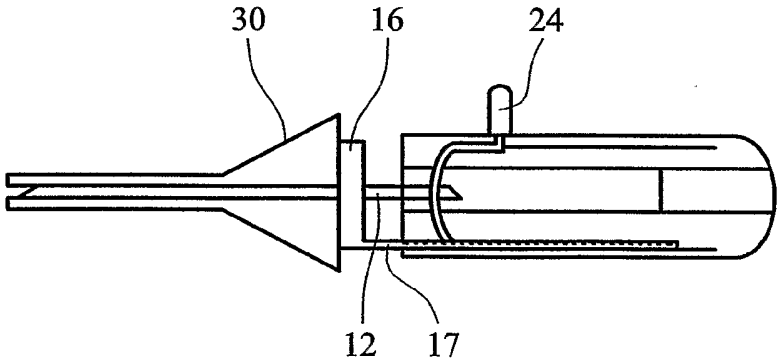

FIG. 11

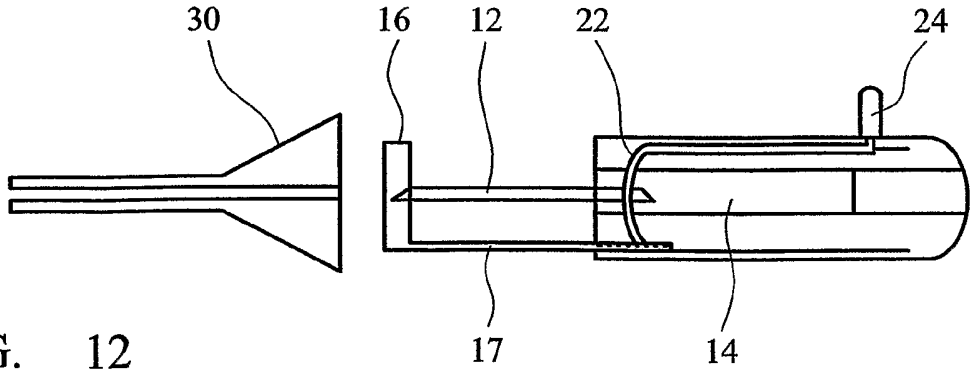

FIG. 12

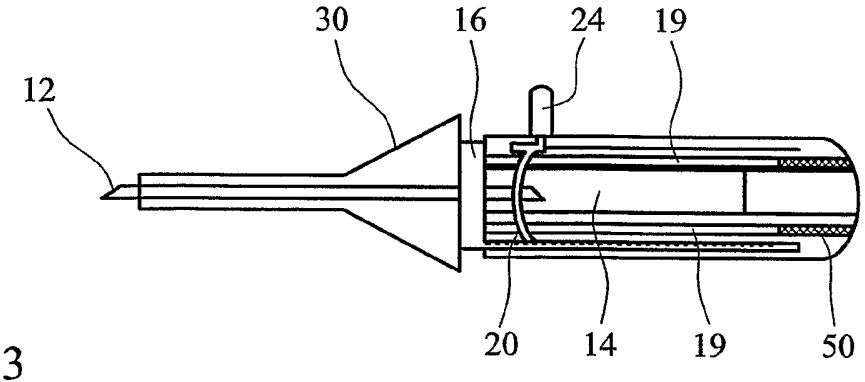

FIG. 13

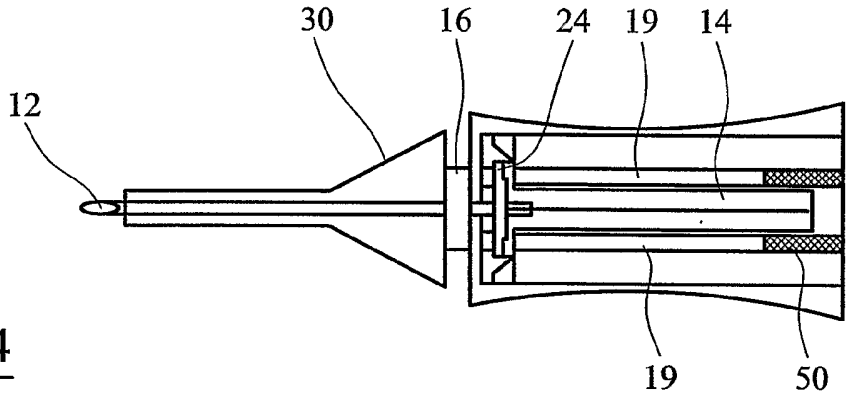

FIG. 14

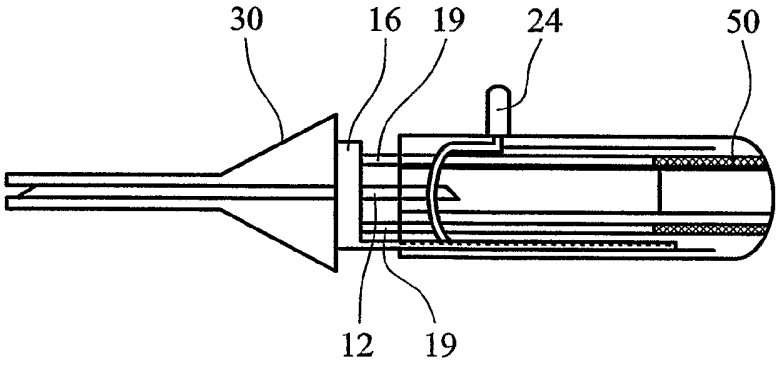

FIG. 15

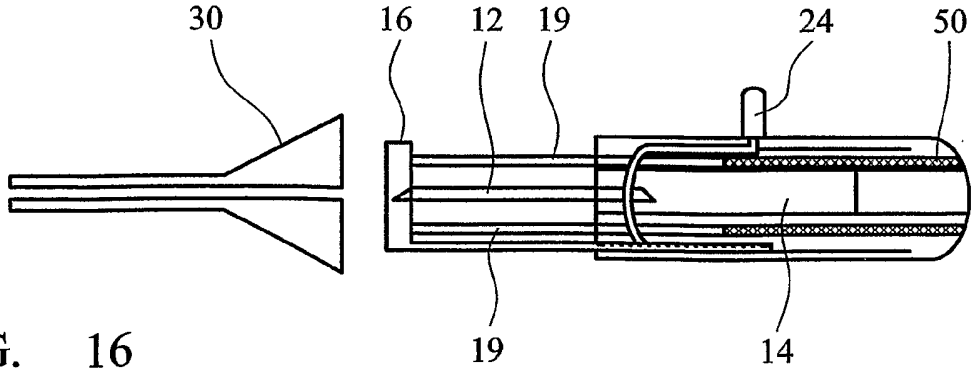

FIG. 16