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(54) **Title:** AN IMPROVED STOPCOCK FOR ADMINISTERING MEDICAMENTS INTO THE PATIENT'S BODY

(57) **Abstract:** The present invention is an improved stopcock for safely administering dangerous medicaments that are injected into a patient's body. The stopcock comprises: A fluid guiding device comprising an outer body provided with four openings and an inner body provided with a first conduit, from which an additional conduit branches. The first conduit lies essentially along the diameter of the outer body, wherein the openings provided in the outer body correspond to the ends of the first and the additional conduits. The chord between the ends of the first and the additional conduits is essentially equal to the chord between two corresponding openings of the outer body. One opening has an axis that makes an angle of about 90 degrees with the axes of each of the two openings adjacent to it. The stopcock also comprises two inlet/outlet ports that are independently connected to the first and second openings of the outer body and a spike or a vial holding member that is independently connected to the third and fourth openings of the outer body.

AN IMPROVED STOPCOCK FOR ADMINISTERING MEDICAMENTS INTO THE PATIENT'S BODY

Field of the Invention

The present invention relates to medicament administering apparatus. More particularly, the invention relates to a fluid guiding device and to an improved stopcock for safely administering dangerous medicaments into the patient's body.

Definitions, Acronyms and Abbreviations

Throughout this specification, the following definitions are employed:

Hydrophobic filter: is commonly used in airway management and usually composed of synthetic fibers like polypropylene. Because the fibers are hydrophobic, they do not absorb moisture from air flow. Moisture and particulates (viruses, bacteriums, etc.) are collected on the fiber surfaces or pass through the filter. The relative efficiency of the filter diminishes as particles decrease in size (viruses are smaller than bacterium) and when the filter is subjected to higher volumes of airflow or is used over a prolonged period of time, due to that moisture and particulate are able to migrate through the filter.

Stopcock: is a valve used to restrict or isolate the flow of a liquid or gas through a pipe or conduit. In medicine, a stopcock is usually used for regulating the flow of intravenous medicaments to be administered into a patient's body. Generally, each stopcock is used as a needleless injection port. Thus, when administering fluids (e.g. medicaments) through a needle into the patient's body by opening an injection port, subsequent injections and infusions are possible through the same injection port by using a stopcock having two or more ports, each port separated from another by a

shut-off valve, and connecting the stopcock to two or more reservoirs filled with medicaments.

Background of the Invention

As known from the prior art, there is a variety of conventional fluid-delivery systems having flexible conduits connected to one or more reservoirs that are filled with fluids (e.g. medicaments) to be administered into the patient's body. Usually, it is desirable to switch from one reservoir to another during administering fluids, in order to change the medicament being administered. This is done by using a stopcock that allows a doctor (nurse) to select a required reservoir to be placed in a fluid-flow communication with the patient, usually by rotating a stem connected to the body of the stopcock. However, it is not always apparent to the doctor which reservoir is currently in the fluid-flow communication with the patient. In addition, the doctor can switch (by mistake) the stem of the stopcock to a wrong reservoir, and that can lead to the irreversible damage to the patient. This issue is especially critical when administering dangerous medicaments that are not usually administered directly into the patient's body, but are first mixed with other fluid(s) (e.g., glucose, water) within an infusion bag.

The prior art has failed to provide a sufficient solution to the above problems. For example, US 3,678,960 discloses a stopcock type of device for selectively interconnecting a plurality of fluid-carrying ducts in a variety of configurations. The device includes a plurality of outstanding ports that selectively communicate with a rotatable central hub provided with a predetermined configuration of annular passageways. This makes possible the selection of any one of the variety of flow configurations depending upon the angular position of the valve with respect to the ports. Another patent, US 5,443,453, presents a stopcock valve useable in conjunction with a fluid delivery set for delivering fluids such as intravenous fluids or enteral fluids from one or more containers to a patient. The valve includes a shear-away

interference member, which holds the valve in a closed position prior to use, in order to prevent accidental premature free flow of fluid therethrough. The valve also includes a venting passage for allowing access of sterilization gas into all fluid flow passages of the valve, even when the valve stem is rotated to a closed position. Still another patent, US 5,074,334, discloses a multi-way cock that comprises a housing including a cylinder having a plurality of branch tubes extending from the periphery thereof, and a plug including a barrel adapted to be rotatably fitted in the cylinder and having a corresponding plurality of channels formed therein. However, the above prior art patents do not teach preventing dangerous medicaments from being directly administered into the patient's body.

Therefore, there is a need to ensure that medicaments from one or more reservoirs (such as vials, syringes, etc.) are prevented from being administered directly into the patient's body due to a human error or due to any other reason.

It is an object of the present invention to provide a method and system for safely administering dangerous drugs into the patient's body by using an improved stopcock that prevents medicaments, within one or more reservoirs of a fluid-delivery set, from being directly administered into the patient's body.

It is another object of the present invention to provide a method and system in which dangerous (poisonous) medicaments are sealed within said system, and are not evaporated into the air, so that harm is prevented both to the health of a patient and of the medical personnel that take care of the patient.

It is still another object of the present invention to provide a fluid guiding device to be used with a fluid-delivery set that indicates to a person operating the stopcock, the fluid-flow position of the stopcock stem.

Other objects and advantages of the invention will become apparent as the description proceeds.

Summary of the Invention

The present invention relates to a fluid guiding device and to an improved stopcock for safely administering dangerous medicaments that are injected into the patient's body.

The fluid guiding device comprises an outer body provided with four openings, and an inner body provided with a first conduit, from which an additional conduit branches, said first conduit lying essentially along the diameter of said outer body, wherein said openings provided in said outer body correspond to the ends of said first and said additional conduits, and wherein the chord between the ends of said first and additional conduits is essentially equal to the chord between two corresponding openings of said outer body, and wherein one opening has an axis that makes an angle of about 90 degrees with the axes of each of the two openings adjacent to it.

The stopcock for guiding a fluid comprises: (a) a fluid guiding device, comprising: (a.1.) an outer body having four openings; (a.2.) an inner body provided with a first conduit, from which an additional conduit branches, said first conduit lying essentially along the diameter of said outer body, wherein said openings provided in said outer body correspond to the ends of said first and said additional conduits, and wherein the chord between the ends of said first and additional conduits is essentially equal to the chord between two corresponding openings of said outer body, and wherein one opening has an axis that makes an angle of about 90 degrees with the axes

of each of the two openings adjacent to it; (b) two inlet/outlet ports, independently connected to the first and second openings of said outer body; and (c) a spike or a vial holding member that are independently connected to the third and fourth openings of said outer body.

According to a preferred embodiment of the invention, the spike is connected to a fluid-dispensing reservoir. According to another preferred embodiment of the invention, the inlet/outlet port is connected to a pump. According to still another preferred embodiment of the invention, the inlet/outlet port is connected to a conduit.

Preferably, but not limitatively, the pump is a syringe.

Typically, a vial is connected to a vial holding member which is filled with the fluid or powder, comprising: (a) a medicament; (b) one or more types of vitamins; and (c) one or more types of food additives.

According to a preferred embodiment of the invention, the outer body further comprises a protrusion for restricting rotation of the inner body within said outer body. Preferably, the inner body further comprises a protrusion for restricting its rotation within the outer body.

According to a preferred embodiment of the invention, the pump pumps the fluid from the vial to the fluid-dispensing reservoir and/or from said fluid-dispensing reservoir to said vial, e.g., the fluid is dispensed from the fluid-dispensing reservoir to the conduit.

According to a preferred embodiment of the invention, the stopcock allows the fluid to flow from one inlet/outlet port to another. According to another preferred embodiment of the invention, the stopcock allows the fluid to flow

from the inlet/outlet port to the vial holding member and/or from said vial holding member to said inlet/outlet port.

According to still another preferred embodiment of the invention, the stopcock allows the fluid to flow from the spike to the inlet/outlet port and/or from said inlet/outlet port to said spike. Preferably, the stopcock allows the fluid flow from the spike to the vial holding member and/or from said vial holding member to said spike.

According to a preferred embodiment of the invention, the stopcock is further connected to one or more additional stopcocks for administering one or more medicaments, or one or more types of vitamins, or one or more types of food additives, or a combination thereof. Preferably, the inner body is connected by means of a connector to a computer for controlling its rotation within the outer body by means of said computer.

Brief Description of the Drawings

In the drawings:

Fig. 1A is a top view of a fluid guiding device, according to a preferred embodiment of the present invention;

Figs. 1B and 1C are schematic illustrations of a system for administering medicaments into the patient's body (e.g. under the skin), according to a preferred embodiment of the present invention;

Fig. 2A is a perspective view of a stopcock outer body, according to a preferred embodiment of the present invention;

Figs. 2B to 2D are schematic illustrations of a stopcock inner body (stem), according to a preferred embodiment of the present invention;

Fig. 2E is a perspective view of a vial holder, according to a preferred embodiment of the present invention;

Fig. 2F is a cross-sectional perspective view of a stopcock connected to a vial holder, according to a preferred embodiment of the present invention;

Fig. 2G is another perspective view of a stopcock outer body, according to another preferred embodiment of the present invention;

Figs. 3A and 3B are schematic illustrations of connecting a vial to a stopcock by means of a vial holder, according to a preferred embodiment of the present invention;

Fig. 4A is a schematic illustration of connecting a syringe to a stopcock, according to a preferred embodiment of the present invention;

Fig. 4B is a schematic illustration of connecting an infusion bag to a stopcock, according to a preferred embodiment of the present invention;

Fig. 4C is a schematic illustration of connecting a conduit to a stopcock, according to a preferred embodiment of the present invention;

Fig. 5 is a schematic illustration of jointly connecting two or more stopcocks, according to a preferred embodiment of the present invention;

Fig. 6 is a schematic illustration of connecting two vials to a stopcock, according to another preferred embodiment of the present invention; and

Figs. 7A and 7B are bottom views of a stem, according to another preferred embodiment of the present invention.

Detailed Description of the Preferred Embodiments

Fig. 1A is a top view of a fluid guiding device, according to a preferred embodiment of the present invention. The fluid guiding device comprises a rotatable inner body (stem) 123 having a first conduit (channel) 232 lying essentially along the diameter of an outer body and an additional conduit 231 that branches from said first conduit; and an outer body 122 that has four openings, wherein said openings correspond to the ends of said conduits. Stem 123 can be rotated within body 122 to allow or isolate (block) the fluid flow within conduits 231 and 232. Chord BA, between the ends of said first conduit and said additional conduit, is essentially equal to each one of chords B'A' and A' C between openings 221 and 223, and also 223 and 224, respectively, of said outer body.

According to a preferred embodiment of the present invention, fluid guiding device (and its stem 123) has three fluid guiding states:

(1) allows fluid delivery between openings 223 and 221;
(2) allows fluid delivery between openings 223 and 224; and
(3) allows fluid delivery between openings 224 and 222.

According to a preferred embodiment of the present invention, one opening of outer body 122 has an axis that makes an angle of about 90 degrees with the axes of each of the two openings adjacent to it. It should be noted that when the term "about 90 degrees" is used it refers to the angle between 70 and 110 degrees.

According to a preferred embodiment of the present invention, outer body 122 has a U-shaped protrusion 210 (Fig. 2A) that prevents stem 123 from being rotated around its axis more than a predefined number of degrees (e.g., 180 degrees), thus preventing a fluid from flowing from opening 223 to opening 222 and vice-versa.

According to another preferred embodiment of the present invention, stem 123 from can be rotated around its axis by 360 degrees, enabling a fluid to flow from opening 223 to opening 222 and vice-versa.

It should be noted that if conduit 231 is substantially perpendicular to conduit 232, then by canceling U-shaped protrusion 210 (Fig. 2A), a fluid can flow from opening 221 to opening 222 and vice-versa.

Figs. 1B and 1C are schematic illustrations of a system 100 for administering medicaments into the patient's body (e.g. under the skin), according to a preferred embodiment of the present invention. The system comprises: a fluid-dispensing reservoir, such as an intravenous infusion bag 101 containing a fluid to be administered into the patient's body through a conduit 125; a vial 105 filled with a medicament 107 and connected to a stopcock 115 by means of a vial holding member 119; a pump (e.g., syringe) 110 for pumping medicaments from or to said vial 105 or said infusion bag 101; a stopcock 115 for selectively interconnecting infusion bag 101, vial 105, pump 110 and conduit 125 that is connected to a conventional infusion set (not shown) for administering medicaments into the patient's body; and a conventional infusion set (not shown) connected to stopcock 115 by means of conduit 125.

According to a preferred embodiment of the present invention, stopcock 115 (and its stem 123) has three fluid guiding states:

(1) allows fluid delivery between syringe 110 and vial 105;

(2) allows fluid delivery between syringe 110 and infusion bag 101; and

(3) allows fluid delivery between infusion bag 101 and infusion set through conduit 125.

The fluid from syringe 110 and/or vial 105 is prevented from flowing into conduit 125, thus ensuring the safety of a patient, especially when administering dangerous (poisonous) medicaments. Stopcock 115 comprises: a rotatable stem (inner body) 123 for allowing or isolating (blocking) the flow of a fluid from or to syringe 110, vial 105, infusion bag 101 and conduit 125; and a body (outer body) 122 having inlet/outlet ports 116 and 117 for connecting conduit 125 and syringe 110, respectively, a spike 118 for connecting infusion bag 101, and vial holding member 119 for connecting vial 105.

According to a particular preferred embodiment of the present invention, syringe 110 can be permanently connected to stopcock 115 for preventing possible fluid dripping from inlet/outlet port 117 of said stopcock 115. In addition, vial holding member 119 is hermetically connected to vial 105 for preventing dripping of the fluid from said vial 105 and/or from opening 221 (Fig. 2A).

For example, administering a medicament into the patient's body can be performed by the following steps:

- Connecting infusion bag 101 to spike 118 of stopcock 115, when stem 123 of said stopcock 115 is in the first fluid guiding state, allowing the fluid delivery between syringe 110 and vial 105;
- Connecting an infusion set to inlet/outlet port 116 of stopcock 115;
- Connecting vial 105 to stopcock 115 by means of vial holding member 119;
- Rotating stem 123 to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 to the infusion set (not shown) through conduit 125;
- Opening a dripping portion of the infusion set in order to fill a half of said dripping portion with the fluid from infusion bag 101;

- Removing air from the infusion set by opening (and then closing) a roller clamp (not shown) within said infusion set;
- Rotating stem 123 to the first fluid guiding state;
- Pumping the medicament from vial 105 to syringe 110 by means of a piston 111;
- Rotating stem 123 to the second fluid guiding state, allowing the fluid to flow from syringe 110 to infusion bag 101;
- Pumping the medicament from syringe 110 to infusion bag 101;
- Pumping the fluid from infusion bag 101 to syringe 110 for cleaning said syringe 110 from the medicament, and then pumping said fluid back to said infusion bag 101 (this step can be performed more than once); and
- Rotating stem 123 to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 to the infusion set.

According to another preferred embodiment of the present invention, vial 105 contains powder medicament 107. The powder medicament is diluted before administering it to the patient by pumping fluid from infusion bag 101 into syringe 110, and then injecting said fluid into vial 105 by means of said syringe 110.

For example, administering powder medicament 107 can be performed by the following steps:

- Connecting infusion bag 101 to spike 118 of stopcock 115, when stem 123 of said stopcock 115 is in the first fluid guiding state, allowing fluid delivery between syringe 110 and vial 105;
- Connecting an infusion set to inlet/outlet port 116 of stopcock 115;
- Connecting vial 105 to stopcock 115 by means of vial holding member 119;
- Rotating stem 123 to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 to the infusion set through conduit 125;

- Opening a dripping portion of the infusion set in order to fill a half of said dripping portion with the fluid from infusion bag 101;
- Removing air from the infusion set by opening (and then closing) a roller clamp (not shown) within said infusion set;
- Rotating stem 123 to the second fluid guiding state, allowing fluid delivery between syringe 110 and infusion bag 101;
- Pumping the fluid from infusion bag 101 to syringe 110;
- Rotating stem 123 to the first fluid guiding state;
- Pumping the fluid from syringe 110 to vial 105;
- Dissolving the powder within vial 105 by shaking said vial 105 (when connected to stopcock 115);
- Pumping the medicament from vial 105 to syringe 110 by means of a piston 111;
- Rotating stem 123 to the second fluid guiding state, allowing the fluid to flow from syringe 110 to infusion bag 101;
- Pumping said medicament from syringe 110 to infusion bag 101;
- Pumping the fluid from infusion bag 101 to syringe 110 for cleaning said syringe 110 from said medicament, and then pumping said fluid back to said infusion bag 101 (this step can be performed more than once); and
- Rotating stem 123 to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 to the infusion set through conduit 125.

It should be noted that according to a preferred embodiment of the present invention, dangerous (poisonous) medicaments, that can be provided within vial 105, are sealed within said vial 105, syringe 110, infusion bag 101, stopcock 115 and conduit 125, and are not evaporated into the air, which in turn do not harm the health of a patient nor the health of the medical personnel that take care of the patient.

Fig. 2A is a perspective view of a stopcock outer body 122, according to a preferred embodiment of the present invention. Body 122 comprises a cylindrical portion 250, inlet/outlet ports 116 and 117 extending from said cylindrical portion 250 for connecting conduit 125 and syringe 110 into corresponding openings 222 and 223 of said inlet/outlet ports; a spike 118, having an opening 224, for connecting infusion bag 101; and a vial holding member 119 (having opening 221) for connecting vial 105 to said stopcock body 122 by (hermetically) connecting portion 106 (Fig. 2E) of said vial holding member 119 to its another portion 120.

According to a preferred embodiment of the present invention, body 122 comprises a U-shaped protrusion 210 that prevents stem 123 (Fig. 1C) from being rotated around its axis more than a predefined number of degrees (e.g., 180 degrees), thus preventing medicaments from syringe 110 (Fig. 1B) and/or vial 105 (Fig. 1B) from being directly administered into the patient's body by restricting and isolating the fluid-flow through stopcock 115.

It should be noted that the angle between inlet/outlet ports 116 and 117 can be, for example, 45 degrees; and the angle between vial holding member 119 and inlet/outlet port 116 can be, for example, 90 degrees. For another example, the angle between inlet/outlet ports 116 and 117 is 90 degrees.

In addition, it should be noted that the angle between inlet/outlet port 117 and vial holding member 119 is substantially equal to the angle between inlet/outlet port 117 and spike 118 (the angle can be, for example, 135 degrees (or 225 degrees)).

Figs. 2B to 2D are schematic illustrations of a stopcock inner body (stem) 123, according to a preferred embodiment of the present invention. Stem 123 restricts and isolates the flow of a fluid from or to syringe 110 (Fig. 1B), vial 105 (Fig. 1B), infusion bag 101 (Fig. 1B) and conduit 125 (Fig. 1B). Stem

123 comprises conduits (channels) 231 and 232 for allowing the fluid to flow from openings 235 and 236 to opening 237, and vice-versa.

According to a preferred embodiment of the present invention, stem 123 can be rotated around its axis by a predefined number of degrees (e.g., 90 degrees) due to U-shaped protrusion 210 (Fig. 2A) provided within stopcock outer body 122. Thus, medicaments from vial 105 (Fig. 1B) and syringe 110 (Fig. 1B) cannot be directly administered into the patient's body because there cannot be any physical fluid-flow communication between said vial 105 and conduit 125, or said syringe 110 and conduit 125 (that is further connected to the infusion set). When rotating stem 123 around its axis, protrusion 215 of said stem is blocked by protrusion 210 of said stopcock body 122, preventing stem 123 from continuing to rotate.

Fig. 2E is a perspective view of a portion 106 of vial holding member 119 (Fig. 1B), according to a preferred embodiment of the present invention. Portion 106 of vial holding member 119 is hermetically connected to portion 120 (Fig. 2A) of said vial holding member 119 by means of its approximate end 201 for preventing dripping of the fluid. According to a preferred embodiment of the present invention, a conventional hydrophobic filter 205 (Fig. 2F) is provided between said approximate end 201 and said portion 120. It should be noted, that any other filter can be provided instead or in addition to said hydrophobic filter, such as a hydrophobic filter or the like.

Fig. 2F is a cross-sectional perspective view of a stopcock 115 with vial holding member 119, according to a preferred embodiment of the present invention. Stopcock 115 comprises: a rotatable stem 123 for allowing or blocking the flow of a fluid from or to syringe 110 (Fig. 1B), vial 105 (Fig. 1B), infusion bag 101 (Fig. 1B) and conduit 125 (Fig. 1B); and an outer body 122 having a cylindrical portion 250, inlet/outlet ports 116 and 117 extending from said cylindrical portion 250 for connecting conduit 125 and

syringe 110 into corresponding openings 222 and 223 of said inlet/outlet ports; a spike 118, having an opening 224, for connecting infusion bag 101; and a vial holding member 119 (having an opening 221) for connecting vial 105 to said stopcock body 122 by (hermetically) connecting portion 106 (Fig. 2E) of said vial holding member 119 to its another portion 120.

According to a preferred embodiment of the present invention, stem 123 can be rotated around its axis by a predefined number of degrees (e.g., 90 degrees) due to U-shaped protrusion 210 (Fig. 2A) provided within stopcock body 122. Thus, medicaments from vial 105 (Fig. 1B) and syringe 110 (Fig. 1B) can not be directly administered into the patient's body because there cannot be any physical fluid-flow communication between vial 105, syringe 110 and conduit 125 (that is connected to the infusion set). When rotating stem 123 around its axis, protrusion 215 (Fig. 2D) of said stem is blocked by means of protrusion 210 of said stopcock body 122, preventing stem 123 from continuing to rotate.

According to a preferred embodiment of the present invention, a conventional hydrophobic filter 205 (Fig. 2F) is provided between approximate end 201 of portion 106 and portion 120 of vial holding member 119. Hydrophobic filter 205 collects moisture and particulates (viruses, bacteriums, etc.) by means of channel 240. It should be noted, that any other filter can be provided instead of or in addition to said hydrophobic filter, such as a hydrophobic filter or the like.

Fig. 2G is another perspective view of a stopcock outer body 122, according to another preferred embodiment of the present invention. According to this preferred embodiment, body 122 does not have U-shaped protrusion 210 (Fig. 2A), thus enabling stem 123 (Fig. 1C) to be rotated around its axis by 360 degrees. As a result, syringe 110 (Fig. 1B) can be directly connected to conduit 125 (which is, in turn, connected to the infusion set) and the

medicament from said syringe 110 can be directly administered into the patient's body through said conduit 125.

It should be noted that if conduit 231 (Fig. 2C) that branches from conduit 232 (Fig. 2C) is substantially perpendicular to said conduit 232, then by canceling U-shaped protrusion 210, vial 105 (Fig. 1B) can be directly connected to conduit 125 (which is, in turn, connected to the infusion set) and medicament 107 (Fig. 1B) from said vial 105 can be directly administered into the patient's body through said conduit 125.

Figs. 3A and 3B are schematic illustrations of connecting a vial 105 to a stopcock 115 by means of a vial holding member 119, according to a preferred embodiment of the present invention. The upper section 301 of vial 105 is inserted inside portion 106 of said vial holding member 119 and can be held inside it by means of one or more teeth provided on an inner side of said portion 106, or by means of an elastic force of said portion 106.

Fig. 4A is a schematic illustration of connecting a syringe 110 to a stopcock 115, according to a preferred embodiment of the present invention. The upper end 401 of syringe 110 is inserted inside opening 223 of inlet/outlet port 117 of stopcock body 122.

Fig. 4B is a schematic illustration of connecting an infusion bag to a stopcock, according to a preferred embodiment of the present invention. Spike 118 is inserted inside the bottom end 405 of infusion bag 101, allowing fluid flow through opening 224 (Fig. 2F) of said spike 118.

Fig. 4C is a schematic illustration of connecting a conduit 125 to a stopcock 115, according to a preferred embodiment of the present invention. Conduit 125 is inserted inside opening 222 of inlet/outlet port 116 of stopcock body 122.

Fig. 5 is a schematic illustration of jointly connecting two or more stopcocks, according to a preferred embodiment of the present invention. If more than one medicament is required to be administered into the patient's body, then two or more stopcocks can be connected one to another in a row. Spike $118_{(2)}$ of stopcock $115_{(2)}$ can be connected to inlet/outlet port $116_{(1)}$ of another stopcock $115_{(1)}$. Infusion bag 101 (Fig. 1B) can be connected to spike $118_{(1)}$, and the infusion set can be connected to inlet/outlet port $116_{(2)}$ by means of conduit 125. Then, two or more medicaments can be mixed in infusion bag 101 by using pump 110 (such as a syringe), and after that, administered into the patient's body.

For example, administering of two medicaments into the patient's body can be performed by the following steps:

- Connecting infusion bag 101 to spike $118_{(1)}$ of the first stopcock $115_{(1)}$, when stem $123_{(1)}$ of said stopcock $115_{(1)}$ is in the first fluid guiding state, allowing fluid delivery between syringe $110_{(1)}$ and vial $105_{(1)}$;
- Connecting the second stopcock $115_{(2)}$ to inlet/outlet port $116_{(2)}$ of said first stopcock $115_{(1)}$, when stem $123_{(2)}$ of said second stopcock $115_{(2)}$ is also in the first fluid guiding state;
- Connecting an infusion set to inlet/outlet port $116_{(2)}$ of the second stopcock $115_{(2)}$;
- Connecting vials $105_{(1)}$ and $105_{(2)}$ to stopcocks $115_{(1)}$ and $105_{(2)}$, respectively, by means of vial holding members $119_{(1)}$ and $119_{(2)}$;
- Rotating stems $123_{(1)}$ and $123_{(2)}$ of stopcocks $115_{(1)}$ and $115_{(2)}$, respectively, to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 to the infusion set through conduit 125 (Fig. 1B);
- Opening a dripping portion of the infusion set in order to fill a half of said dripping portion with the fluid from infusion bag 101;

- Removing air from the infusion set by opening (and then closing) a roller clamp (not shown) within said infusion set;
- Rotating stem $123_{(1)}$ of stopcock $115_{(1)}$ to the first fluid guiding state;
- Pumping the medicament from vial $105_{(1)}$ to syringe $110_{(1)}$ by means of a piston $111_{(1)}$;
- Rotating stem $123_{(1)}$ of stopcock $115_{(1)}$ to the second fluid guiding state, allowing the fluid to flow from syringe $110_{(1)}$ to infusion bag 101;
- Pumping said medicament from syringe $110_{(1)}$ to infusion bag 101;
- Pumping the fluid from infusion bag 101 to syringe $110_{(1)}$ for cleaning said syringe $110_{(1)}$ from said medicament, and then pumping said fluid back to said infusion bag 101 (this step can be performed more than once);
- Rotating stem $123_{(1)}$ of stopcock $115_{(1)}$ to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 toward the infusion set;
- Pumping the medicament from vial $105_{(2)}$ to syringe $110_{(2)}$ by means of a piston $111_{(2)}$;
- Rotating stem $123_{(2)}$ of stopcock $115_{(2)}$ to the second fluid guiding state, allowing the fluid to flow from syringe $110_{(2)}$ to infusion bag 101;
- Pumping said medicament from syringe $110_{(2)}$ to infusion bag 101;
- Pumping the fluid from infusion bag 101 to syringe $110_{(2)}$ for cleaning said syringe $110_{(2)}$ from said medicament, and then pumping said fluid back to said infusion bag 101; and
- Rotating stem $123_{(2)}$ of stopcock $115_{(2)}$ to the third fluid guiding state, allowing the fluid to flow from infusion bag 101 to the infusion set.

It should be noted that according to a preferred embodiment of the present invention, vials $110_{(1)}$ and/or $110_{(2)}$ can comprise one or more of the

following: medicaments; various types of vitamins; various types of food additives; and the like.

Fig. 6 is a schematic illustration of connecting two vials $105_{(1)}$ and $105_{(2)}$ to a stopcock 115, according to another preferred embodiment of the present invention. Either vial $105_{(1)}$ or $105_{(2)}$ can be used instead of infusion bag 101 (Fig. 1B), enabling the mixing of medicaments and/or the diluting of powder medicaments. For example, it is supposed that vial $105_{(1)}$ is filled with medicament $107_{(1)}$ and vial $105_{(2)}$ is filled with another medicament $107_{(2)}$. Then, medicament $107_{(1)}$ can be pumped by means of syringe 110 from vial $105_{(1)}$ to vial $105_{(2)}$ for mixing it with medicament $107_{(2)}$. After that, the mixed solution of both medicaments $107_{(1)}$ and $107_{(2)}$ can be administered into the patient's body through a conduit 125 (Fig. 1B) connected to inlet/outlet port 116. For another example, vial $105_{(1)}$ can be filled with powder medicaments $107_{(1)}$ and vial $105_{(2)}$ can be filled with infusion solution $107_{(2)}$. Powder medicaments $107_{(1)}$ can be pumped by means of syringe 110 from vial $105_{(1)}$ to vial $105_{(2)}$ for diluting it with said infusion solution $107_{(2)}$. After that, the diluted medicament is administered into the patient's body through a conduit 125.

It should be noted that according to a preferred embodiment of the present invention, location of each inlet/outlet port 116, 117, spike 118 and vial-holding member 119 on stopcock 115 can vary. Thus, spike 118 can be provided, for example, instead of inlet/outlet port 116, and vice-versa; or inlet/outlet port 117 can be provided, for example, instead of vial-holding member 119 and vice-versa. In addition, according to a preferred embodiment of the present invention, each of inlet/outlet ports 116, 117, or spike 118 can be connected to any one of the following: (a) an infusion bag; (b) a syringe (pump); (c) a conduit (further connected to a conventional infusion set for administering medicaments into the patient's body); and the like.

Further, according to another preferred embodiment of the present invention, vial $105_{(1)}$ and/or vial $105_{(2)}$ can be replaced upon the need (e.g., if empty) without replacing their corresponding vial-holding members $119_{(1)}$ and $119_{(2)}$.

Figs. 7A and 7B are bottom views of stem 123, according to another preferred embodiment of the present invention. Channel 232 of said stem 123 comprises a protrusion 233 to be inserted into a slot of a connector (not shown) that is further connected to a computer for automatically rotating said stem 123 within stopcock 115 (Fig. 1B). Thus, a doctor (or nurse) is not required to manually set the desirable fluid guiding state of stopcock 115. The doctor enters into the computer the exact location of the stopcock in the space (for example, the stopcock is located vertically, and spike 118 is on the top). After that, the doctor automatically controls rotation of stem 123 by means of a computer (rotating stem 123 from its one fluid guiding state to another), enabling him to administer one or more medicaments into the patient's body. The automatic control of stem 123 position can be especially useful when administering more than one medicament, as shown on Fig. 5.

According to a preferred embodiment of the present invention, stopcock 115 can have only one possible location in the space (e.g., vertical position with spike 118 is on the top). In addition, the connector can be connected to protrusion 233 by one way only.

While some embodiments of the invention have been described by way of illustration, it will be apparent that the invention can be put into practice with many modifications, variations and adaptations, and with the use of numerous equivalents or alternative solutions that are within the scope of persons skilled in the art, without departing from the spirit of the invention or exceeding the scope of the claims.

Claims

1. A fluid guiding device, comprising an outer body provided with four openings, and an inner body provided with a first conduit, from which an additional conduit branches, said first conduit lying essentially along the diameter of said outer body, wherein said openings provided in said outer body correspond to the ends of said first and said additional conduits, and wherein the chord between the ends of said first and additional conduits is essentially equal to the chord between two corresponding openings of said outer body, and wherein one opening has an axis that makes an angle of about 90 degrees with the axes of each of the two openings adjacent to it.

2. A stopcock for guiding a fluid, comprising:
   a. a fluid guiding device, comprising:
      a.1. an outer body having four openings;
      a.2. an inner body provided with a first conduit, from which an additional conduit branches, said first conduit lying essentially along the diameter of said outer body,

   wherein said openings provided in said outer body correspond to the ends of said first and said additional conduits, and wherein the chord between the ends of said first and additional conduits is essentially equal to the chord between two corresponding openings of said outer body, and wherein one opening has an axis that makes an angle of about 90 degrees with the axes of each of the two openings adjacent to it;
   b. two inlet/outlet ports, independently connected to the first and second openings of said outer body; and
   c. a spike or a vial holding member that are independently connected to the third and fourth openings of said outer body.

3. A stopcock according to claim 2, wherein the spike is connected to a fluid-dispensing reservoir.

4. A stopcock according to claim 2, wherein the inlet/outlet port is connected to a pump.

5. A stopcock according to claim 2, wherein the inlet/outlet port is connected to a conduit.

6. A stopcock according to claim 4, wherein the pump is a syringe.

7. A stopcock according to claim 2, wherein the vial holding member is connected to a vial.

8. A stopcock according to claim 7, wherein the vial is filled with the fluid or powder, comprising:
   a. a medicament;
   b. one or more types of vitamins; and
   c. one or more types of food additives.

9. A stopcock according to claim 2, wherein the outer body further comprises a protrusion for restricting rotation of the inner body within said outer body.

10. A stopcock according to claim 2, wherein the inner body further comprises a protrusion for restricting its rotation within the outer body.

11. A stopcock according to claims 3, 4 and 7, wherein the pump pumps the fluid from the vial to the fluid-dispensing reservoir and/or from said fluid-dispensing reservoir to said vial.

12. A stopcock according to claims 3 and 5, wherein the fluid is dispensed from the fluid-dispensing reservoir to the conduit.

13. A stopcock according to claim 2, wherein said stopcock allows the fluid to flow from one inlet/outlet port to another.

14. A stopcock according to claim 2, wherein said stopcock allows the fluid to flow from the inlet/outlet port to the vial holding member and/or from said vial holding member to said inlet/outlet port.

15. A stopcock according to claim 2, wherein said stopcock allows the fluid to flow from the spike to the inlet/outlet port and/or from said inlet/outlet port to said spike.

16. A stopcock according to claim 2, wherein said stopcock allows the fluid flow from the spike to the vial holding member and/or from said vial holding member to said spike.

17. A stopcock according to claim 2, further connected to one or more additional stopcocks for administering one or more medicaments, or one or more types of vitamins, or one or more types of food additives, or a combination thereof.

18. A stopcock according to claim 2, wherein the inner body is connected by means of a connector to a computer for controlling its rotation within the outer body by means of said computer.

19. A fluid guiding device according to claim 1, substantially as described and illustrated.

20. A stopcock according to claim 2, substantially as described and illustrated.

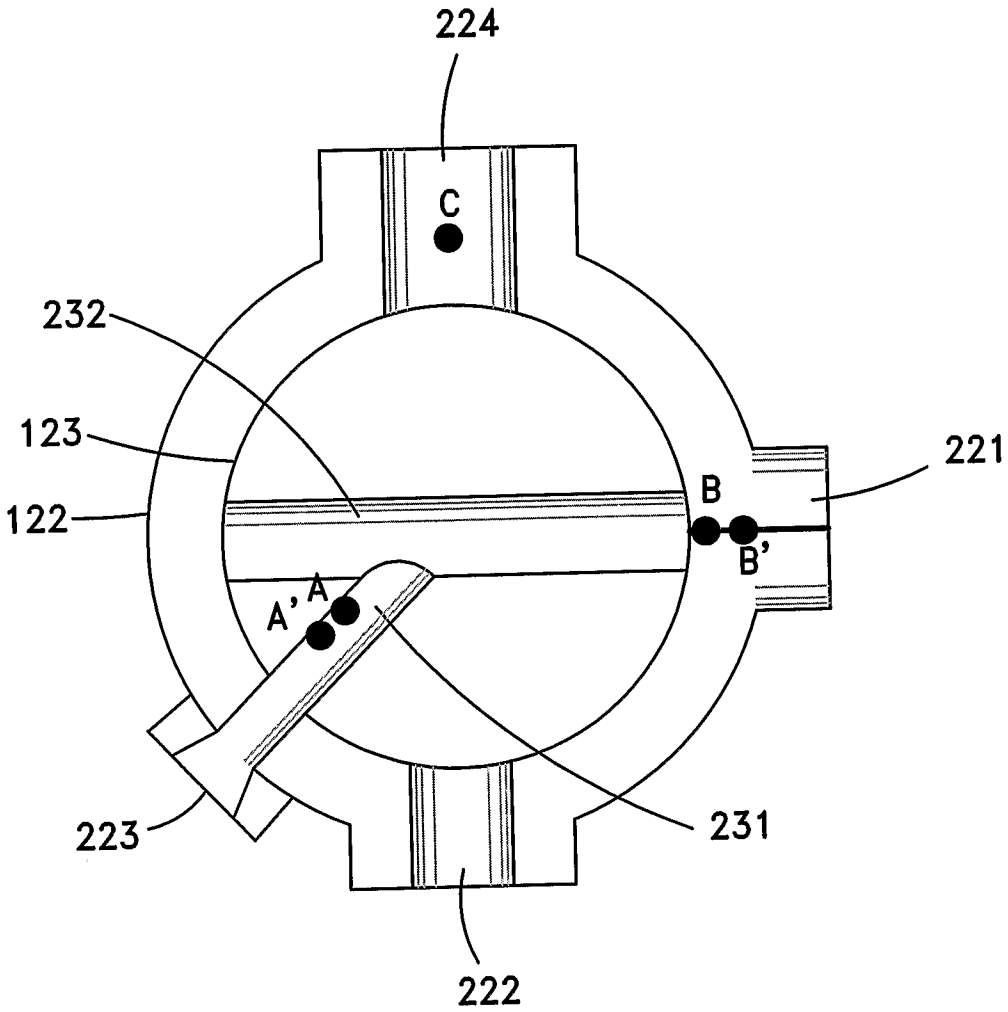

Fig. 1A

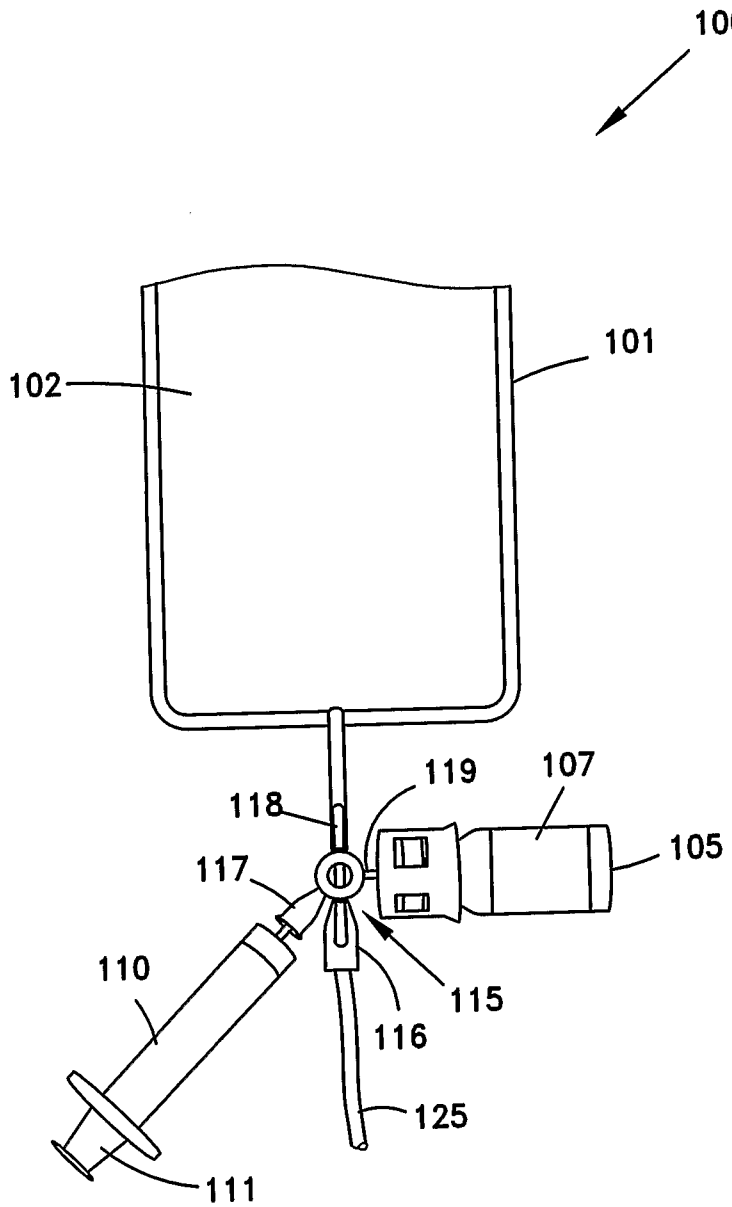

Fig. 1B

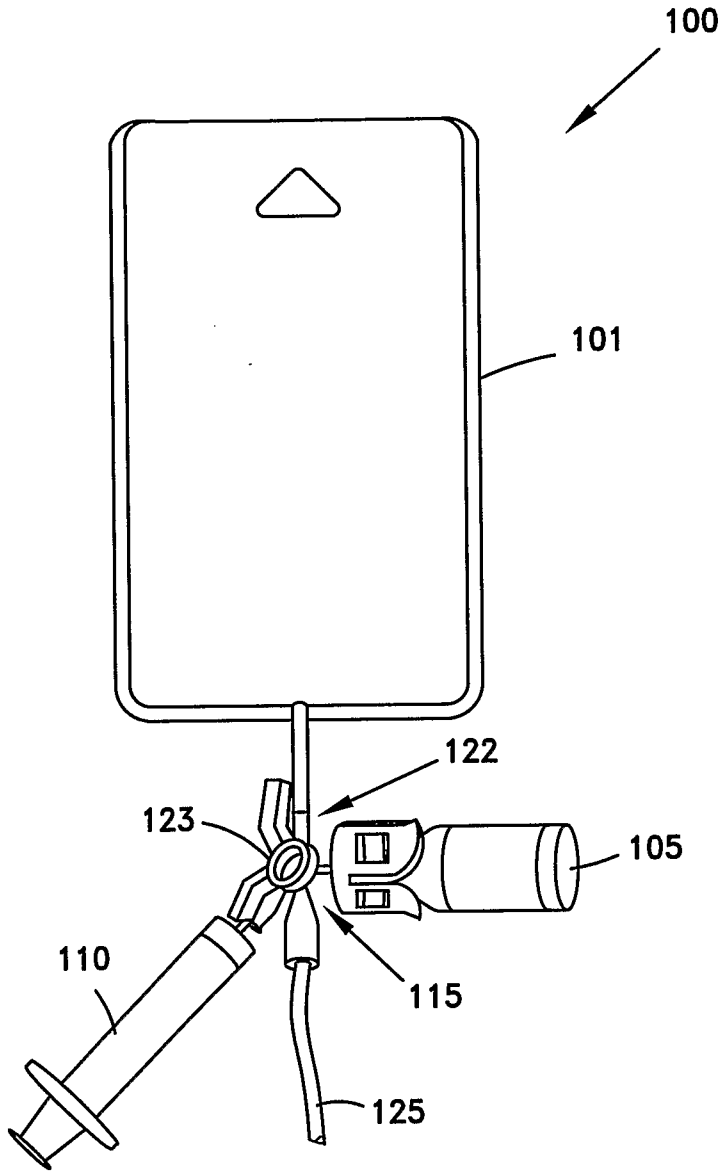

Fig. 1C

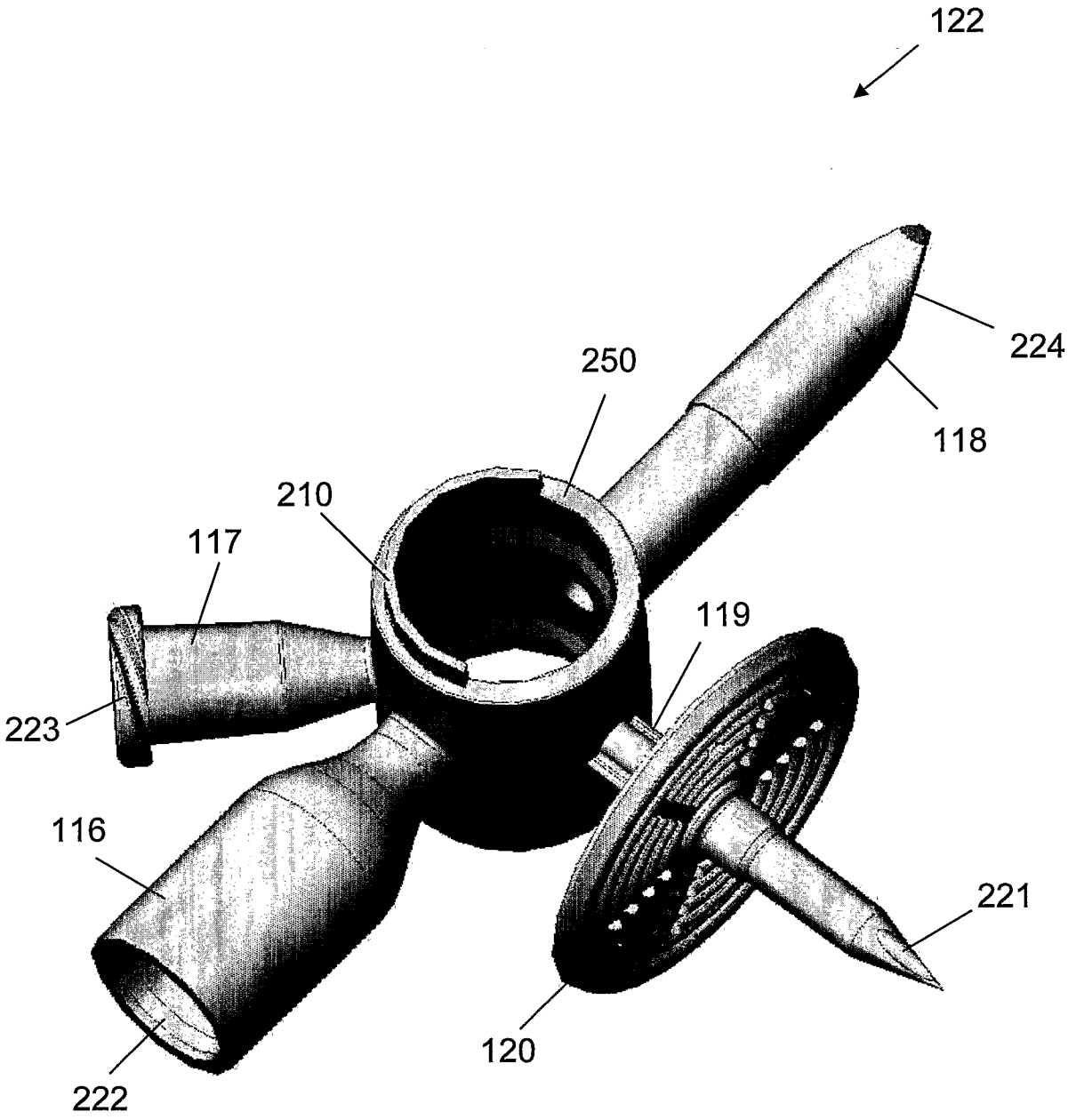

Fig. 2A

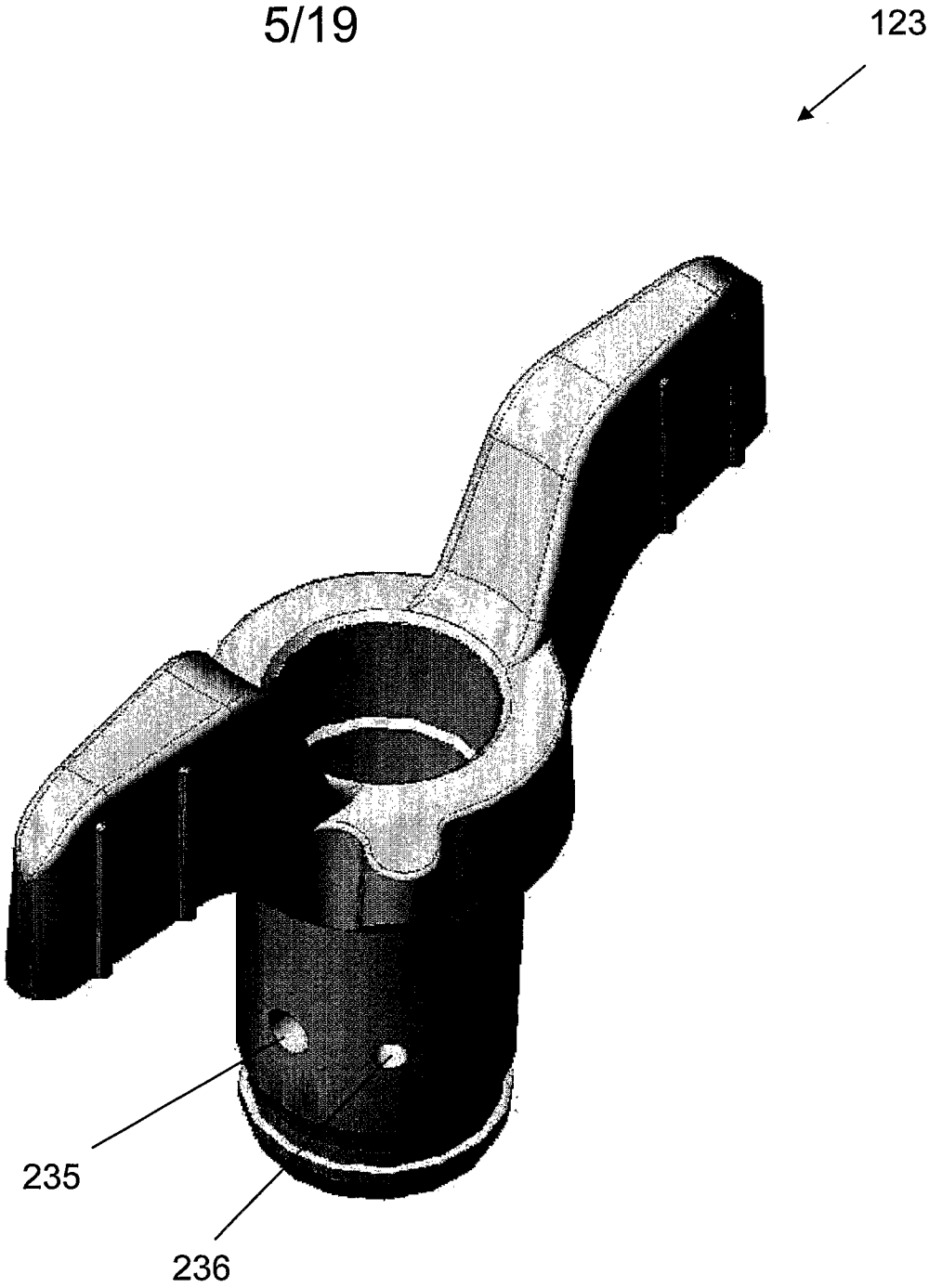

Fig. 2B

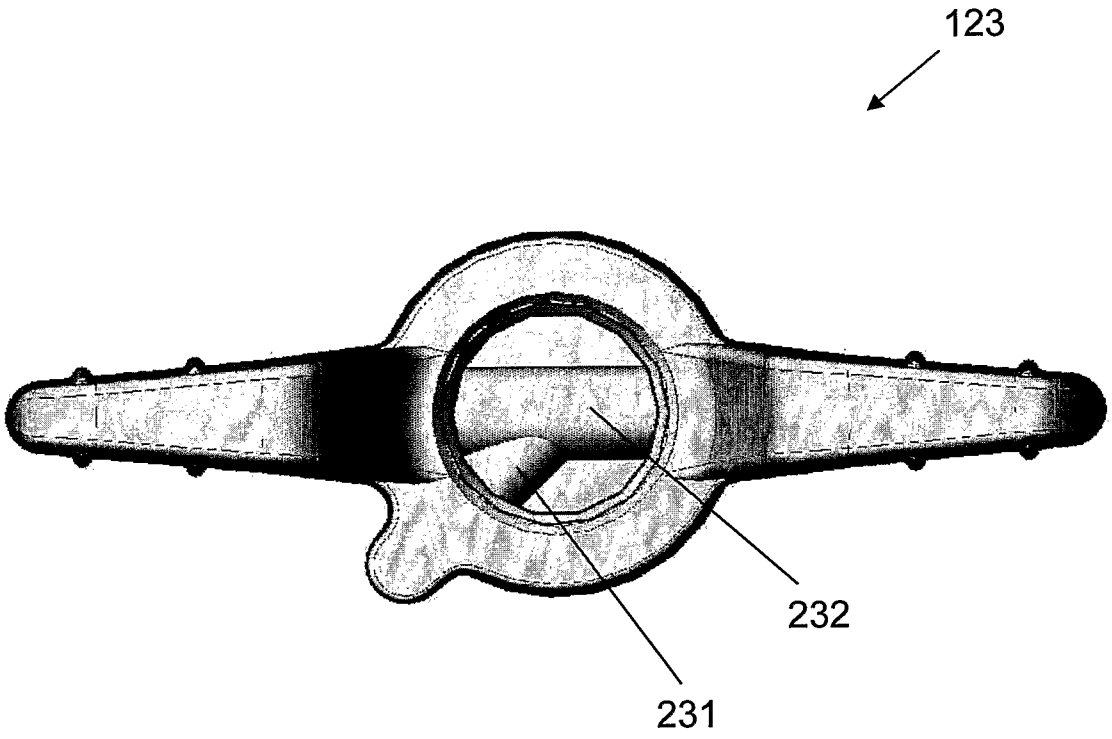

Fig. 2C

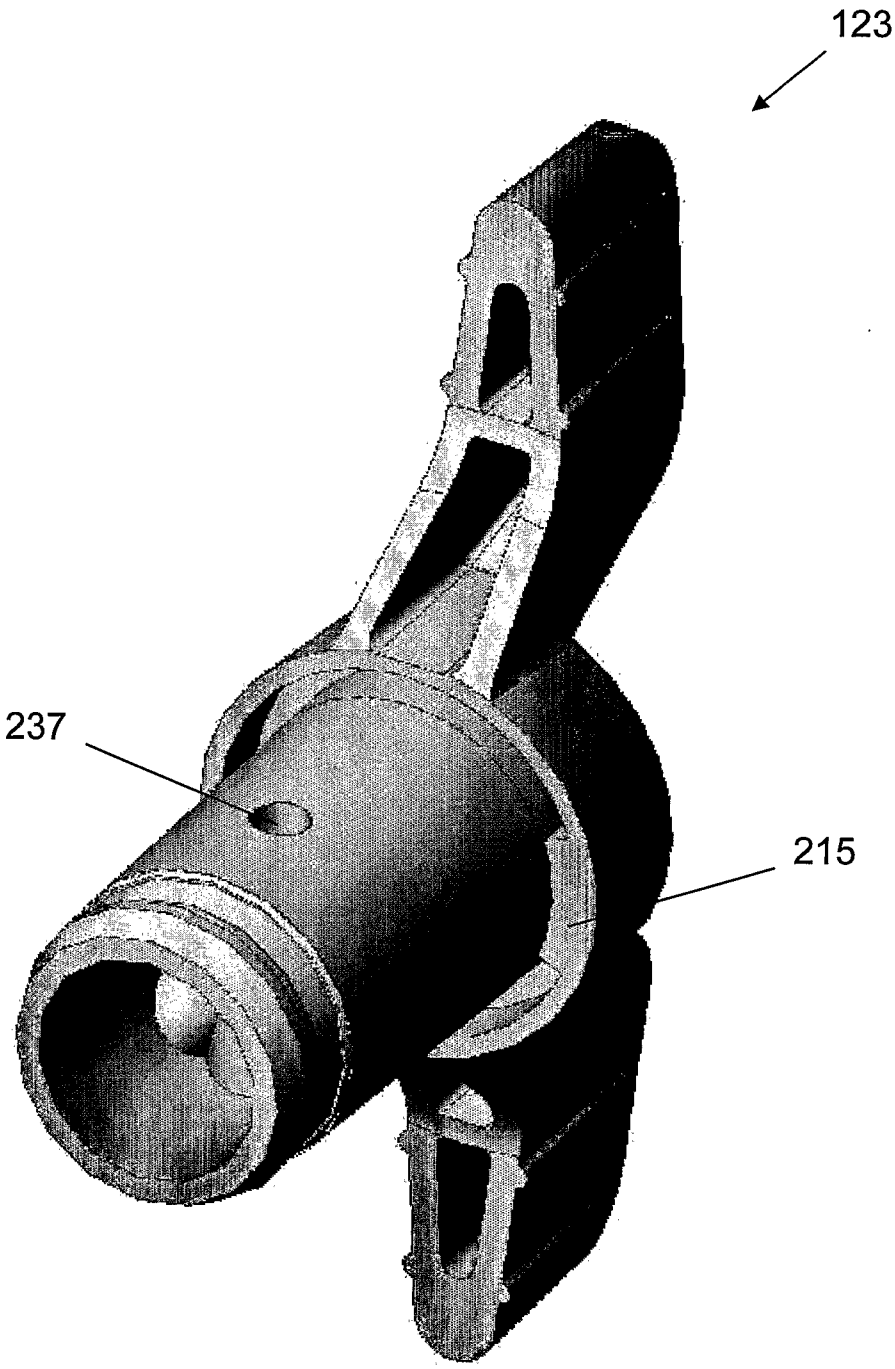

Fig. 2D

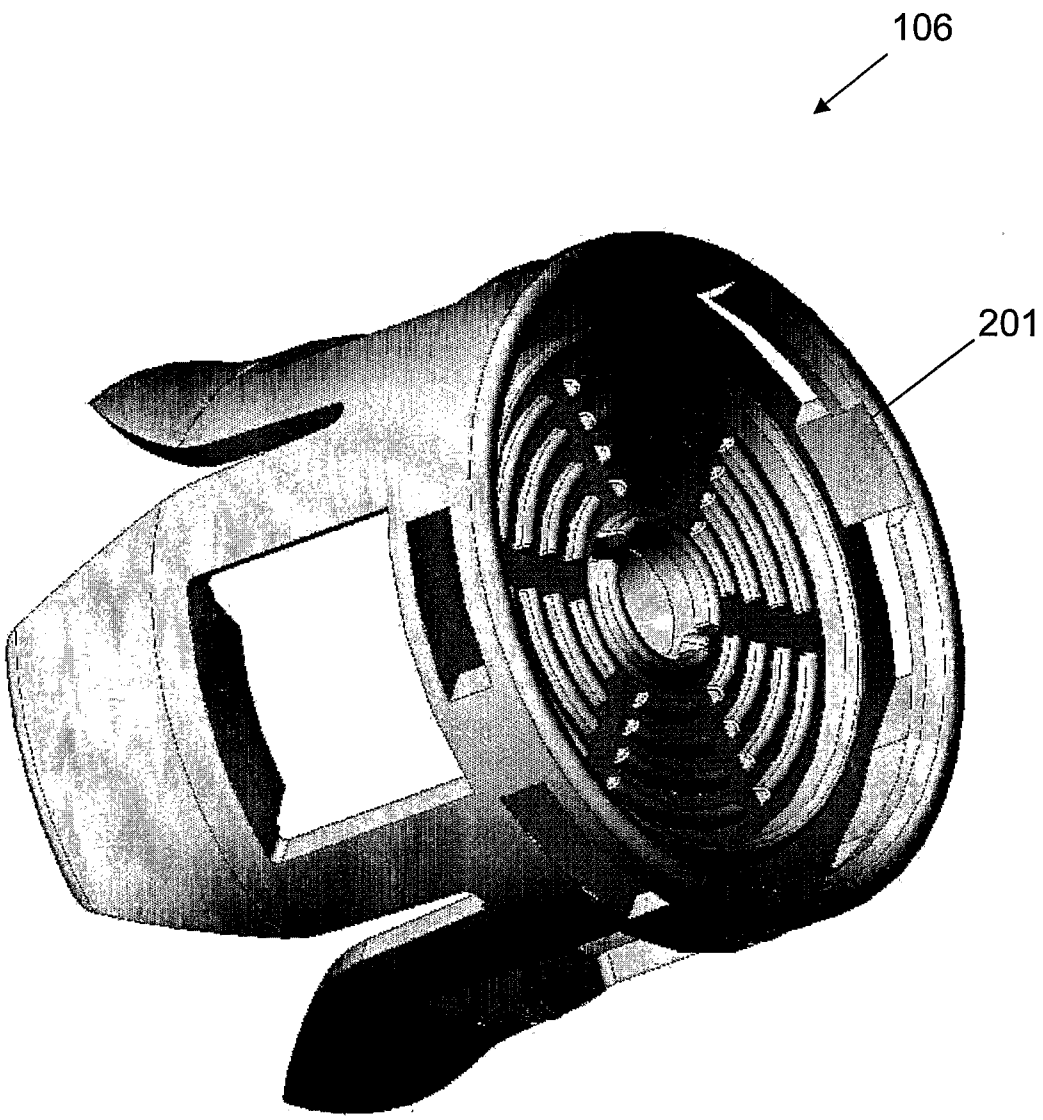

Fig. 2E

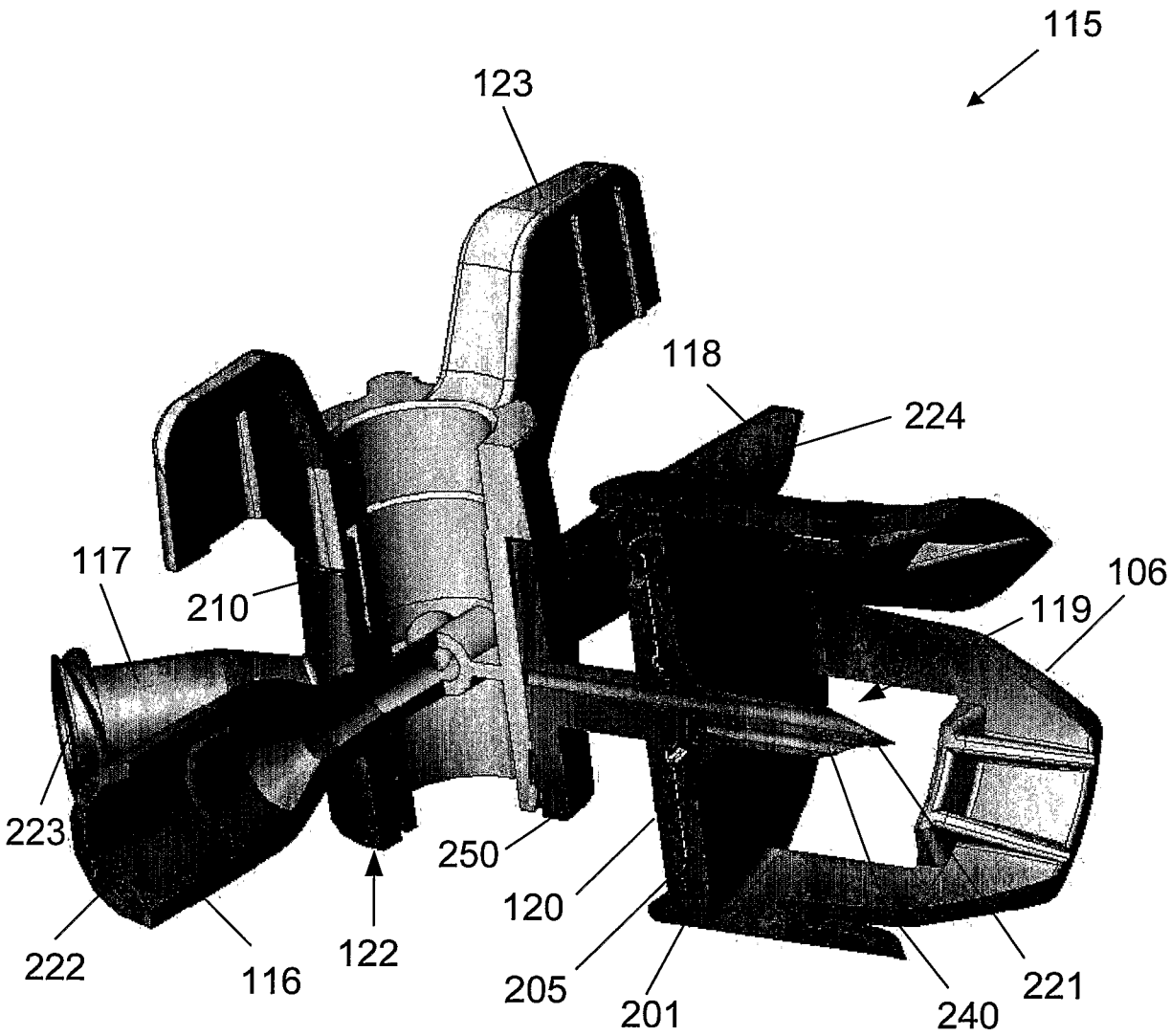
115
123
118
224
117
210
106
119
223
250
120
222
116
122
205
201
240
221

Fig. 2F

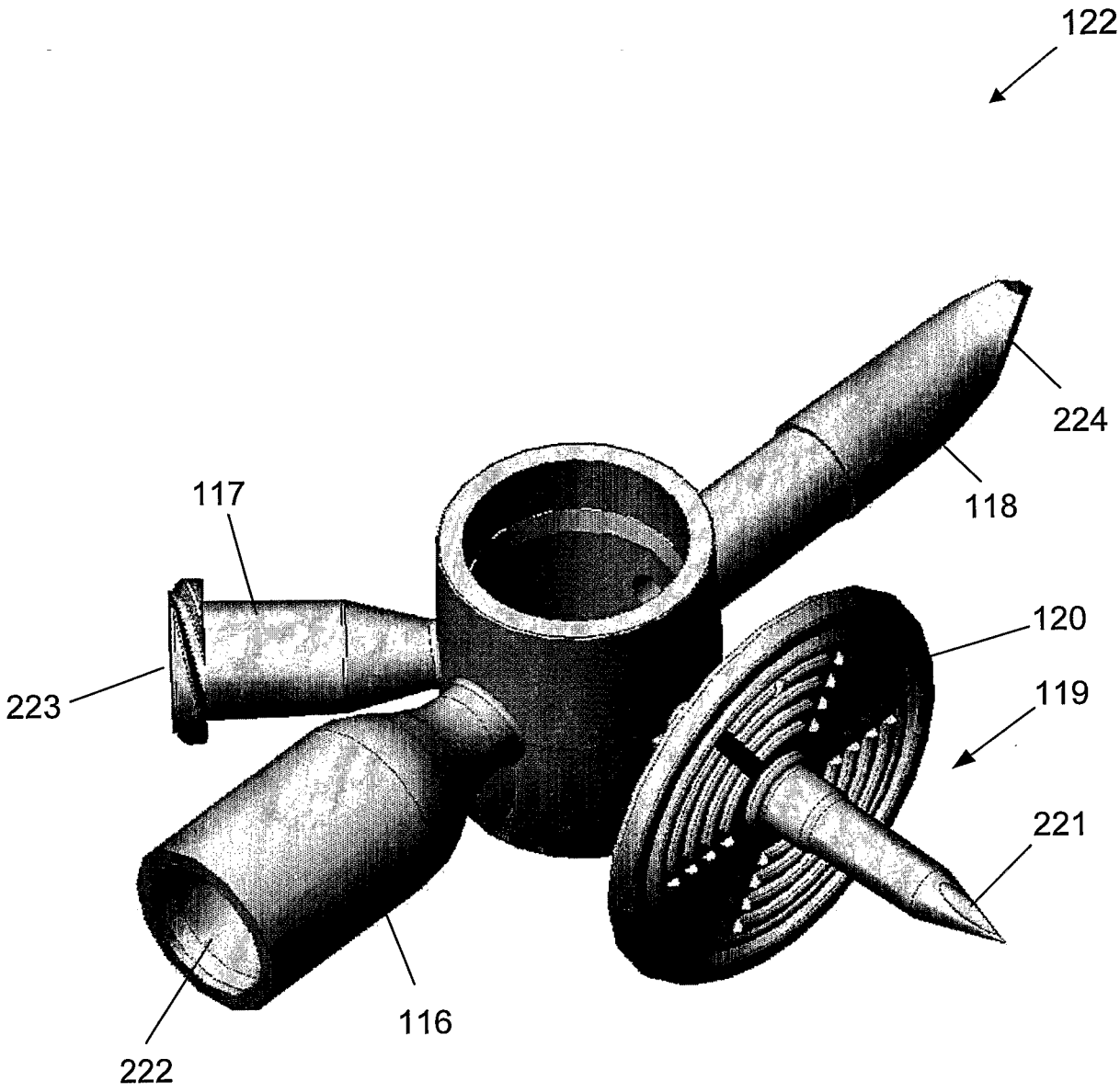

Fig. 2G

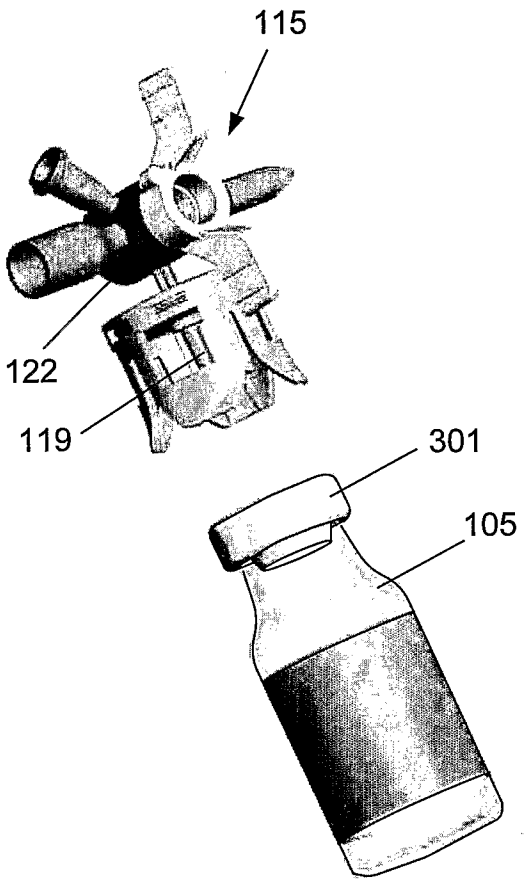

Fig. 3A

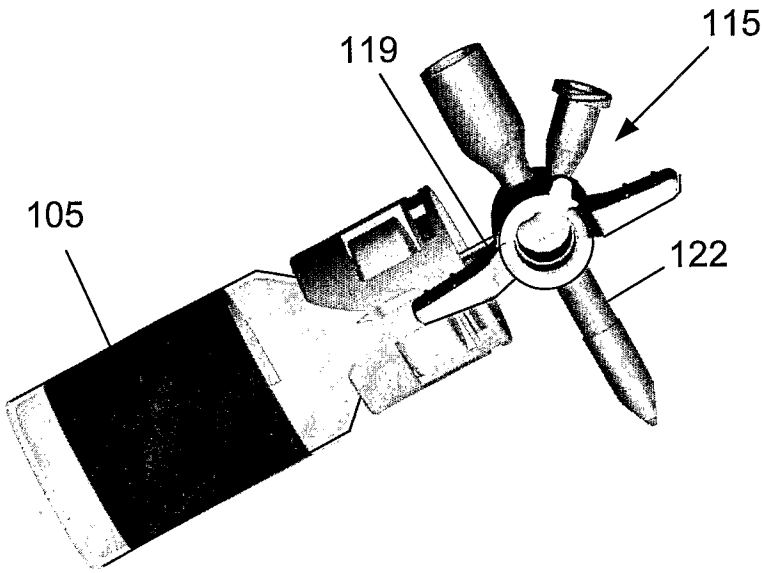

Fig. 3B

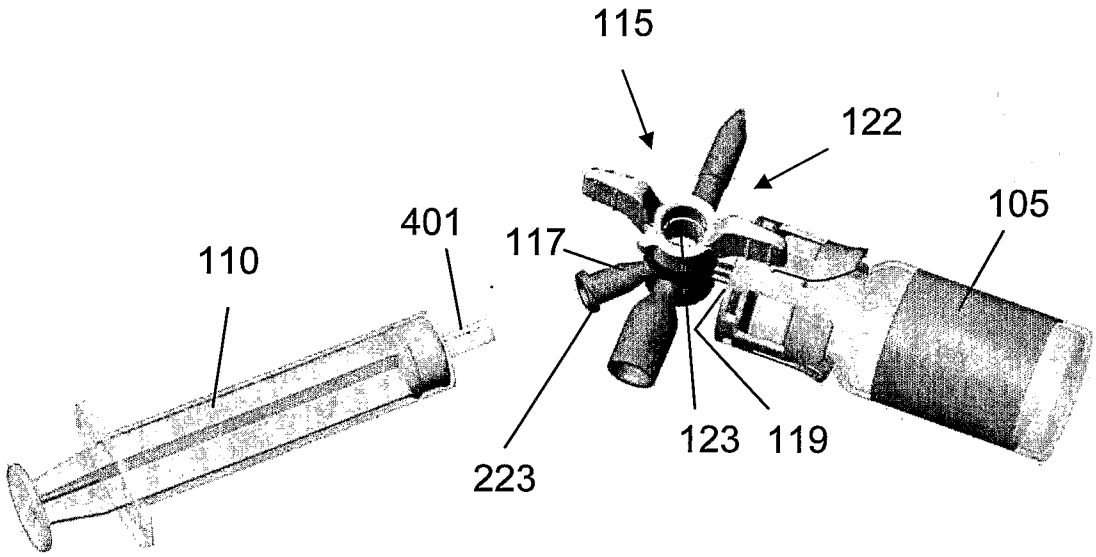

Fig. 4A

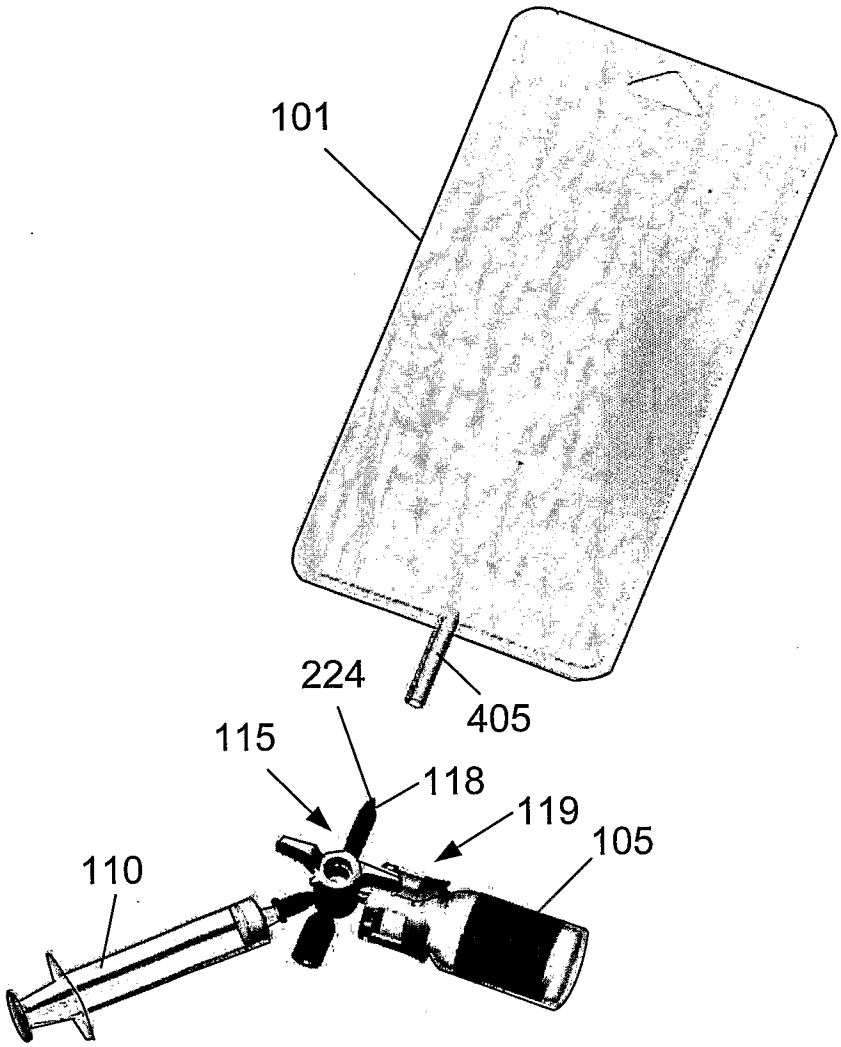

Fig. 4B

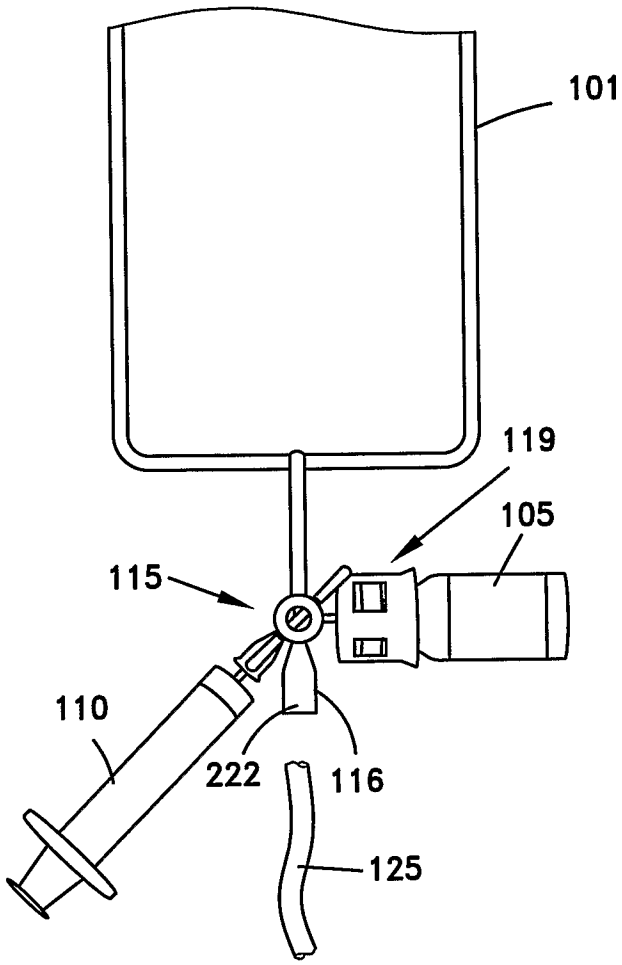

Fig. 4C

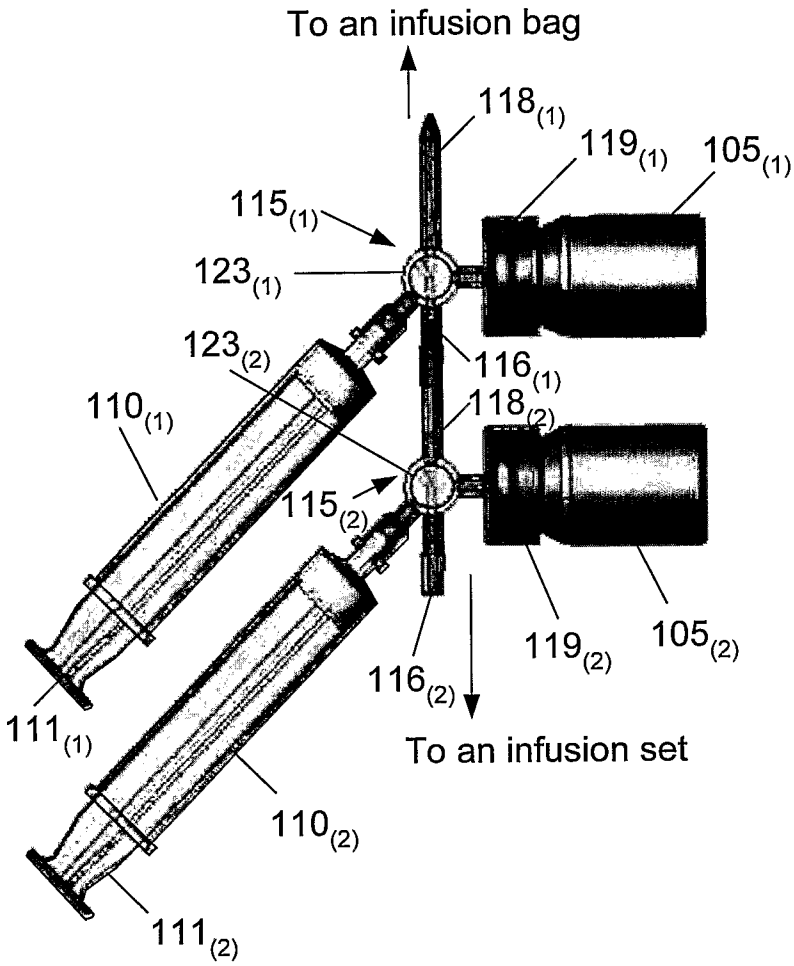
To an infusion bag
118(1)
119(1)
105(1)
115(1)
123(1)
123(2)
116(1)
110(1)
118(2)
115(2)
119(2)
105(2)
116(2)
111(1)
To an infusion set
110(2)
111(2)

Fig. 5

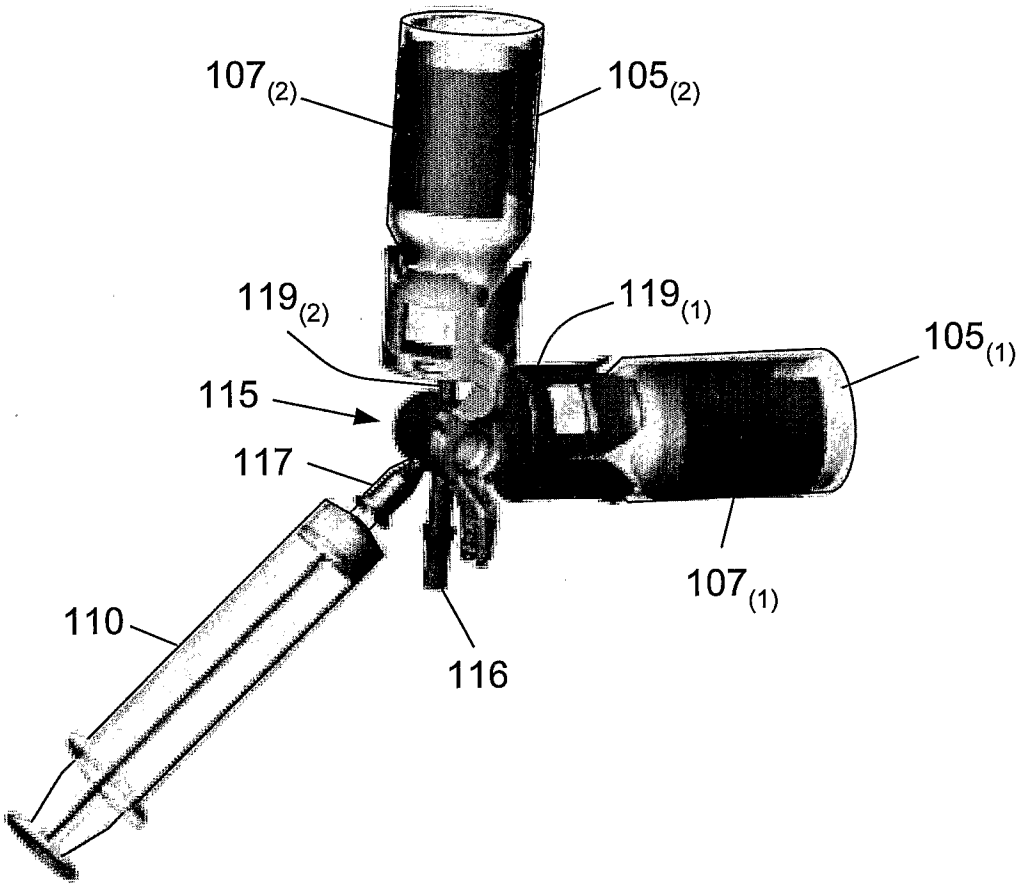

Fig. 6

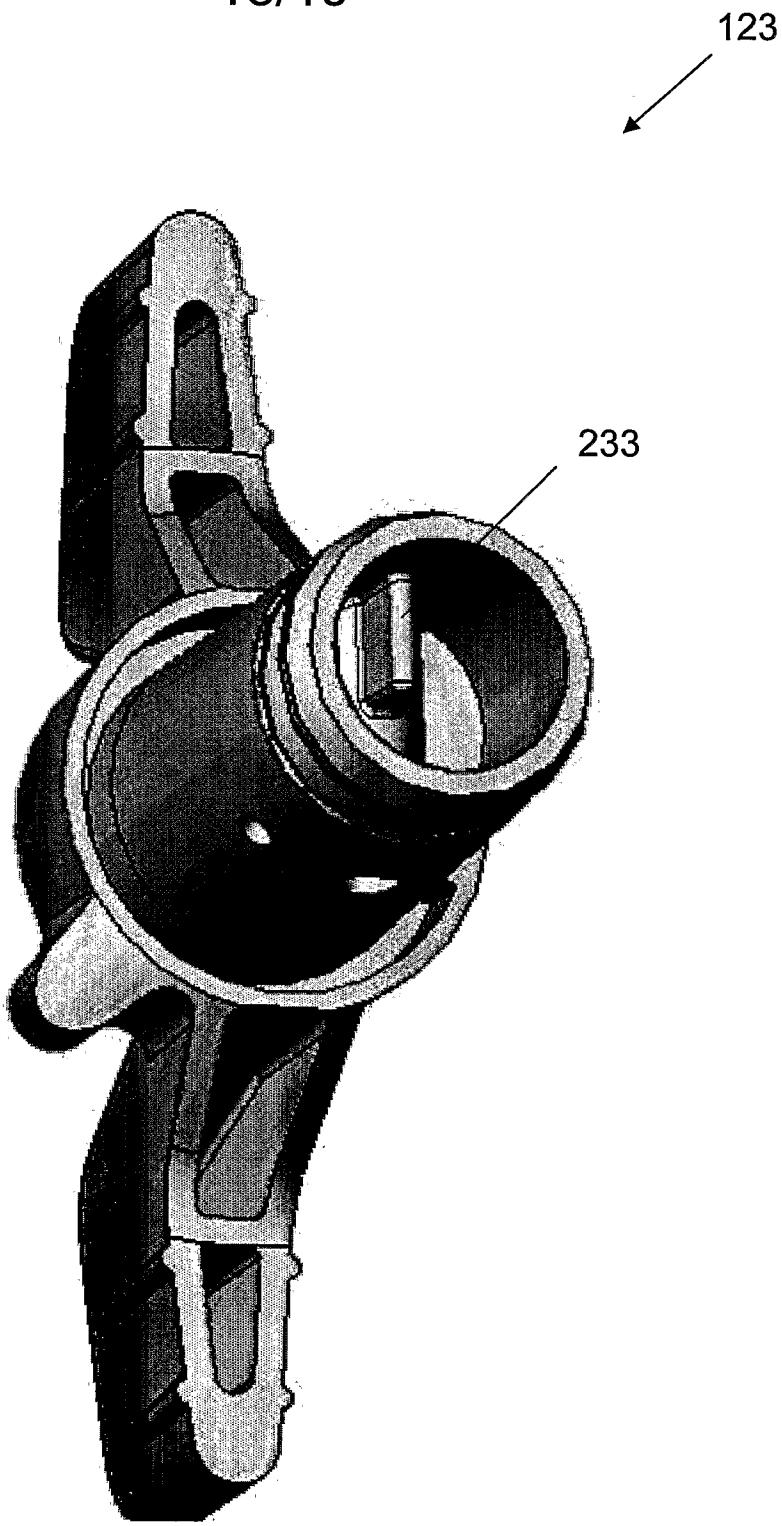

Fig. 7A

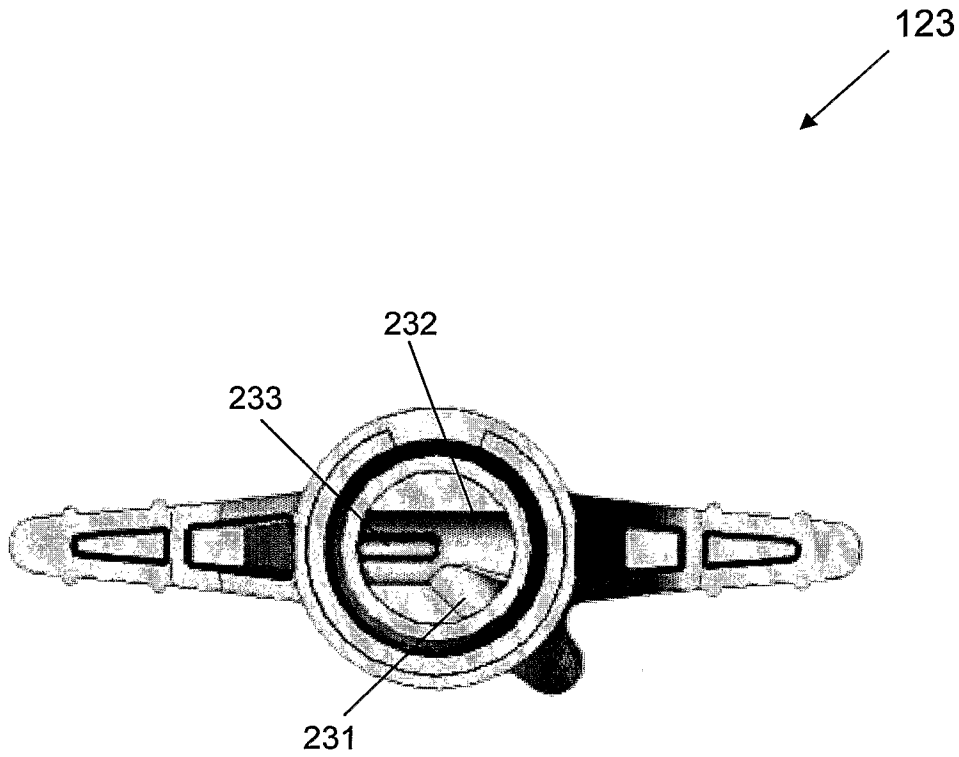

Fig. 7B