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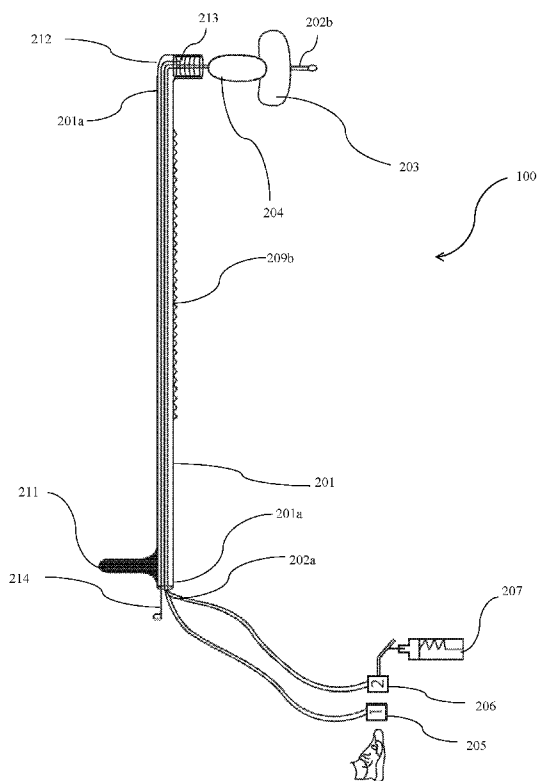


FIG. 4A

(57) Abstract: A medical apparatus (100) for dilating a narrowed or blocked opening (A) of a subject, the medical apparatus (100) comprising: a guiding tube (201); a dilator system tube (202) guidable inside the guiding tube (201). The dilator system tube (202) includes a near end (202a) and a far end (202b), said far end (202b) is configured with a dilating element (204) and a retention element (203), configured adjacent to the dilating element (204), wherein the retention element (203) is expanded inside the subject to identify the cavity (C). The dilator system tube (202) is retractable for anchoring the dilator system tube (202) by the expanded retention element (203) inside the cavity (C), to position the dilating element (204) at the narrowed or blocked opening (A) for dilating the narrowed or blocked opening (A) upon expanding the dilating element (204).



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“A MEDICAL APPARATUS, SYSTEM AND METHOD FOR DILATING
NARROWED OR BLOCKED OPENINGS”

TECHNICAL FIELD

The present disclosure in general relates to a medical apparatus. Particularly but
5 not exclusively, to an apparatus, system and method for identifying, positioning and
dilating a narrowed or blocked paranasal sinus opening of a human being.

BACKGROUND OF DISCLOSURE

An adult human skull is divided into two parts having two different bones. One is
the the neurocranium and the other is the viscerocranium. The neurocranium (or braincase)
10 is a protective cranial vault that surrounds the brain and brainstem. The viscerocranium
(also splanchnocranium or facial skeleton) is formed by the bones supporting the face. The
skull is a predominant part of the human body which houses the brain and gives an
identity to the human body by virtue of a face.

Paranasal sinuses are bony cavities located within the skull. They are present
15 beneath the cheek bones and above the eye sockets. The paranasal sinus cavities consist of
frontal sinuses, ethmoidal sinuses, sphenoidal sinuses and maxillary sinuses. The main
function of the paranasal sinuses is to aid a natural flow of mucous in order to keep the
nasal cavity and sinuses clean.

Many a times, paranasal sinuses are prone to get infected because of the failure to
20 drain out the mucous naturally. The main reason for failure in draining out the mucous is
due to the blocked ostium or the paranasal openings. Also another factor for the blocked
ostium is the edematous muscosal linings which are prone to inflate due to inflammatory
conditions such as mucus deposition and fat deposition. Due to these factors, the ostium or
the paranasal openings tend to get blocked over a period of time. As an effect of the
25 inflammatory process the patient develops fever, headaches, facial pain, eye pain and tooth
pain along with production of yellowish to thick brown mucus. This inflammation of the
paranasal sinuses is called as sinusitis condition.

Sinusitis in a patient can be generally treated by instilling consumption of drugs
such as anti-biotics or pain killers. However, if the inflammatory process persists the
30 ostium gets permanently blocked and leads to recurrent or chronic sinusitis.

In case of recurrent or chronic sinusitis, the only way forward is to dilate the blocked ostium and clear the mucosa by performing a sinus surgery. Conventional procedures involve functional endoscopic sinus surgery which utilizes a rigid endoscope and specialized tools which aid in removing the mucosa around the sinus openings and
5 also used to widen the sinus opening. Some of the above processes or surgeries result in removal of certain bony structures including the ethmoidal bulla. Uncinate process is one such process which removes part of the bony structures. Also, other side effects of such surgical processes include impaired sinuses and excess removal of the mucosa leading to excessive aeration, dryness, crusting of mucous and secretions causing infections.

10 In light of the above, there is a need to develop a medical apparatus for widening or dilating the sinus opening at an early stage of detection of the chronic sinusitis such that, it is economical and avoids the above mentioned disadvantages.

SUMMARY OF THE DISCLOSURE

The shortcomings of the prior art are overcome and additional advantages are
15 provided through the provision as claimed in the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

In an embodiment of the present disclosure, a medical apparatus for dilating a
20 narrowed or blocked opening of a subject is disclosed. The medical apparatus comprising: a guiding tube, a dilator system tube guidable inside the guiding tube, wherein the dilator system tube includes a near end and a far end, said far end is configured with a dilating element and a retention element, configured adjacent to the dilating element. The retention
25 element is expanded inside the subject to identify the cavity, and the dilator system tube is retractable for anchoring the dilator system tube by the expanded retention element inside the cavity, to position the dilating element at the narrowed or blocked opening for dilating the narrowed or blocked opening upon expanding the dilating element.

In an embodiment of the present disclosure, the dilating element is selected from a
30 group comprising at least one of a balloon, a wire mesh, a radially expanding mechanical diaphragm in cylindrical form.

In an embodiment of the present disclosure, the retention element is a balloon.

In an embodiment of the present disclosure, diameter of the retention element is greater than diameter of the dilating element when the dilating element and the retention
5 element are fully expanded.

In an embodiment of the present disclosure, the guiding tube comprises an arcuate end at a far end of the guiding tube to facilitate guiding of the dilator system tube into the narrowed or blocked opening.
10

In an embodiment of the present disclosure, an arcuate tube element inside the guiding tube at the arcuate end which upon actuation by the user protrudes outwardly to configure an arcuate extended guide way for the dilator system tube.

In an embodiment of the present disclosure, the arcuate tube element is connected
15 to a wire for providing extension and retraction movement of the arcuate tube element at the arcuate end of the guiding tube.

In an embodiment of the present disclosure, the dilator system tube is configured
20 with a first hollow tube and a second hollow tube for inflating the balloons using at least one inflation device.

In an embodiment of the present disclosure, the dilator system tube is configured with a central wire for expanding and contracting the wire mesh in cylindrical form by
25 pulling and pushing the central wire respectively.

In an embodiment of the present disclosure, the subject comprises a cavity with an opening.

In an embodiment of the present disclosure, the subject is selected from a group
30 comprising of paranasal sinus, eustachian tube, lacrymal duct, stoma of a human being or of an animal.

In an embodiment of the present disclosure, a medical system for dilating a narrowed or blocked opening of a subject is disclosed. The medical system comprising: an endoscope having a near end and a far end, wherein the endoscope is used for viewing the
35 narrowed or blocked opening of the subject; a guiding tube connectable to the endoscope;

a dilator system tube guidable inside the guiding tube, wherein the dilator system tube includes a near end and a far end, said far end is configured with a dilating element and a retention element, configured adjacent to the dilating element. The retention element is expanded inside the subject to identify the cavity, and the dilator system tube is retractable
5 for anchoring the dilator system tube by the expanded retention element inside the cavity, to position the dilating element at the narrowed or blocked opening for dilating the narrowed or blocked opening upon expanding the dilating element.

In an embodiment of the present disclosure, a sheath in cylindrical shape is used
10 for attaching the endoscope and the guiding tube.

In an embodiment of the present disclosure, a slider mechanism having a second guide rail provided on the guiding tube and a first guide rail provided on the sheath configured around the endoscope for sliding the guiding tube over the endoscope towards
15 the narrowed or blocked opening.

In an embodiment of the present disclosure, a near end of the guiding tube is provided with a handle for actuating the guiding tube linearly over the slider mechanism.

In an embodiment of the present disclosure, a method of dilating a narrowed or blocked opening of a subject using the medical apparatus is disclosed. The method comprising acts of: introducing the guiding tube comprising the dilator system tube into the subject till the guiding tube is in line with the narrowed or blocked opening. Actuating the arcuate tube element outwardly till it faces the narrow or blocked opening. Progressing
20 the dilator system tube into the narrowed or blocked opening till the retention element is inside the cavity. Expanding the retention element of the dilator system tube positioned inside the cavity for confirming presence of the retention element inside the cavity. Retracting the dilator system tube for anchoring the retention element inside the cavity and positioning the dilating element at the opening. Expanding the dilating element for dilating
25 the narrowed or blocked opening.
30

In an embodiment of the present disclosure, the balloon is inflated using an inflation device and the wire mesh is expanded and contracted by pulling or pushing a central wire.

In an embodiment of the present disclosure, the medical apparatus is used in paranasal sinus opening dilation procedures such as maxillary sinus opening dilation, frontal sinus opening dilation, sphenoid sinus opening dilation or in any other sinus opening dilation procedures.

5

The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

10 **BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

The novel features and characteristic of the disclosure are set forth in the appended claims. The disclosure itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying figures. One or more embodiments are now described, by way of example
15 only, with reference to the accompanying figures wherein like reference numerals represent like elements and in which:

Fig. 1 illustrates front cut sectional view of paranasal sinus cavities located at various locations within the human skull according to an exemplary embodiment of the
20 present disclosure.

Fig. 2 illustrates maxillary sinus depicting the ostium or paranasal sinus opening according to an exemplary embodiment of the present disclosure.

Fig. 3 illustrates medical system according to an exemplary embodiment of the present disclosure.

25 Fig. 4 illustrates medical system according to an exemplary embodiment of the present disclosure.

Fig. 4A illustrates the medical apparatus according to an exemplary embodiment of the present disclosure.

30 Fig. 4B illustrates the medical apparatus according to an alternative embodiment of the present disclosure.

Fig. 5 illustrates the medical system in operation according to an exemplary embodiment of the present disclosure.

Fig. 6 illustrates an alternate embodiment of the medical system in operation according to an exemplary embodiment of the present disclosure.

5 Figs. 7A and 7B illustrates the guide tube with arcuate tube element according to exemplary embodiments of the present disclosure.

Fig. 8 illustrates sheath provided around the endoscope according to an exemplary embodiment of the present disclosure.

10 Fig. 9 illustrates top and sectional view of the sheath according to an exemplary embodiment of the present disclosure.

Fig. 10 illustrates a ball probe used in guiding the dilator system tube into the sinus cavity according to an exemplary embodiment of the present disclosure.

The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative
15 embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the disclosure described herein.

DETAILED DESCRIPTION OF THE DISCLOSURE

20 The foregoing has broadly outlined the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter which form the subject of the claims of the disclosure. It should be appreciated by those skilled in the art that the conception and specific embodiment
25 disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the disclosure as set forth in the appended claims. The novel features which are believed to be characteristic of the disclosure, both as to its organization and method of
30 operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is

to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are explicitly contemplated and make part of this disclosure.

Referring now to the drawings wherein the drawings are for the purpose of illustrating an exemplary embodiment of the disclosure only, and not for the purpose of limiting the same.

A medical apparatus for dilating a narrowed or blocked opening of a subject is disclosed, the medical apparatus comprises: a guiding tube, a dilator system tube guidable inside the guiding tube, wherein the dilator system tube includes a near end and a far end. Far end is configured with a dilating element and a retention element, which is configured adjacent to the dilating element. The retention element is expanded inside the subject to identify the cavity, and anchoring the dilator system tube by the expanded retention element inside the cavity, which positions the dilating element at the narrowed or blocked opening for dilating the narrowed or blocked opening upon expanding the dilating element.

Fig. 1 illustrates front sectional view of the human skull (S). Paranasal sinus cavities are located within the human skull (S) beneath the facial skin and bones as depicted. The paranasal sinus situated above the eye sockets are termed as frontal sinuses (FS). Ethmoidal sinus (ES) cavity lies just behind the nasal bone along the narrow path in-between the left and right eye sockets. The maxillary sinus (MS) is located on either side of the nasal cavity beneath the left and right cheek bones which form cavities or sacks. The paranasal sinuses have a common opening such as maxillary sinus opening (MSO) and the frontal sinus opening (FSO) such that air and other bodily fluids pass through the mouth or the nose and facilitates various breathing operations.

Fig. 2 illustrates left maxillary sinus (MS) which is located behind the left cheek bone of the human skull (S). The constructional feature of the maxillary sinus (MS) is such that the nasal septum (NS) divides the left maxillary sinus (MS) from the right maxillary sinus (not shown in figure). In a coronal section of the human skull (S), the observer can notice that the nasal septum (NS) runs from the teeth bone up to the forehead

bone in a vertical manner. The left and right maxillary sinus has only one opening (A) respectively through which the mucus is deposited and exited. Around the opening of the maxillary sinus (MS), there is provided with a middle turbinate (MT) which is a long, narrow and curled bone shelf that protrudes into the breathing passage of the nose. During the inflammatory process, the maxillary sinus opening (MSO) hereon referred to as sinus opening (A) gets blocked due to the inflammation process. During the inflammatory process, the edematous mucosal lining gets swollen and blocks the sinus opening (A). This leads to the mucus being blocked within the maxillary sinus (MS) herein referred to as sinus cavity (C). This non-flow and blockage of the mucus within the sinus cavity (C) leads to fever, headache, pain and other symptoms or in other words it is termed as sinusitis condition.

Fig. 3 illustrates a medical system (101) according to an exemplary embodiment of the present disclosure. The medical system (101) consists of a guiding tube (201) having a near end (201a) and a far end (201b). The near end (201a) of the guiding tube (201) consists of a handle (211). The handle (211) is fixed to the guiding tube (201) so as to facilitate the user to actuate the guiding tube (201) linearly over an endoscope (208). The far end (201b) of the guiding tube (201) is constructed to have an arcuate end (212). The arcuate end (212) of the guiding tube (201) houses an arcuate tube element (213). The arcuate tube element (213) is connected to a wire (214) which is operated by the user to extend and retract the arcuate tube element (213) out through the arcuate end (212) of the guiding tube (201). In one embodiment, the user pushes on the wire (214) to extend the arcuate tube element (213) out through the arcuate end (212) of the guiding tube (201). In one embodiment, the user pulls on the wire (214) to retract the arcuate tube element (213) into the arcuate end (212) of the guiding tube (201). In one embodiment, the guiding tube (201) is a translucent hollow arcuate tube element (213). The guiding tube (201) is provided with a second guide rail (209b) on the bottom portion such that, the second guide rail (209b) forms part of a slider mechanism (209) when assembled with a first guide rail (209a) provided on a sheath (210). The first guide rail (209a) and the second guide rail (209b) are part of the slider mechanism (209) and aid in linear movement of the guiding tube (201). The guiding tube (201) within its hollow tubular structure houses a dilator system tube (202) wherein, the dilator system tube (202) is inserted through the opening provided at the near end (201a) of the guiding tube (201) and exits out through the opening provided at the far end (201b) of the guiding tube (201). The dilator system tube

(202) consists of a near end (202a) and a far end (202b). The dilator system tube (202) at its far end (202b) consists of a dilating element (204) and a retention element (203) which is provided adjacent to each other. In one embodiment, the dilator system tube (202) at its near end (202a) divides into of a first hollow tube (205) and a second hollow tube (206).

5 In an embodiment, the first hollow tube (205) and the second hollow tube (206) are connected to one or more inflation device (207). The first hollow tube (205) and the second hollow tube (206) are held together at the near end (202a) of the dilator system tube (202). The first hollow tube (205) and the second hollow tube (206) are connected to the retention element (203) and the dilating element (204) respectively. The user during

10 the time of operation can inflate either the retention element (203) or the dilating element (204) based on the requirement. In an embodiment, the retention element (203) and the dilating element (204) can be a balloon or a mechanical mesh or a wire mesh in cylindrical form.

In an embodiment, the medical apparatus (100) and the endoscope (208) are held

15 together by a sheath (210). The guiding tube (201) having the second guide rail (209b) at the bottom portion is mated to the first guide rail (209a) provided within the sheath (210) which is provided around the endoscope (208) and the guiding tube (201). In an embodiment, the sheath (210) provided on the guiding tube (201) and the endoscope (208) is at least one of cylindrical sheath, semi-circular cylindrical sheath. The slider mechanism

20 (209) aids the guiding tube (201) to actuate linearly over the endoscope (208) up to the ostium or paranasal sinus opening herein referred to as narrowed or blocked sinus opening (A). In an embodiment, the narrow or blocked sinus opening (A) relates to paranasal sinus opening, maxillary sinus opening, sphenoid sinus opening and frontal sinus opening or any other sinus opening which is blocked due to inflammation and mucosal swelling.

25 The medical system (101) as disclosed in fig. 3 consists of an endoscope (208) which has a near end (208a) and a far end (208b). The near end (208a) of the endoscope (208) is used by the user to view the internal part of the nasal cavity of the patient. The far end (208b) of the endoscope (208) is inserted into the nasal cavity of the patient in order to

30 aid the guiding tube (201) for sliding up to the narrowed or blocked sinus opening (A).

The endoscope (208) and the guiding tube (201) in construction are separated by the slider mechanism (209) and the sheath (210), the slider mechanism (209) aids in linear movement of the guiding tube (201) over the endoscope (208) up to the narrowed or

blocked sinus opening (A). The dilator system tube (202) is passed within the hollow guiding tube (201) and the dilator system tube (202) is operated from the near end (201a) of the guiding tube (201) by a user who pushes the dilator system tube (202) into the narrowed or blocked sinus opening (A). The dilator system tube is pushed into the
5 narrowed or blocked sinus opening (A) by the users hand or hand operated instrument to progress into the narrowed or blocked sinus opening (A). The arcuate tube element (213) provided at the far end (201b) of the guiding tube (201) is operated by a wire (214) by the user to extend the arcuate tube element (213) up to the narrowed or blocked sinus opening (A).

10 In an embodiment of the present disclosure, the endoscope (208) used in the medical system (101) is at least one of optical endoscope, fibre glass endoscope, flexible endoscope or any other endoscope which serves the purpose.

In an embodiment of the present disclosure, the user holds the endoscope (208) in one hand and the other non-operative hand of the user is used to actuate the guiding tube
15 (201) linearly up to the narrowed or blocked opening (A).

In an embodiment of the present disclosure, the user on pushing the wire (214) protrudes the arcuate tube element (213) outwardly forming an arcuate extended guide way for the dilator system tube (202).

In an embodiment of the present disclosure, once the guiding tube (201) is actuated
20 linearly up to the narrowed or blocked sinus opening (A), the user then uses his non-operative hand to protrude the arcuate tube element (213) outwardly by operating the wire (214) which guides the dilator system tube (202) into the cavity (C) through the blocked or narrowed opening (A) for retracting and anchoring the dilator system tube (202).

In an embodiment of the present disclosure, the dilator system tube (202) is a
25 hollow flexible tube manufactured by using at least one of silicone, poly urethane, Nylon, PEEK, PolyEthylene, Teflon, Polytetrafluoroethylene (PTFE) or any other material which serves the purpose.

In an embodiment of the present disclosure, the retention element (203) and the dilating element (204) are manufactured by using at least one of silicone, poly urethane,
30 PolyEthylene, Teflon, Polytetrafluoroethylene (PTFE), rubber, synthetic rubber, spring

steel, Nitinol, German silver, stainless steel material having clinical grade or any other material which serves the purpose.

In an embodiment of the present disclosure, the outer portion of the retention element (203) and the dilating element (204) are smeared with a pharmacologically active agent with a therapeutic effect to reduce inflammation, swelling, pain and bleeding experienced by the patient during dilation operation.

In an embodiment of the present disclosure, the guiding tube (201) is a translucent hollow flexible tube manufactured by using at least one of silicone, poly urethane, PolyEthylene, Teflon, Polytetrafluoroethylene (PTFE) or any other material which serves the purpose.

In an embodiment of the present disclosure, the near end (201a) of the guiding tube (201) is provided with a handle (211). The handle (211) is located on the guiding tube (201) such that, the user can actuate the guiding tube (201) linearly over the endoscope (208). The handle (211) is manufactured using material which is at least one of Polyethylene terephthalate, High-density polyethylene, Polyvinyl chloride, rubber and any other material which serves the purpose.

In an embodiment of the present disclosure, the dilating element (204) is selected from a group comprising at least one of a balloon, a wire mesh, a radially expanding mechanical diaphragm in cylindrical form.

In an embodiment, the subject comprises a cavity with an opening.

In an embodiment, the subject is selected from a group comprising paranasal sinus, eustachian tube, lacrymal duct, stoma of a human being or of an animal. The animals including but not limiting to canines, primates, cows, horses or any other animal, which can be prone to sinusitis conditions.

In an embodiment, the balloon is inflated by a means comprising but not limiting to air pump, compressed air cylinder or any other inflation means that serves the purpose.

In an embodiment, the wire mesh and the radially expanding mechanical diaphragm is expanded in cylindrical form by mechanical push and pull operation or any other expansion means that serves the purpose.

In an embodiment, the inflation device (207) is at least one of an air pump, a compressed air cylinder any other inflation means that serves the purpose.

5 Fig. 4 illustrates the guiding tube (201) in an exemplary embodiment of the present disclosure. The guiding tube (201) is provided over the endoscope (208). The slider mechanism (209) aids in linear movement of the guiding tube (201) over the endoscope (208). The slider mechanism (209) consists of first guide rail (209a) and a second guide rail (209b) such that the first guide rail (209a) is provided on the sheath (210) which is
10 provided over the endoscope (208) and the second guide rail (209b) is provided on bottom portion of the guiding tube (201). Assembling the first and second guide rails (209a, 209b) forms the slider mechanism (209). The slider mechanism (209) is constructed such that, the guiding tube (201) can be linearly actuated i.e extended or retracted by the user as per the requirement. The dilator system tube (202) as shown in fig. 4 is inserted through the
15 near end (201a) of the guiding tube (201) and exits out from the far end (201b) of the guiding tube (201). During the time of operation, the user progresses the dilator system tube (202) from the near end (201a) of the guiding tube (201) into the narrowed or blocked sinus opening (A). The near end (202a) of the dilator system tube (202) is connected to the one or more inflation device (207) wherein, the user with his foot or hand operates the
20 inflation device (207) to inflate the retention element (203) and the dilating element (204) through the first and second hollow tubes (205, 206) respectively, based on the requirement of the user/surgeon/doctor.

 In an embodiment of the present disclosure, the guiding tube (201) which is actuated linearly over the endoscope (208) constraints itself at specific location on the
25 slider mechanism (209) after actuation preventing the guiding tube (201) from accidentally extending in to the patient at the time of operation. Accidental extending of the guiding tube (201) can relate to unintentional movements of the user and patient.

 In an embodiment of the present disclosure, the guiding tube (201) actuated linearly over the endoscope (208) constraints itself at specific locations on the slider
30 mechanism (209) after actuation preventing the guiding tube (201) from accidentally retracting back at during the time of operation. Accidental retracting of the guiding tube (201) can relate to unintentional movements of the user and patient.

Fig. 4A illustrates the medical apparatus (100) in an exemplary embodiment of the present disclosure. The medical apparatus (100) comprises a guiding tube (201) having a near end (201a) and a far end (201b). The guiding tube (201) within the hollow flexible tube consists of a dilator system tube (202) guidable inside the guiding tube (201). The dilator system tube (202) includes a near end (202a) and a far end (202b), said far end (202b) is configured with a dilating element (204) and a retention element (203), configured adjacent to the dilating element (204). In an embodiment, the far end (202b) of the dilator system tube (202) comprises the retention element (203) and the dilating element (204). In an embodiment, the retention element (203) and the dilating element (204) is a balloon. The handle (211) is provided on top portion of the guiding tube (201) which aids the user to slide the guiding tube (201) over the endoscope (208) during operation. The bottom portion of the guiding tube (201) is provided with a second guide rail (209b) which is assembled with a first guide rail (209a) to form the slider mechanism (209). At the near end (201a) of the guiding tube (201), the dilator system tube (202) divides itself into a first hollow tube (205) and a second hollow tube (206). The first hollow tube (205) and the second hollow tube (206) is connected to at least one inflation device (207) for inflating the retention element (203) or the dilating element (204) respectively based on the requirement of the user. The far end (201b) of the guiding tube (201) consists of an arcuate end (212) which aids an arcuate tube element (213) housed within the arcuate end (212) to protrude outwardly to configure an arcuate extended guide way for the dilator system tube (202). In an embodiment, the arcuate tube element (213) is connected to a wire (214) wherein, pushing the wire (214) extends the arcuate tube element (213) outwardly through the arcuate end (212). In an embodiment, the arcuate tube element (213) is connected to a wire (214) wherein, pulling the wire (214) retracts the arcuate tube element (213) into the arcuate end (212).

In an embodiment, at least one inflation device (207) is actuated by the user through a foot pedal or hand operated lever or switch for inflating the retention element (203) or the dilating element (204) based on requirement.

Fig. 4B illustrates an alternative embodiment of the medical apparatus (100) in operation. The medical apparatus (100) comprises a guiding tube (201) having a near end (201a) and a far end (201b). The guiding tube (201) consists of a dilator system tube (202) guidable inside the guiding tube (201). The dilator system tube (202) includes a near end

(202a) and a far end (202b), said far end (202b) is configured with a dilating element (204) and a retention element (203), configured adjacent to the dilating element (204). In an embodiment, the far end (202b) of the dilator system tube (202) comprises the retention element (203) which is a balloon and the dilating element (204) which is a wire mesh. In
5 an embodiment, the balloon and wire mesh are in cylindrical form.

In an embodiment, the retention element (203) is a balloon which is inflated by at least one inflation device (207).

In an embodiment, the dilating element (204) is a wire mesh which is connected to a central wire (215). Expansion and contraction of the wire mesh is possible by pulling or
10 pushing the central wire (215) respectively.

Fig. 5 illustrates the medical system (101) in operation according to an exemplary embodiment of the present disclosure. The dilator system tube (202) consists of the retention element (203) and the dilating element (204) which is progressed into the subject. Once the retention element (203) is progressed into the subject, the user expands
15 the retention element (203) by actuating the inflation device (207). During this operation, the retention element (203) within the subject is inflated. When the retention element (203) is being inflated by the inflation device (207), the retention element (203) if it does not retract out of the subject or slip out of the patient, then the user/surgeon/doctor confirms the identification of the sinus cavity (C). The user upon identification of the sinus
20 cavity (C) tugs back on the dilator system tube (202) to anchor the dilator system tube (202) within the sinus cavity (C). Once the retention element (203) is anchored within the sinus cavity (C), the dilating element (204) is positioned at the narrowed or blocked sinus opening (A) due to the anchoring of the retention element (203). The dilation of the narrowed or blocked sinus opening (A) is carried out by the dilating element (204)
25 wherein, the user initiates the inflation of the dilating element (204) by means of the inflation device (207). The dilating element (204) inflates about an axis A-A radially and the retention element (203) inflates or expands about an axis B-B radially. The retention element (203) which inflates or expands radially about the axis B-B has a larger diameter in comparison with the dilating element (204) which inflates or expands radially about the
30 axis A-A.

In an embodiment, the inflation of the retention element (203) and the dilating element (204) can be controlled by the user through the at least one inflation device (207).

In an embodiment of the present disclosure, the dilating element (204) and the retention element (203) on their outer surfaces are smeared with a pharmacologically active agent with a therapeutic effect which aids in reduction of inflammation, swelling, pain and bleeding experienced by the patient during dilation operation.

5 Fig. 6 illustrates alternative embodiment of the medical system (101) in operation. The dilator system tube (202) has a near end (202a) and a far end (202b) which is inserted into the guiding tube (201). The far end (202b) of the dilator system tube (202) comprises of a retention element (203) and a dilating element (204) provided adjacent to the retention element (203). During operation, the dilator system tube (202) comprising the retention
10 element (203) and the dilating element (204) which is progressed into the subject. Once the retention element (203) is progressed into the subject, the user inflates the retention element (203) by actuating the inflation device (207). During this operation, the retention element (203) within the subject is inflated. When the retention element (203) is being inflated and if the retention element (203) does not retract out or slip out of the subject,
15 then the user/surgeon/doctor confirms the identification of the sinus cavity (C). The user upon identification of the sinus cavity (C), tugs back on the dilator system tube (202) to anchor the dilator system tube (202) within the sinus cavity (C). The anchoring of the retention element (203) within the sinus cavity (C) positions the dilating element (204) at the narrowed or blocked sinus opening (A). The dilation of the narrowed or blocked sinus
20 opening (A) is carried out by the dilating element (204). In an embodiment, the dilating element (204) is a wire mesh which is connected to the central wire (215) wherein, the user pulls on the central wire (215) to expand the wire mesh. In an embodiment, the dilating element (204) is a wire mesh which is connected to the central wire (215) wherein, the user pushes the central wire (215) to contract the wire mesh.

25 In an embodiment, expansion and contraction of the dilating element (204) can be controlled by the user by controlling the force applied on the central wire (215).

 In an embodiment of the present disclosure, the dilating element (204) which is a wire mesh is manufactured by using materials which is at least one of spring steel, stainless steel, Nitinol material having clinical grade or any other material which serves
30 the purpose.

 Figs. 7A and 7B illustrates guiding tube (201) in an exemplary embodiment of the present disclosure provided with an arcuate tube element (213). The guiding tube (201) at

its far end (201b) is provided with an arcuate end (212). The arcuate tube element (213) is provided within the arcuate end (212) of the guiding tube (201) (as shown in Fig. 7A). The arcuate tube element (213) is connected to a wire (214) wherein pushing the wire (214) by the user protrudes the arcuate tube element (213) outwardly to configure an arcuate
5 extended guide way for the dilator system tube (202) (as shown in Fig. 7B). The guiding tube (201) at its bottom portion is provided with a second guide rail (209b) which when assembled with the first guide rail (209a) (shown in Fig. 8) forms the slider mechanism (209). A handle (211) is provided on top portion of the guiding tube (201) which aids the user to slide the guiding tube (201) over the endoscope (208) (not shown in figure) during
10 operation.

Fig. 8 illustrates sheath (210) provided around the endoscope (208) in an exemplary embodiment of the present disclosure. The sheath (210) consists of the first guide rail (209a) which when assembled with the second guide rail (209b) (shown in Figs. 7A and 7B) forms the slider mechanism (209). The sheath (210) also aids in holding the
15 medical apparatus (100) and the endoscope (208) together.

Fig. 9 illustrates top and sectional view of the sheath according to an exemplary embodiment of the present disclosure. The sheath (210) is provided around the endoscope (208) as well as around the medical apparatus (100). The sheath (210) aids in binding the medical apparatus (100) to the endoscope (208). Also, the sheath (210) provided over the
20 endoscope (208) comprises of the first guide rail (209a) which when assembled with the second guide rail (209b) forms the slider mechanism (209).

In an embodiment, the sheath (210) provided on the guiding tube (201) and the endoscope (208) is at least one of cylindrical sheath, semi-circular cylindrical sheath, U-shaped tresca sheath and C-shaped tresca sheath or any other means which serves the
25 purpose.

Fig. 10 illustrates a ball probe (216) used in guiding the dilator system tube (202) into the sinus cavity (C) through the narrowed or blocked sinus opening (A) according to an embodiment of the present disclosure. The dilator system tube (202) when pushed by the user during operation may at certain times not progress into the narrowed or blocked
30 sinus opening (A). Instead, the dilator system tube (202) may progress into some other cavity located adjacent to the narrowed or blocked sinus opening (A). The user in such a scenario uses a ball probe (216) or a standard medical tool such as a forceps to guide the

dilator system tube (202) into the sinus cavity (C) of the patient. The ball probe (216) used in the present disclosure is a standard ball probe used in medical treatments and operations. The tip end of the ball probe (216) is hooked to a hook element (217) provided at the tip end of the dilator system tube (202) at the far end (202b). Due to the angular
5 movement achieved by the ball probe (216), the user by viewing through the endoscope (208) can easily insert the dilator system tube (202) into the sinus cavity (C) of the patient. In an embodiment, the hook element (217) is at least one of a ring, a C-shaped hook, a U-shaped hook or any other means which serves the purpose.

ADVANTAGES

10 In an embodiment, the medical apparatus is integrated to an endoscope for carrying out the dilation procedure.

In an embodiment, the medical apparatus is integrated to the endoscope and hence the non-operative hand of the user can be used for inflation of the dilatation and retention elements. Also, the user can perform minor surgical modifications necessary to relieve the
15 patient from sinus obstruction without the aid of an assistant.

In an embodiment, the medical apparatus is simple in construction and therefore reduces total cost of manufacturing the apparatus. Thus, the overall cost for treatment for sinus is also reduced substantially.

In an embodiment, the cost involved in performing the dilation procedure are reduced by
20 making the medical apparatus economical leading to affordability of the patient.

In an embodiment, the medical apparatus disclosed in the present disclosure is used to carry-out the dilation procedure by way of minimal invasive procedure.

In one embodiment, the slider mechanism used in the medical apparatus provides safety due to smooth and regulated movement of the medical apparatus into the patient. Thus, the
25 medical apparatus is safe for operation.

In an embodiment, the dilation procedure using the medical apparatus can be carried out in the endoscopy room and there is no need to admit the patient in an operation theatre.

In an embodiment, the medical apparatus does not utilize additional components such as fluid irrigation or embedded electronics that can lead to potential injury or aspiration (fluid entering the lungs) of the patient.

5 In an embodiment, the medical apparatus can be used on the patient without providing general anaesthesia.

INDUSTRIAL APPLICABILITY

The medical apparatus is used in dilation procedures such as maxillary sinus opening dilation, frontal sinus opening dilation, sphenoid sinus opening dilation or in any other sinus dilation procedures.

10 The medical apparatus can be used in sinus opening dilation of human beings as well as animals.

EQUIVALENTS

15 With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally
20 intended as “open” terms (e.g., the term “including” should be interpreted as “including but not limited to,” the term “having” should be interpreted as “having at least,” the term “includes” should be interpreted as “includes but is not limited to,” etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the
25 absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases “at least one” and “one or more” to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles “a” or “an” limits any particular claim containing such introduced
30 claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases “one or more” or “at least one” and indefinite articles such as “a” or “an” (e.g., “a” and/or “an” should typically be interpreted to mean

“at least one” or “one or more”); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation *is* explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean *at least* the recited number (e.g., the bare recitation of “two recitations,” without other modifiers, typically means *at least* two recitations, or *two or more* recitations). Furthermore, in those instances where a convention analogous to “at least one of A, B, and C, etc.” is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., “a system having at least one of A, B, and C” would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to “at least one of A, B, or C, etc.” is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., “a system having at least one of A, B, or C” would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase “A or B” will be understood to include the possibilities of “A” or “B” or “A and B.”

In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

REFERRAL NUMERALS

100	Medical Apparatus
101	Medical System
201	Guiding tube
201a	Near end
201b	Far end
202	Dilator system tube
202a	Near end
202b	Far end
203	Retention element
204	Dilating element
205	First Hollow tube
206	Second Hollow tube
207	Inflation device
208	Endoscope
208a	Near end
208b	Far end
209	Slider mechanism
209a	First guide rail
209b	Second guide rail
210	Sheath
211	Handle
212	Arcuate end
213	Arcuate tube element
214	Wire
215	Central wire
216	Ball Probe
217	Hook element
A	Narrowed or blocked opening
C	Sinus Cavity

Claims:

1. A medical apparatus (100) for dilating a narrowed or blocked opening (A) of a subject, the medical apparatus (100) comprising:
 - a guiding tube (201);
 - 5 a dilator system tube (202) guidable inside the guiding tube (201), wherein the dilator system tube (202) includes a near end (202a) and a far end (202b), said far end (202b) is configured with a dilating element (204) and a retention element (203), configured adjacent to the dilating element (204),
wherein the retention element (203) is expanded inside the subject to identify
10 the cavity (C), and the dilator system tube (202) is retractable for anchoring the dilator system tube (202) by the expanded retention element (203) inside the cavity (C), to position the dilating element (204) at the narrowed or blocked opening (A) for dilating the narrowed or blocked opening (A) upon expanding the dilating element (204).
- 15 2. The medical apparatus (100) as claimed in claim 1, wherein the dilating element (204) is selected from a group comprising at least one of a balloon, a wire mesh, a radially expanding mechanical diaphragm in cylindrical form.
- 20 3. The medical apparatus (100) as claimed in claim 1, wherein the retention element (203) is a balloon.
4. The medical apparatus (100) as claimed in claim 1, wherein diameter of the retention element (203) is greater than diameter of the dilating element (204) when the dilating
25 element (204) and the retention element (203) are fully expanded.
5. The medical apparatus (100) as claimed in claim 1, wherein the guiding tube (201) comprises an arcuate end (212) at a far end (201b) of the guiding tube (201) to facilitate guiding of the dilator system tube (202) into the narrowed or blocked
30 opening (A).
6. The medical apparatus (100) as claimed in claim 1, comprises an arcuate tube element (213) inside the guiding tube (201) at the arcuate end (212) which upon actuation by the user protrudes outwardly to configure an arcuate extended guide way for the
35 dilator system tube (202).

7. The medical apparatus (100) as claimed in claim 6, wherein the arcuate tube element (213) is connected to a wire (214) for providing extension and retraction movement of the arcuate tube element (213) at the arcuate end (212) of the guiding tube (201).
- 5 8. The medical apparatus (100) as claimed in claims 1, wherein the dilator system tube (202) is configured with a first hollow tube (205) and a second hollow tube (206) for inflating the balloons using at least one inflation device (207).
- 10 9. The medical apparatus (100) as claimed in claims 1, wherein the dilator system tube (202) is configured with a central wire (215) used for expanding and contracting the wire mesh in cylindrical form by pulling and pushing the central wire (215) respectively.
- 15 10. The medical apparatus (100) as claimed in claim 1, wherein the subject comprises a cavity (C) with an opening (A).
11. The medical apparatus (100) as claimed in claim 1, wherein the subject is selected from a group comprising Paranasal sinus, eustachian tube, lacrymal duct, stoma of a human being or of an animal.
- 20 12. A medical system (101) for dilating a narrowed or blocked opening (A) of a subject, the medical system (101) comprising:
- an endoscope (208) having a near end (208a) and a far end (208b), wherein
- 25 the endoscope (208) is used for viewing the narrowed or blocked opening (A) of the subject;
- a guiding tube (201) connectable to the endoscope (208);
- a dilator system tube (202) guidable inside the guiding tube (201), wherein the dilator system tube (202) includes a near end (202a) and a far end (202b),
- 30 said far end (202b) is configured with a dilating element (204) and a retention element (203), configured adjacent to the dilating element (204),
- wherein the retention element (203) is expanded inside the subject to identify the cavity (C), and the dilator system tube (202) is retractable for anchoring the dilator system tube (202) by the expanded retention element (203) inside the cavity

(C), to position the dilating element (204) at the opening (A) for dilating the opening (A) upon expanding the dilating element (204).

13. The medical system (101) as claimed in claim 12, wherein the dilating element (204)
5 is selected from a group comprising at least one of a balloon, a wire mesh, a radially expanding mechanical diaphragm in cylindrical form.
14. The medical system (101) as claimed in claim 12, wherein the retention element (203)
10 is a balloon.
15. The medical system (101) as claimed in claim 12, wherein diameter of the retention
element (203) is greater than diameter of the dilating element (204) when the dilating
element (204) and the retention element (203) are fully expanded.
16. The medical system (101) as claimed in claim 12, wherein the guiding tube (201)
15 comprises an arcuate end (212) at a far end (201b) of the guiding tube (201) to facilitate guiding of the dilator system tube (202) into the narrowed or blocked opening (A).
17. The medical system (101) as claimed in claim 12, comprises an arcuate tube element
20 (213) inside the guiding tube (201) at the arcuate end (212) which upon actuation by the user protrudes outwardly to configure an arcuate extended guide way for the dilator system tube (202).
18. The medical system (101) as claimed in claim 17, wherein the arcuate tube element
25 (213) is connected to a wire (214) for providing movement of the arcuate tube element (213) at the arcuate end (212) of the guiding tube (201).
19. The medical system (101) as claimed in claim 12, wherein the dilator system tube
30 (202) is configured with a first hollow tube (205) and a second hollow tube (206) for inflating the balloons using at least one inflation device (207).
20. The medical system (101) as claimed in claim 12, wherein the dilator system tube
35 (202) is configured with a central wire (215) for expanding and contracting the wire mesh which is in cylindrical form by pulling and pushing on the central wire (215) respectively.

21. The medical apparatus (100) as claimed in claim 12, wherein the subject comprises a cavity (C) with an opening (A).
- 5 22. The medical system (101) as claimed in claim 12, wherein the subject is selected from a group comprising Paranasal sinus, eustachian tube, lacrymal duct, stoma of a human being or of an animal.
- 10 23. The medical system (101) as claimed in claim 12, comprises a sheath (210) in cylindrical shape for attaching the endoscope (208) and the guiding tube (201).
- 15 24. The medical system (101) as claimed in claim 12, comprises a slider mechanism (209) having a second guide rail (209b) provided on the guiding tube (201) and a first guide rail (209a) provided on the sheath (210) configured around the endoscope (208) for sliding the guiding tube (201) over the endoscope (208) towards the narrowed or blocked opening (A).
- 20 25. The medical system (101) as claimed in claim 12, wherein a near end (201a) of the guiding tube (201) is provided with a handle (211) for actuating the guiding tube (201) linearly over the slider mechanism (209).
26. A method of dilating a narrowed or blocked opening (A) of a subject, using the medical apparatus (100) as claimed in claim 1, the method comprising acts of:
- 25 introducing the guiding tube (201) comprising the dilator system tube (202) into the subject till the guiding tube (201) is in line with the narrowed or blocked opening (A);
- actuating an arcuate tube element (213) outwardly till it faces the narrow or blocked opening (A);
- 30 progressing the dilator system tube (202) into the narrowed or blocked opening (A) till the retention element (203) is inside the cavity (C);
- expanding the retention element (203) of the dilator system tube (202) positioned inside the cavity (C) for confirming presence of retention element (203) inside the cavity (C);
- 35 retracting the dilator system tube (202) for anchoring the retention element (203) inside the cavity (C) and positioning the dilating element (204) at the opening (A);

expanding the dilating element (204) for dilating the narrowed or blocked opening (A).

27. The method as claimed in claim 26, wherein the dilating element (204) is selected
5 from a group comprising at least one of a balloon, a wire mesh, a radially expanding
mechanical diaphragm in cylindrical form.
28. The method as claimed in claim 26, wherein the balloon is inflated using an inflation
10 device (207) and the wire mesh is expanded and contracted by pulling or pushing a
central wire (215).
29. The medical apparatus (100) as claimed in claim 1 is used in paranasal sinus opening
dilation procedures such as maxillary sinus opening dilation, frontal sinus opening
15 dilation, sphenoid sinus opening dilation or in any other sinus opening dilation
procedures.

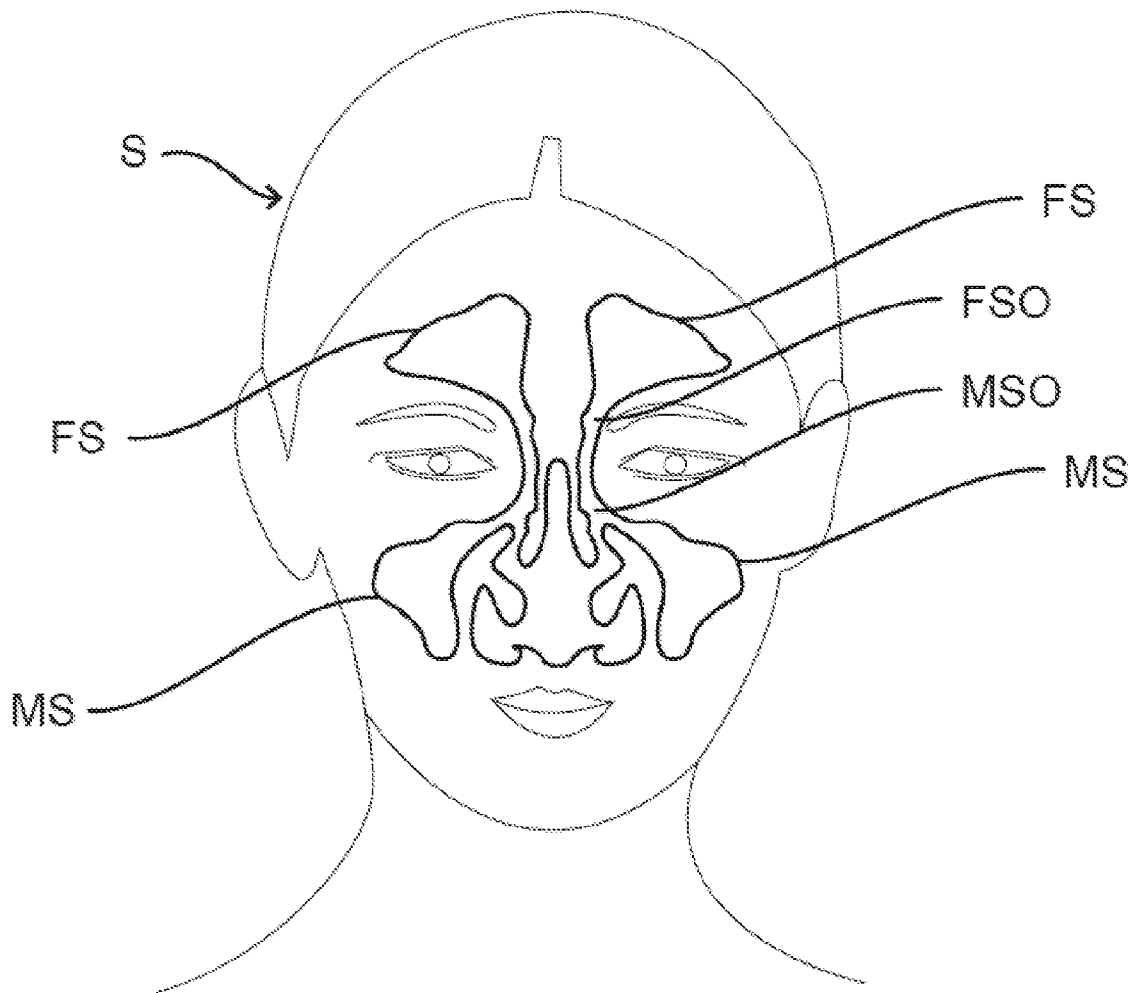


FIG. 1

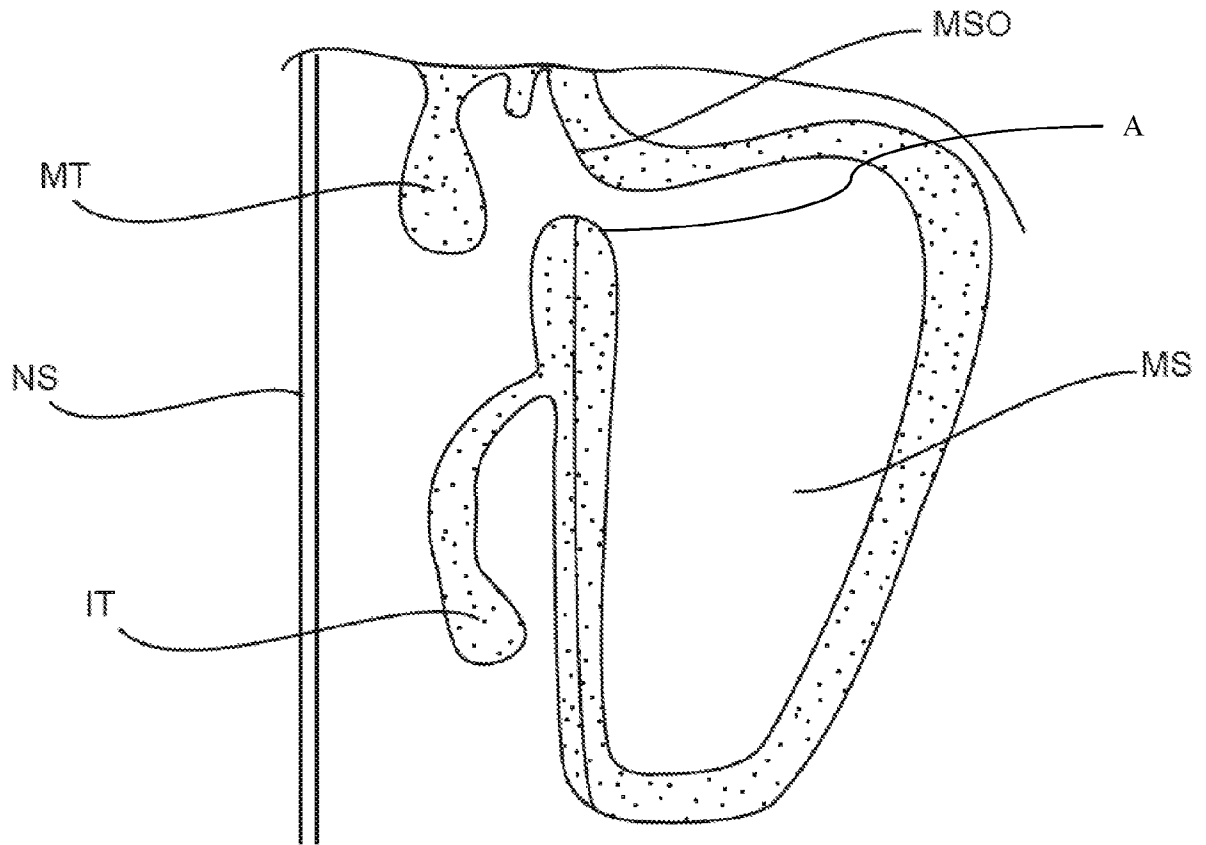


FIG. 2

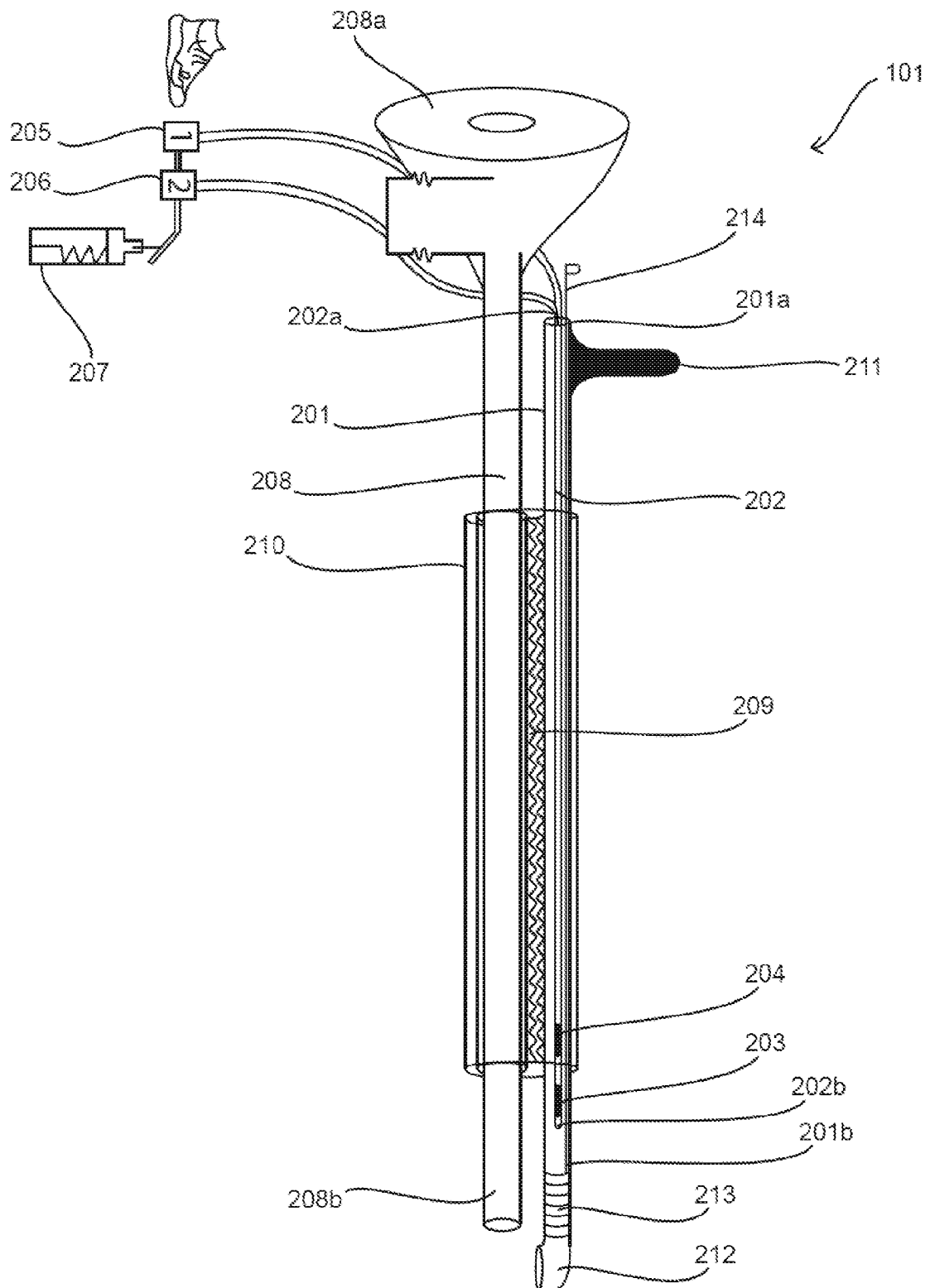


FIG. 3

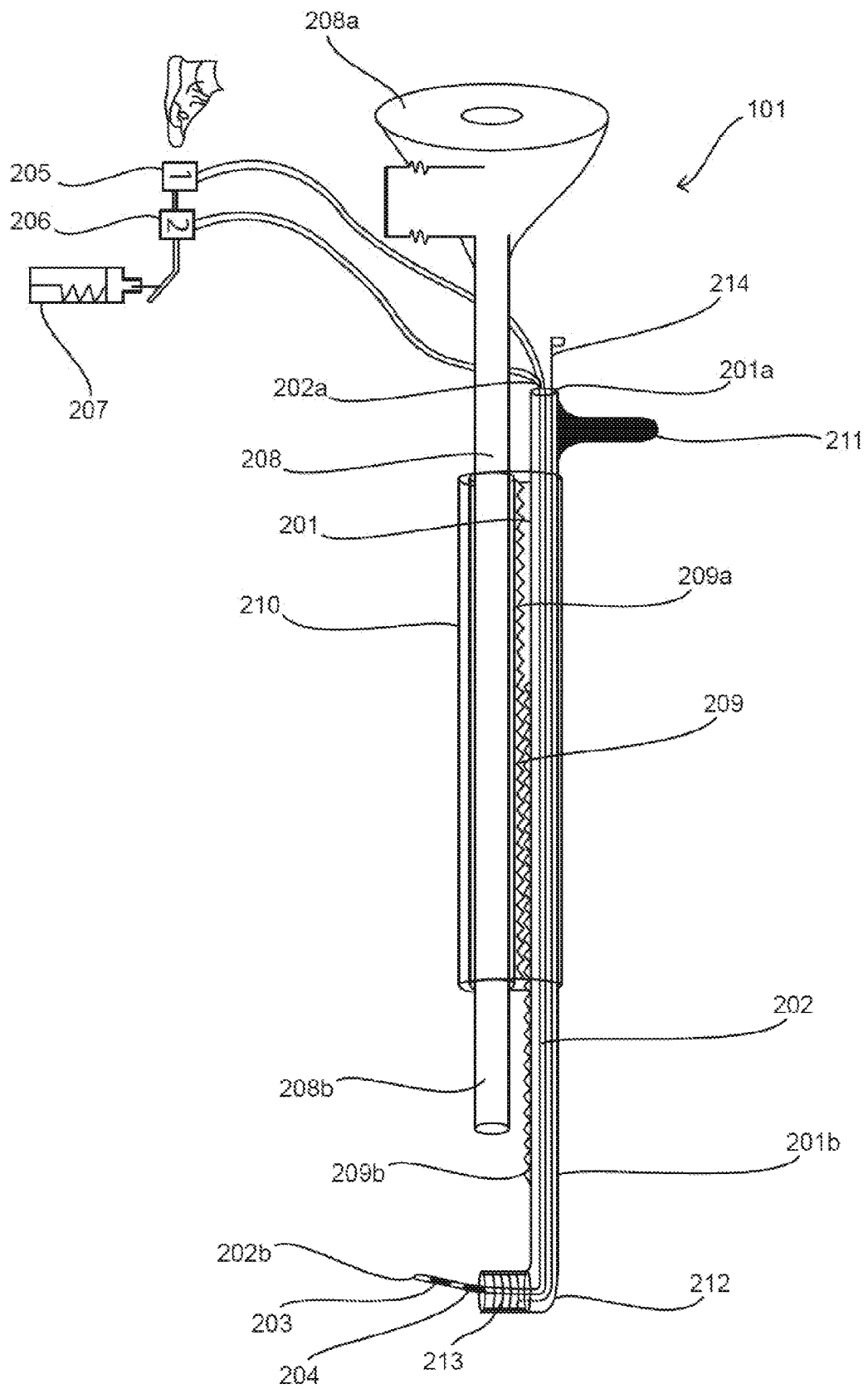


FIG. 4

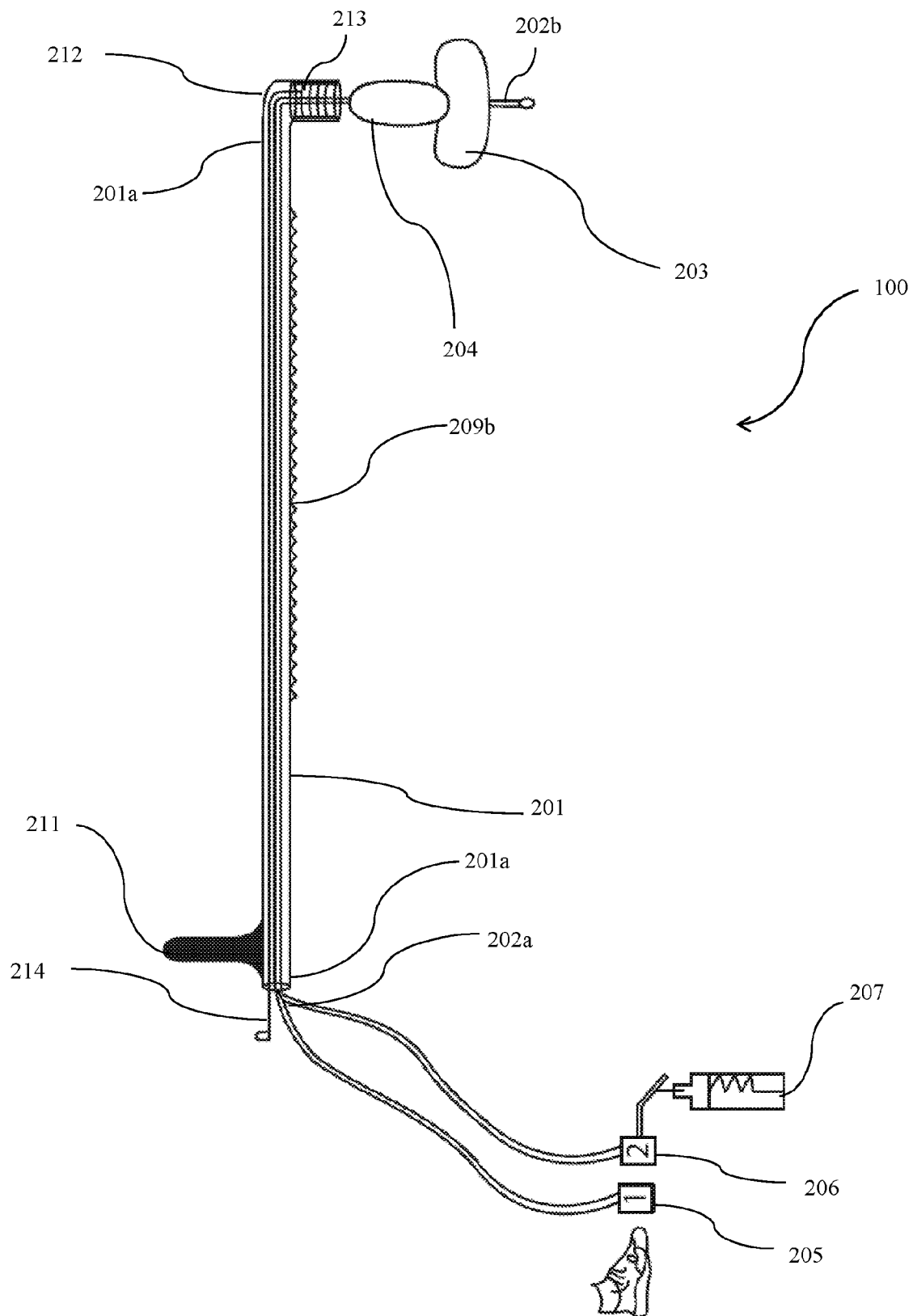


FIG. 4A

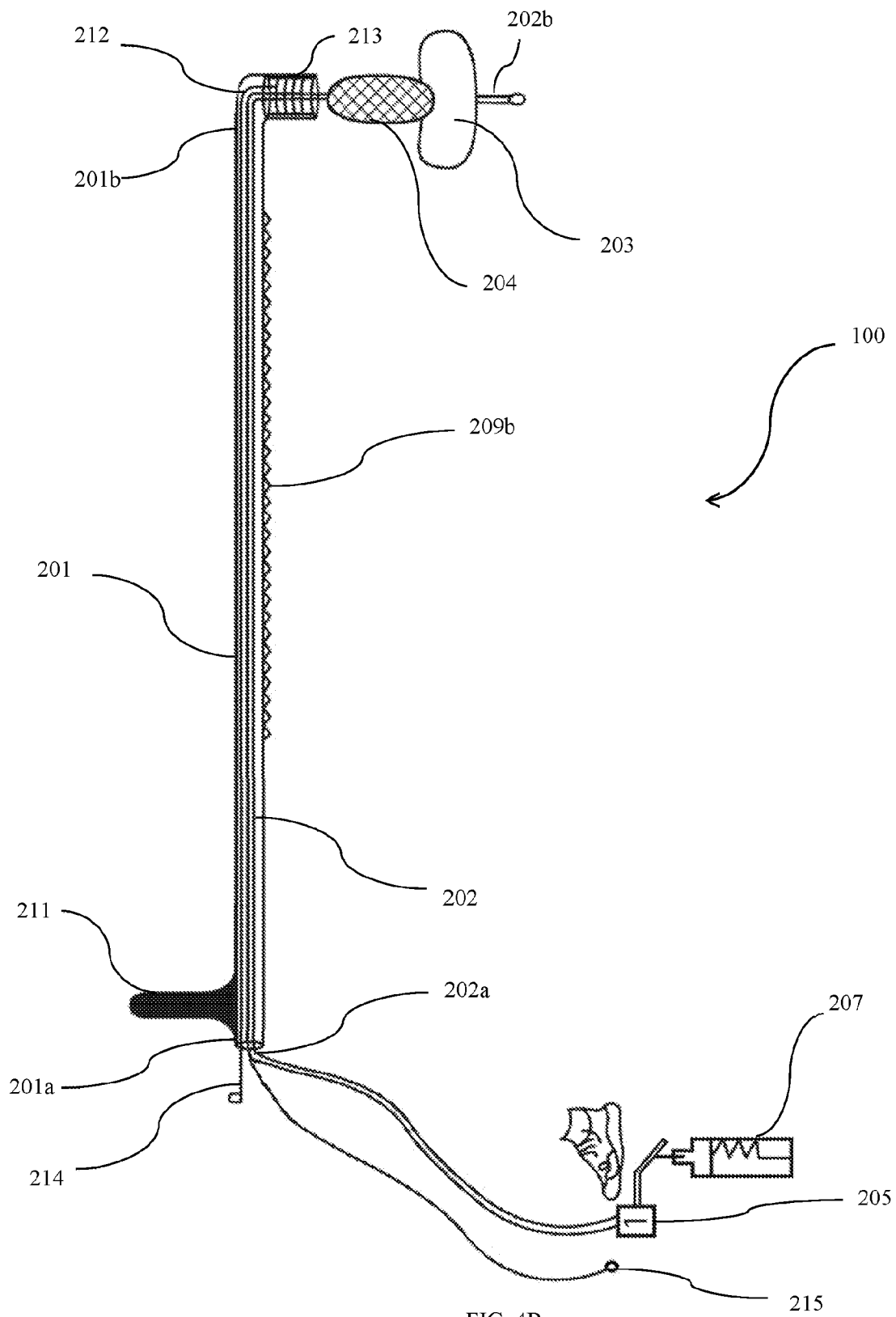


FIG. 4B

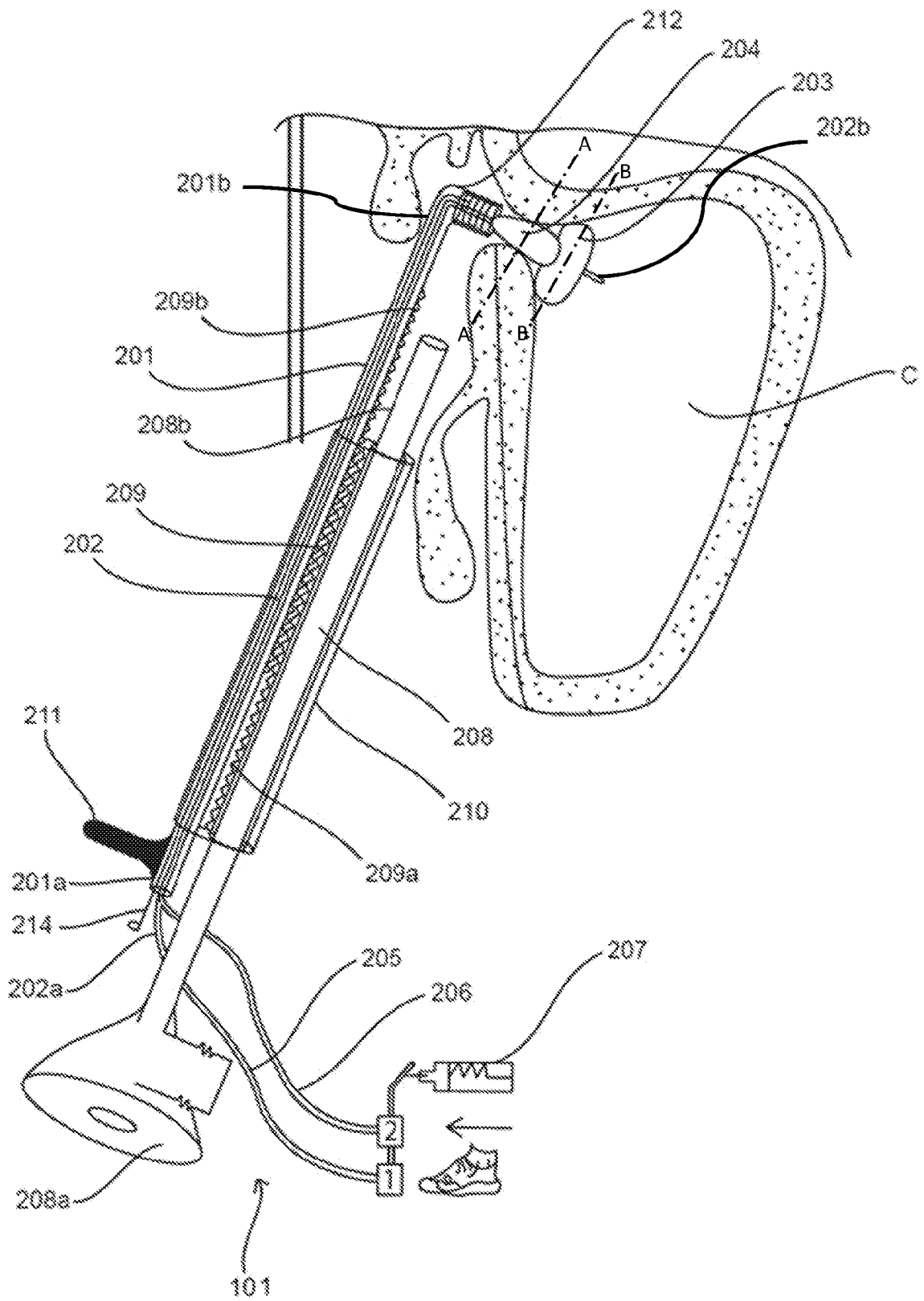


FIG. 5

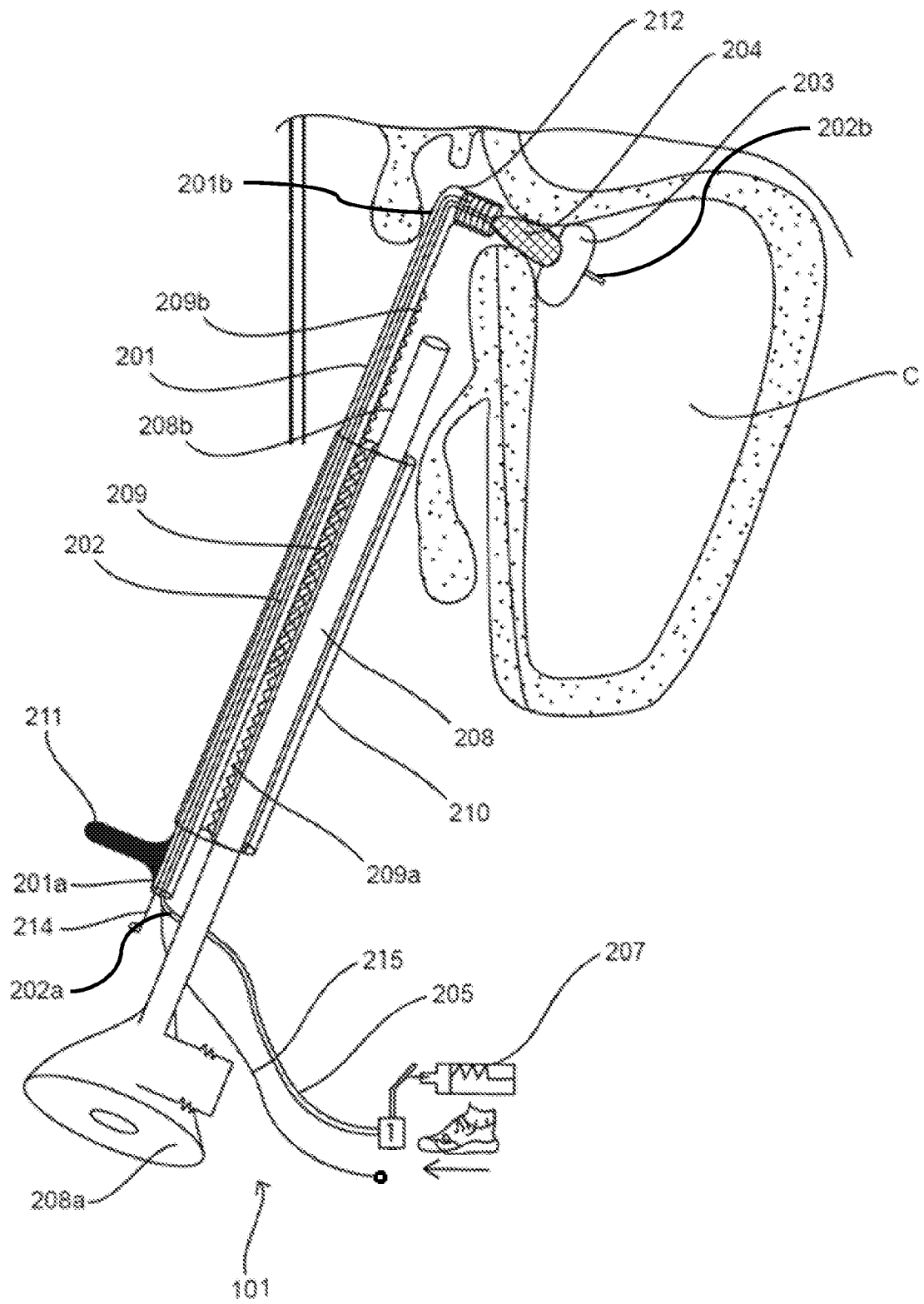


FIG. 6

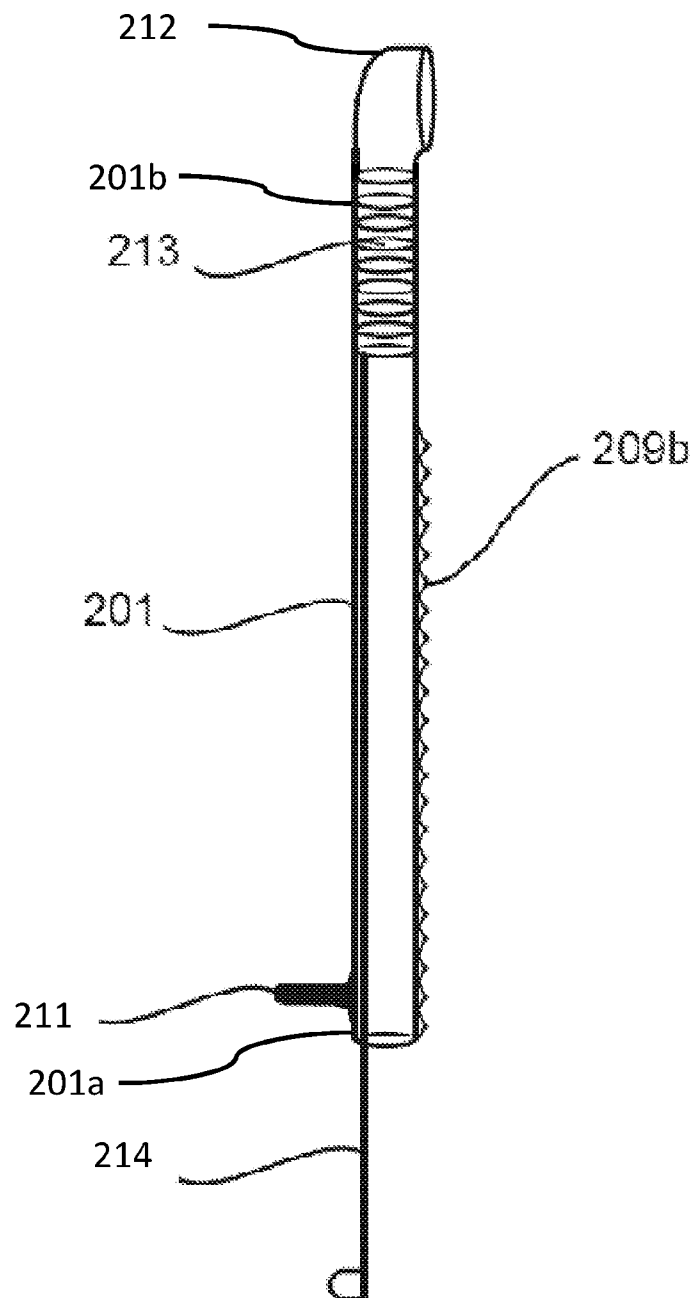


FIG. 7A

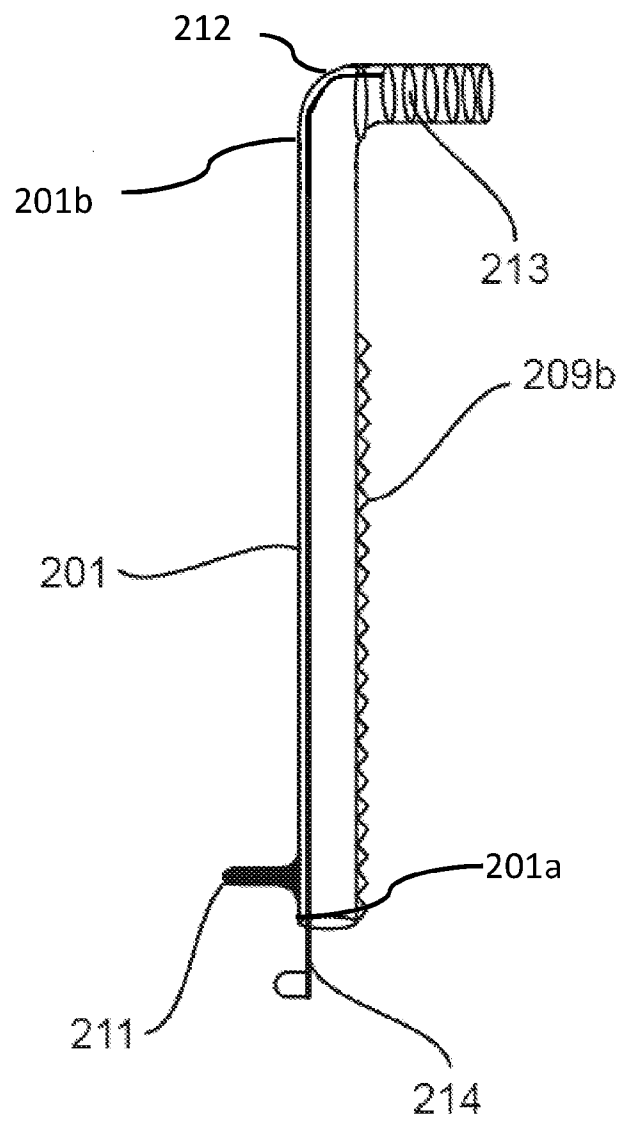


FIG. 7B

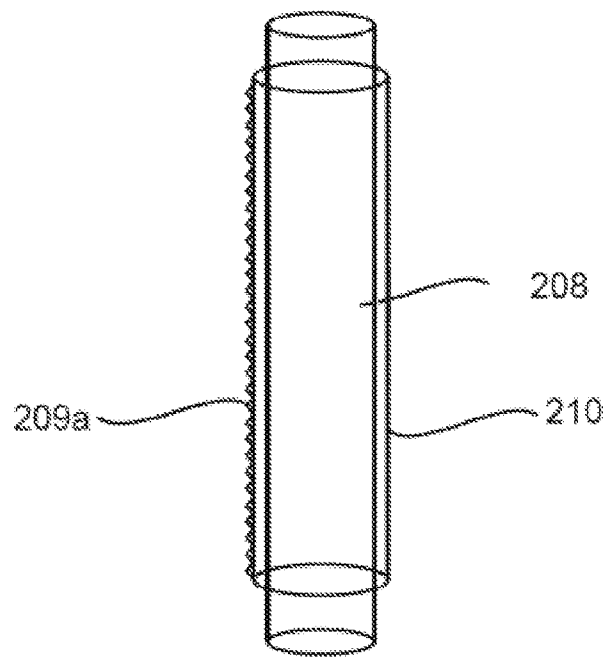


FIG. 8

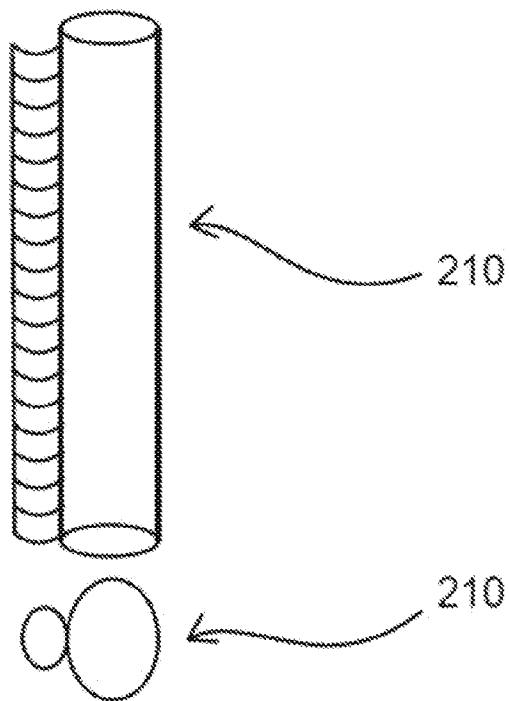


FIG. 9

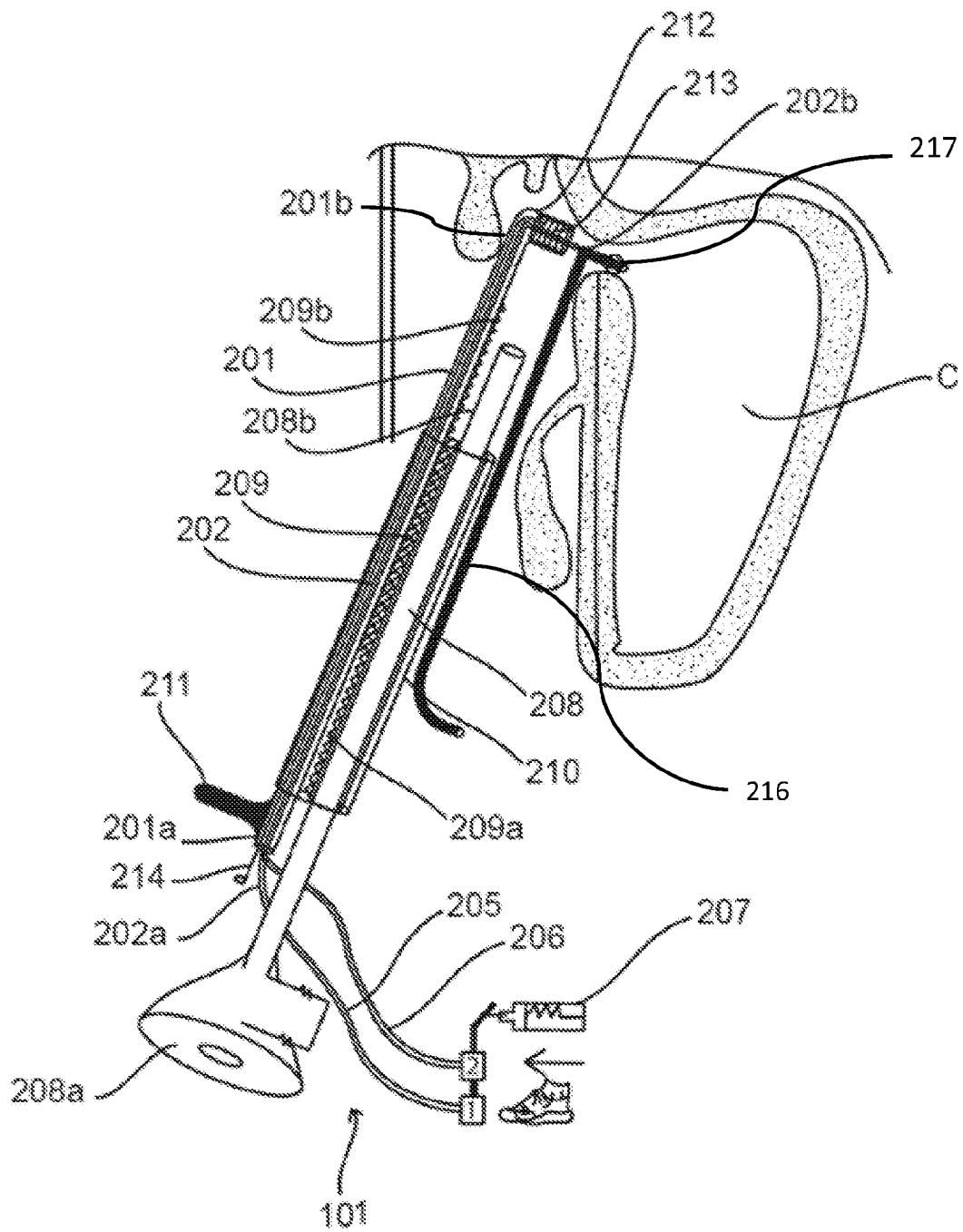


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/050516

A. CLASSIFICATION OF SUBJECT MATTER INV. A61M29/00 A61M29/02 A61M25/10 A61B17/24 A61B17/22 A61B1/233 A61B1/00 A61M25/00 A61M25/06 A61B17/00 ADD. According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A61M A61B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 5 312 430 A (ROSENBLUTH ROBERT F [US] ET AL) 17 May 1994 (1994-05-17) column 4, lines 53-68; figure 1 column 5, line 52 - column 6, line 24; figures 11, 13, 14, 17 column 7, lines 1-50; figure 10 column 11, line 61 - column 12, line 39; figures 20-21 -----	1-3,8, 10-14, 19,21-25		
X A	US 2010/030113 A1 (MORRISS JOHN H [US] ET AL) 4 February 2010 (2010-02-04) paragraphs [0082] - [0152]; figures 1-28C -----	1-8,10, 11 12		
X	US 2004/116955 A1 (FOLTZ JONATHAN [US] ET AL) 17 June 2004 (2004-06-17) paragraphs [0033] - [0055]; figures 1-3 ----- -/--	1-4,8, 10,11		
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.				
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family				
Date of the actual completion of the international search 22 April 2015		Date of mailing of the international search report 04/05/2015		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Jameson, Patricia		

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2015/050516

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 26-29
because they relate to subject matter not required to be searched by this Authority, namely:
A meaningful search is not possible on the basis of all claims because claims 26-29 are directed to Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2015/050516

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/288051 A1 (BEYER BRUCE [US] ET AL) 13 December 2007 (2007-12-13) paragraphs [0020] - [0022]; figures 1-4 -----	1-4,10, 11
X	US 4 627 837 A (GONZALO GERMAN [US]) 9 December 1986 (1986-12-09) abstract; figures 1-5d -----	1-3,10
Y	US 2013/096378 A1 (ALEXANDER IAN JOSEPH [US] ET AL) 18 April 2013 (2013-04-18) -----	1-7,9, 12-18, 20,23-25
A	paragraphs [0039] - [0110]; figures 1-13 paragraphs [0206] - [0208] -----	10,11, 21,22
Y	EP 2 532 300 A2 (ACCLARENT INC [US]) 12 December 2012 (2012-12-12) -----	1-7,9, 12-18, 20,23-25
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A	paragraphs [0145] - [0150]; figures 1a-g paragraphs [0161] - [0172]; figures 4a-10b paragraphs [0213] - [0224]; figures 23a-25b paragraph [0236]; figures 13a-c -----	1,2,5-7, 10-13, 16,21-25
A	US 2007/249896 A1 (GOLDFARB ERIC [US] ET AL) 25 October 2007 (2007-10-25) ----- paragraphs [0093] - [0094]; figures 1-4b paragraphs [0114] - [0118]; figures 9a-10d paragraphs [0122] - [0132]; figures 14-17d paragraphs [0184] - [0186]; figures 41-43 -----	1,5,6, 10-12, 16,17, 21-23,25

INTERNATIONAL SEARCH REPORT

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International application No

PCT/IB2015/050516

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