



(51) International Patent Classification:

A61B 17/34 (2006.01) A61B 1/018 (2006.01)
A61B 17/00 (2006.01) A61B 1/267 (2006.01)
A61B 19/00 (2006.01) A61M 25/00 (2006.01)

(21) International Application Number:

PCT/IB2009/054991

(22) International Filing Date:

10 November 2009 (10.11.2009)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/140,174 23 December 2008 (23.12.2008) US

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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

[Continued on next page]

(54) Title: NESTED CANNULA CONFIGURATION FOR USE WITH ENDOSCOPE

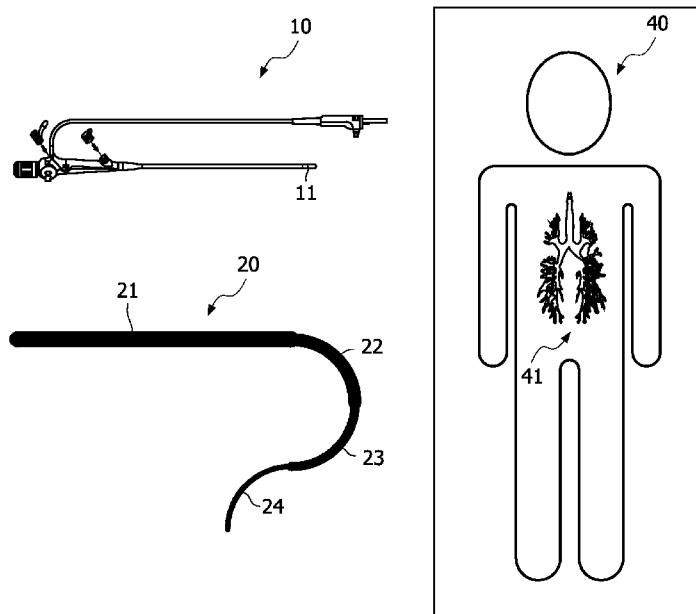


FIG. 3

(57) Abstract: A method for accessing a target location (61) relative to an anatomical region (41) involves a navigation of a distal end (11) of an endoscope (10) to a cannula insertion location (60) that defines a position and an orientation of the distal end (11) of the endoscope (10) relative to the anatomical region (41). The method further involves an insertion of a nested cannula (20) through an instrument channel (12) of the endoscope (10) to the target location (61) with the nested cannula (20) including a plurality of telescoping tubes (21-24) configured to reach the target location (61) relative to the cannula insertion location (60).



ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

Declarations under Rule 4.17:

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NESTED CANNULA CONFIGURATION
FOR USE WITH ENDOSCOPE

5 The present invention generally relates to nested cannula configurations that are customized for a patient to facilitate minimally invasive surgical procedures. The present invention specifically relates to a method and a device for accessing small, deep-seeded lesions within the body by planning a 3D path of a nested cannula through an instrument channel of an endoscope.

10 Endoscopes are widely utilized medical devices. They are used for looking inside the body and are often inserted in body's natural orifices. Besides being used for visual inspection, they often serve as a guide for inserting other devices, such as, for example, catheters or gripping instruments. Therefore, commercial endoscopes usually have one or more "instrument channels" providing insertion path for the instruments.

15 For purposes of the present invention, the term "endoscope" is broadly defined herein as any device having the ability to image from inside a body. Examples of an "endoscope" include, but are not limited to, a bronchoscope, an arthroscope, a choledochoscope, a colonoscope, a cystoscope, a duodenoscope, a gastroscope, a hysteroscope, a laparoscope, a laryngoscope, a neuroscope, an otoscope, a push enteroscope, a rhinolaryngoscope, a sigmoidoscope, a sinuscope and a thorascop.

20 In particular, bronchoscopy is an intra-operative procedure typically performed with a standard bronchoscope (e.g., a bronchoscope 10 shown in FIG. 1) in which the bronchoscope is placed inside of a patient's bronchial tree to provide visual information of the inner structure. Known methods for spatial localization of the bronchoscope include (1) electromagnetic ("EM") tracking involving an external
25 electromagnetic field generator and the bronchoscope being equipped with sensor coils, (2) optical localization tracking of the bronchoscope involving the bronchoscope being equipped with infrared ("IR") reflecting spheres, and (3) image based tracking involving a registration of a pre-operative three-dimensional ("3D") dataset with two-dimensional ("2D") endoscopic images from a bronchoscope.

30 The main disadvantages of currently available endoscopes are their size and limited steerability, making them not capable of reaching distant locations within the body. Tracked endoscopes might overcome some of the steerability problems, since

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they offer on-line position feedback. However, transformation of pre-operative planning to endoscope movement relies on hand-eye coordination of the operator. Tracked endoscopes have the same size as standard endoscopes, making navigation in very small spaces impossible.

5 International Publication no. WO 2008/032230 A1, March 20, 2008 entitled “Active Cannula Configuration for Minimally Invasive Surgery” to Karen I. Trovato teaches systems and methods related to nested cannula configurations that are customized for a patient to facilitate minimally invasive surgical procedures. Generally, the nested cannula configuration is designed for a specific patient based on
10 a pre-acquired 3D image of a particular anatomical region of the patient, and an identification of a target location within the anatomical region.

Specifically, nested cannula (“NC”) configurations are designed by utilizing the 3D image to generate a series of arc and straight shapes from a particular position and orientation in the 3D image of the anatomical region. The generated
15 arc and straight shapes are utilized to calculate a pathway between an entry location and the target location. The generated pathway is utilized to generate a plurality of nested telescoping tubes that are configured and dimensioned with pre-set curved shapes. The tubes are typically extended largest to smallest, and the planner specification defines the lengths and the relative orientations between successive
20 tubes to reach the target location. FIG. 2 illustrates an exemplary nested cannula 20 having a straight tube 21 being the largest tube and smaller arc tubes 22-24.

The tubes are fabricated from a material exhibiting desirable levels of flexibility/elasticity. For example, the material may be Nitinol, which has superelastic properties that allow the Nitinol to bend when a force is applied and to
25 return to its original shape once the force is removed.

NC configuration solves both size and steerability problems, allowing pre-operative planning and intra-operative steering of miniaturized hollow tubes (as small as 0.2mm). The main disadvantage of the NC configuration is that it requires a positioning device to determine the point and the angle of insertion.

30 The present invention solves both problem of steering/pre-operative planning of instrument movement and pre-positioning of NC configuration.

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The present invention is premised on the use of an instrument channel of an endoscope to advance nested cannula tubes towards hard-to-reach lesions within the body. The endoscope is used to explore conventionally reachable areas, whereas the nested cannula performs the final expansion to arrive at the desired target location.

5 One form of the present invention is a method for accessing a target location relative to an anatomical region involves a navigation of a distal end of an endoscope to a cannula insertion location that defines a position and an orientation of the distal end of the endoscope relative to the anatomical region. The method further involves an insertion of a nested cannula through an instrument channel of the endoscope to the
10 target location with the nested cannula including a plurality of telescoping tubes configured to reach the target location relative to the cannula insertion location.

Another form of the present invention is a device for accessing a target location relative to an anatomical region. The device includes an endoscope having a distal end structurally configured to be navigated to a cannula insertion location that defines a
15 position and an orientation of the distal end of the endoscope relative to the anatomical region. The device further includes a nested cannula operable to be inserted through an instrument channel of the endoscope to the target location with the nested cannula including a plurality of telescoping tubes structurally configured to reach the target location relative to the cannula insertion location.

20 Another form of the present invention is a system for accessing a target location relative to an anatomical region. The system the aforementioned device and an imaging unit for displaying intra-operative images of the anatomical region including the endoscope and the nested cannula.

The term “pre-operative” as used herein is broadly defined to describe any
25 activity occurring or related to a period or preparations before an endoscopic application (e.g., path planning for an endoscope and configuring a nested cannula), and the term “intra-operative” as used herein is broadly defined to describe any activity occurring, carried out, or encountered in the course of an endoscopic application (e.g., navigating the endoscope derived from the planned path and extending a nested
30 cannula derived from its configuration). Examples of an endoscopic application include, but are not limited to, a bronchoscopy, a colonoscopy, a laparoscopy, and a brain endoscopy.

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The foregoing forms and other forms of the present invention as well as various features and advantages of the present invention will become further apparent from the following detailed description of various embodiments of the present invention read in conjunction with the accompanying drawings. The detailed description and drawings
5 are merely illustrative of the present invention rather than limiting, the scope of the present invention being defined by the appended claims and equivalents thereof.

FIG. 1. illustrates a bronchoscope as known in the art.

FIG. 2 illustrates a nested cannula as known in the art.

FIG. 3 illustrates an exemplary embodiment of a minimally invasive surgery
10 derived from the present invention.

FIG. 4 illustrates a flowchart representative of a minimally invasive surgical method derived from the present invention.

FIG. 5 illustrates an exemplary endoscope navigation and cannula insertion of the minimally invasive surgical method illustrated in FIG. 4.

15 FIG. 6 illustrates an exemplary extension of a nested cannula configuration from a distal end of an endoscope derived from the present invention.

FIG. 7 illustrates an exemplary embodiment of a minimally invasive surgical system derived from the present invention.

FIGS. 8A-8C illustrate flowcharts representative of exemplary embodiments of
20 the minimally invasive surgical method shown in FIG. 4 derived from the present invention.

As previously stated herein, the present invention is premised on the use of an instrument channel of an endoscope to advance nested cannula tubes towards hard-to-reach lesions within the body. The endoscope is used to explore conventionally
25 reachable areas, whereas the nested cannula performs the final expansion to arrive at the desired target location. One benefit of the present invention is the capability of planning a configuration of the nested cannula and precisely navigating the endoscope/nested cannula through small orifices to small lesions. The present invention may be used with any type of endoscope having an instrument channel (e.g. a
30 bronchoscope, a colonoscope, a laryngoscope, etc), and the nested cannula may be used as a guide for optical fibers (diagnostic), drug delivery or therapy delivery (e.g. guide for micro-instruments, gripping instrument, or phototherapy).

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For example, FIG. 3 illustrates bronchoscope 10 and nested cannula 20 for purposes of demonstrating the premise of the present invention. In tandem, the telescoping tubes 21-24 of nested cannula 20 are configured to reach a target location within a bronchial tree 41 of patient 40 via an instrument channel of bronchoscope 10.

5 More particularly, FIG. 4 illustrates a flowchart 50 representative of a minimally invasive surgical method of the present invention that will now be described herein in the context of bronchoscope 10 and nested cannula 20. A stage S51 of flowchart 50 encompasses a navigation of a distal end 11 of bronchoscope 10 to a cannula insertion location defining a position and orientation of distal end 11 relative to
10 bronchial tree 41. For example, as shown in FIG. 5, distal end 11 of bronchoscope 10 is navigated along a path within bronchial tree 41 to a cannula insertion location 60. The cannula insertion location 60 is either pre-operatively planned or intra-operatively determined as will be further explained herein in connection with the description of FIGS. 8A-8C.

15 Cannula insertion location 60 defines a position and orientation of distal end 11 within the bronchial tree 41 for facilitating access by nested cannula 20 to a target location 61 within bronchial tree 41 during a stage S52 of flowchart 50. Specifically, stage S52 encompasses an insertion of nested cannula 20 through an instrument channel of bronchoscope 10 with the telescoping tubes of nested cannula 20 being structurally
20 configured to reach target location 61 from cannula insertion location 60. For example, as shown in FIG. 6, nested cannula 20 is extended from an instrument channel 12 of bronchoscope 10. The cannula insertion location 60 (FIG. 5) of distal end 11 of bronchoscope 10 facilitates telescoping tubes 21-24 reaching target location 61 (FIG. 5). The configuration of nested cannula 20 may be pre-operatively planned or intra-
25 operatively determined as will be further explained herein in connection with the description of FIGS. 8A-8C.

In practice, the present invention does not impose any limitation or any restrictions to the implementation of flowchart 50. Thus, the following description of a minimally invasive surgical system of the present invention as shown in FIG. 7
30 executing three (3) exemplary embodiments of flowchart 50 as shown in FIGS. 8A-8C is provided to facilitate a further understanding of the present invention.

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The system of FIG. 7 is described in the context of the previous description of bronchoscope 10 and nested cannula 20 in connection with FIGS. 3-6. Specifically, the system employs an endoscope tracking unit 70 as known in the art for tracking movement of bronchoscope 10 within bronchial tree 41 of patient 40, a nested cannula configuration unit 80 for configuring nested cannula 20 and selecting/determining the cannula insertion location within bronchial tree 41, and an imaging unit 90 as known in the art for displaying intra-operative images of bronchial tree 41 including bronchoscope 10 and nested cannula 20 (e.g., the image of FIG. 5).

FIG. 8A illustrates a flowchart 100 including a pre-operative stage S101 and intra-operative stage S102 and S103. Stage S101 encompasses a selection of a cannula insertion location and a configuration of nested cannula 20 derived from the selection of the cannula insertion location as well as the target location. For example, as shown in FIG. 5, cannula insertion location 60 is selected by a user via an image of tree 41, and an automatic algorithm plans the NC configuration from cannula insertion location 60. In one embodiment, the system and method of International Publication no. WO 2008/032230 A1, March 20, 2008, entitled "Active Cannula Configuration for Minimally Invasive Surgery" to Karen I. Trovato, the entirety of which is incorporated herein by reference, is modified to utilize the cannula insertion location 60 as the starting location for planning an NC configuration. This planning can involve a minimal set of pre-shaped cannula. For example, tube 21 of nested cannula 20 may be a flexible tube that is used to advance nested cannula 20 through instrument channel 12 of bronchoscope 10 and the remaining cannula 22-24 of nested cannula 20 may be pre-shaped arcs tubes and/or straight tubes.

Upon commencing the surgery, stage S102 encompasses a tracking of bronchoscope 20 to cannula insertion location 60. For example, as shown in FIGS. 5 and 7, endoscope tracking unit 70 (e.g., electromagnetic, optical or imaging) is utilized to track bronchoscope 10 as bronchoscope 10 is navigated along within tree 41 from a larynx location to cannula insertion location 60.

Upon reaching cannula insertion location 60, stage S103 encompasses an insertion of nested cannula 20 through an instrument channel 12 of bronchoscope 10 to reach target location 61. For example, as shown in FIGS. 5-7, tube 21 having tubes 22-24 nested therein is advanced through instrument channel 12 of bronchoscope 10 to

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distal end 11 whereby tubes 21-24 are extended from cannula insertion location 60 to reach target location 61.

FIG. 8B illustrates a flowchart 110 including a pre-operative stage S111 and intra-operative stage S112 and S113. Stages S111-S113 are synonymous with stages S101-S103 (FIG. 8A) except the configuration nested cannula 20 is executed in intra-operative stage S113.

FIG. 8C illustrates a flowchart 120 including intra-operative stages S121-S123. Upon commencing the surgery, stage S121 encompasses a tracking of bronchoscope 10 through bronchial tree 41 whereby a user can select the cannula insertion location 60 while viewing an image of the tracked bronchoscope 10 via imaging unit 90. For example, as shown in FIGS. 5 and 7, endoscope tracking unit 70 (e.g., electromagnetic, optical or imaging) is utilized to track bronchoscope 10 as bronchoscope 10 is navigated from a larynx location in a direction of target location 61 whereby the user ceases navigating bronchoscope 10 upon selecting cannula insertion location 60 which is in suitable proximity of target location 61. Thereafter, stage S122 encompasses a configuration by unit 80 of nested cannula 20 derived from the selected cannula insertion location 60 and target location 61, and stage S123 involves inserting nested cannula 20 through the instrument channel 11 of bronchoscope 10 and extending tubes 21-24 to target location 61.

From FIGS. 3-8C, those having ordinary skill in the art will appreciate many benefits of the present invention including, but not limited to, smaller endoscopes may be used to reach small deep-seeded lesions, the pre-planning of the instrument path facilitates a straightforward approach to reaching the lesions, and no additional hardware is necessary for access to the lesions by nested cannula in view of the cannula insertion location. Furthermore, those having ordinary skill in art will appreciate how to implement the present invention for any type of endoscope as well as various nested cannula configurations.

While various embodiments of the present invention have been illustrated and described, it will be understood by those skilled in the art that the methods and the system as described herein are illustrative, and various changes and modifications may be made and equivalents may be substituted for elements thereof without departing from the true scope of the present invention. In addition, many modifications may be made to adapt

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the teachings of the present invention to entity path planning without departing from its central scope. Therefore, it is intended that the present invention not be limited to the particular embodiments disclosed as the best mode contemplated for carrying out the present invention, but that the present invention include all embodiments falling within

5 the scope of the appended claims.

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Claims

1. A method for accessing a target location (61) relative to an anatomical region (41), the method comprising:
 - 5 navigating a distal end (11) of an endoscope (10) to a cannula insertion location (60) defining a position and an orientation of the distal end (11) of the endoscope (10) relative to the anatomical region (41); and
 - inserting a nested cannula (20) through an instrument channel (12) of the endoscope (10) to the target location (61), wherein the nested cannula (20) includes a
 - 10 plurality of telescoping tubes (21-24) structurally configured to reach the target location (61) relative to the cannula insertion location (60).
2. The method of claim 1, wherein the navigating of the distal end (11) of the endoscope (10) to the cannula insertion location (60) relative to the target location (61)
 - 15 includes:
 - pre-operatively selecting the cannula insertion location (60); and
 - intra-operatively tracking the navigation of the distal end (11) of the endoscope (10) to the cannula insertion location (60).
- 20 3. The method of claim 2, wherein the inserting of the nested cannula (20) through the instrument channel (12) of the endoscope (10) to the target location (61) includes:
 - pre-operatively deriving a configuration of the nested cannula (20) from the cannula insertion location (60) and the target location (61).
- 25 4. The method of claim 2, wherein the inserting of the nested cannula (20) through the instrument channel (12) of the endoscope (10) to the target location (61) includes:
 - intra-operatively deriving a configuration of the nested cannula (20) from the cannula insertion location (60) and the target location (61)
- 30 5. The method of claim 1, wherein the navigating of the distal end (11) of the endoscope (10) to the cannula insertion location (60) relative to the target location (61) includes:

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intra-operatively tracking the navigation of the distal end (11) of the endoscope (10) in a direction of the target location (61); and

intra-operatively determining the cannula insertion location (60) in proximity of the target location (61).

5

6. The method of claim 5, wherein the inserting of the nested cannula (20) through the instrument channel (12) of the endoscope (10) to the target location (61) includes:

intra-operatively deriving a configuration of the nested cannula (20) from the cannula insertion location (60) and the target location (61).

10

7. A device for accessing a target location (61) relative to an anatomical region (41), the system comprising:

an endoscope (10) having a distal end (11) operable to reach an cannula insertion location (60) defining a position and an orientation of the distal end (11) of the endoscope (10) relative to the anatomical region (41); and

15

a nested cannula (20) operable to be inserted through an instrument channel (12) of the endoscope (10) to the target location (61), wherein the nested cannula (20) includes a plurality of telescoping tubes (21-24) structurally configured to reach the target location (61) relative to the cannula insertion location (60).

20

8. The device of claim 7, wherein:

the endoscope (10) is a bronchoscope;

the plurality of telescoping tubes (21-24) includes a flexible tube as a largest tube (21) and the remaining tubes (22-24) as pre-shaped tubes.

25

9. A system for accessing a target location (61) relative to an anatomical region (41), the system comprising:

an endoscope (10) having a distal end (11) operable to reach an cannula insertion location (60) defining a position and an orientation of the distal end (11) of the endoscope (10) relative to the anatomical region (41);

30

a nested cannula (20) operable to be inserted through an instrument channel (12) of the endoscope (10) to the target location (61), wherein the nested cannula (20)

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includes a plurality of telescoping tubes (21-24) structurally configured to reach the target location (61) relative to the cannula insertion location (60); and

an imaging unit (90) operable to display intra-operative images of the anatomical region (41) including the endoscope (10) and the nested cannula (20).

5

10. The system of claim 9, further comprising:

a nested cannula configuration unit (80) operable to pre-operatively select the cannula insertion location (60); and

an endoscope (10) tracking unit (70) operable to intra-operatively track the navigation of the distal end (11) of the endoscope (10) to the cannula insertion location (60).

11. The system of claim 10, wherein the nested cannula configuration unit (80) is further operable to pre-operatively derive a configuration of the nested cannula (20) from the cannula insertion location (60) and the target location (61).

12. The system of claim 10, wherein the nested cannula configuration unit (80) is further operable to intra-operatively deriving a configuration of the nested cannula (20) from the cannula insertion location (60) and the target location (61).

20

13. The system of claim 9, further comprising:

an endoscope (10) tracking unit (70) operable to intra-operatively track the navigation of the distal end (11) of the endoscope (10) in a direction of the target location (61).

25

14. The system of claim 13, further comprising:

a nested cannula configuration unit (80) operable to intra-operatively determine the cannula insertion location (60) in proximity of the target location (61).

15. The system of claim 14, wherein the nested cannula configuration unit (80) is further operable to intra-operatively deriving a configuration of the nested cannula (20) from the cannula insertion location (60) and the target location (61).

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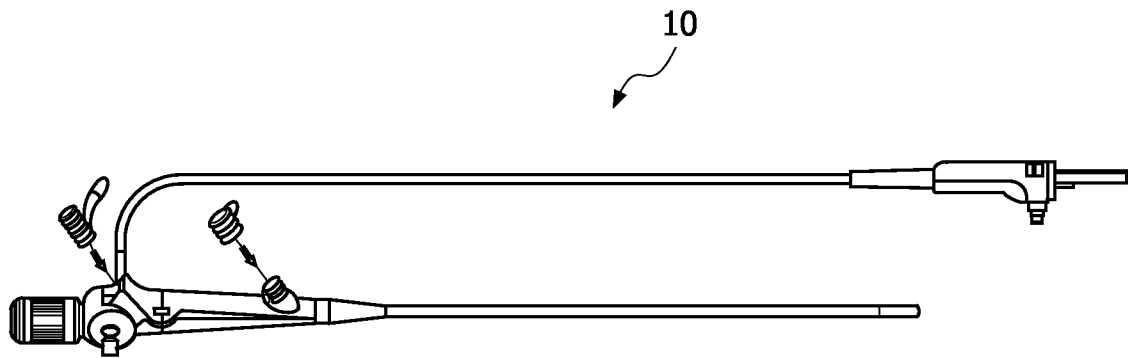


FIG. 1
(PRIOR ART)

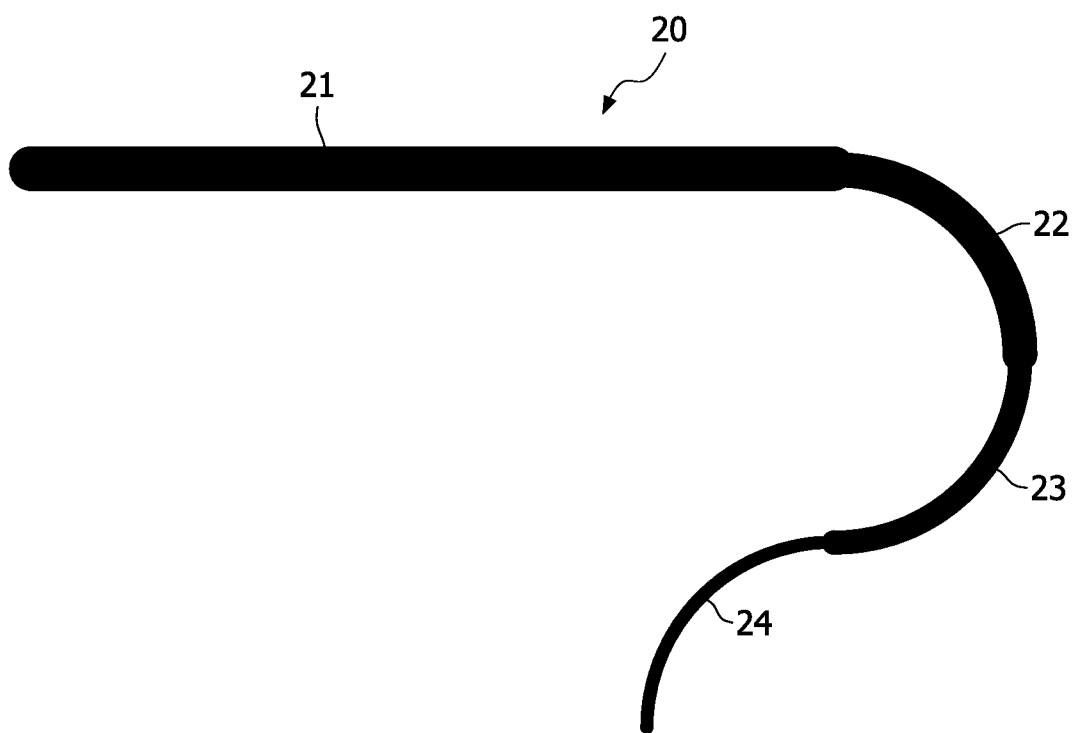


FIG. 2
(PRIOR ART)

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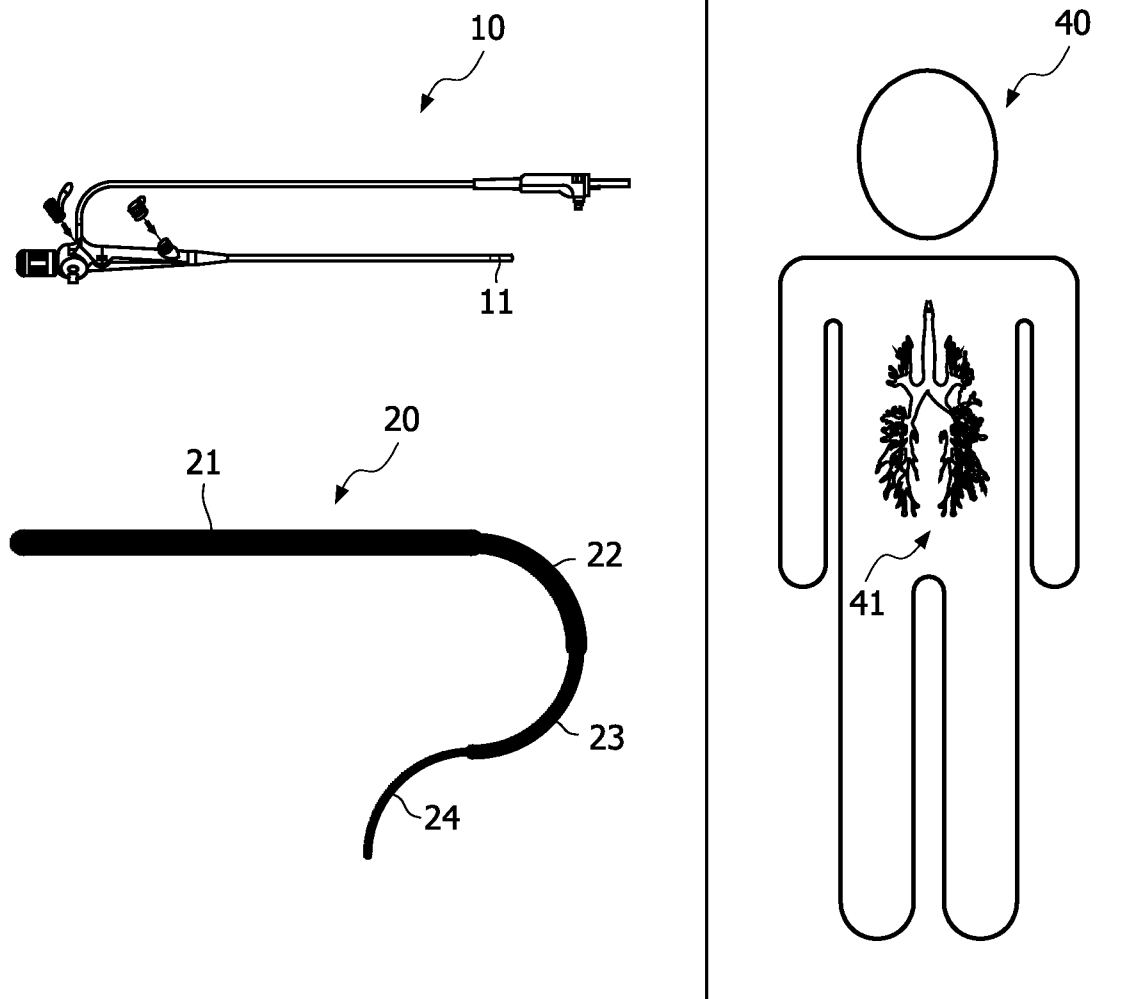


FIG. 3

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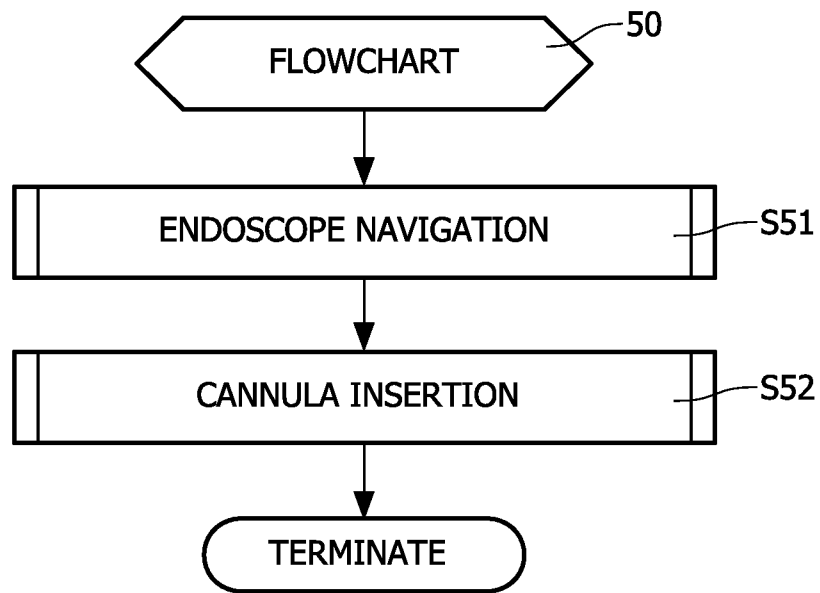


FIG. 4

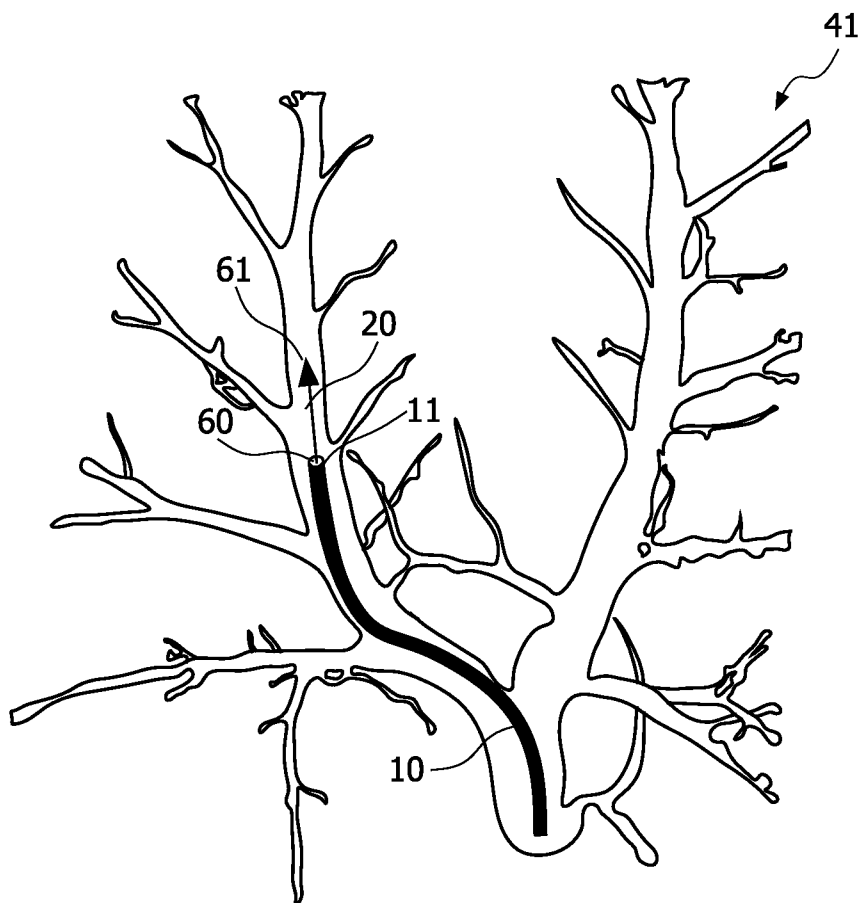


FIG. 5

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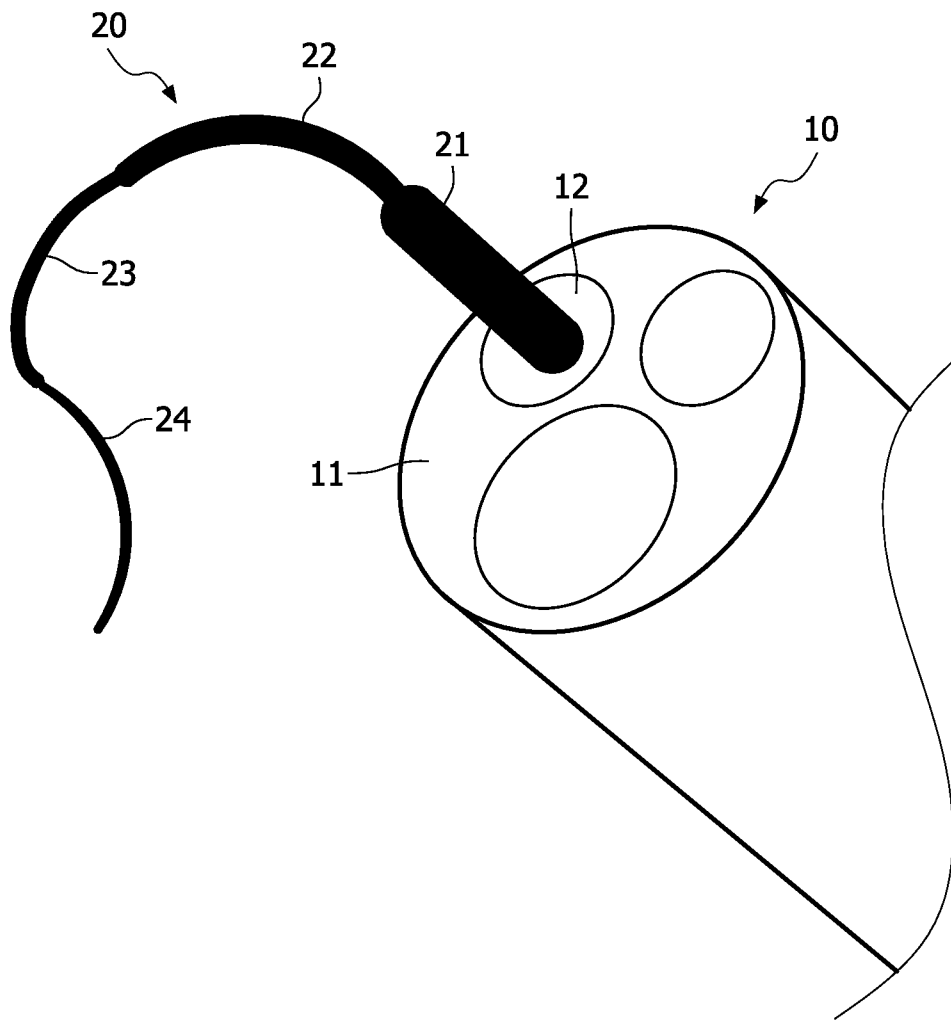


FIG. 6

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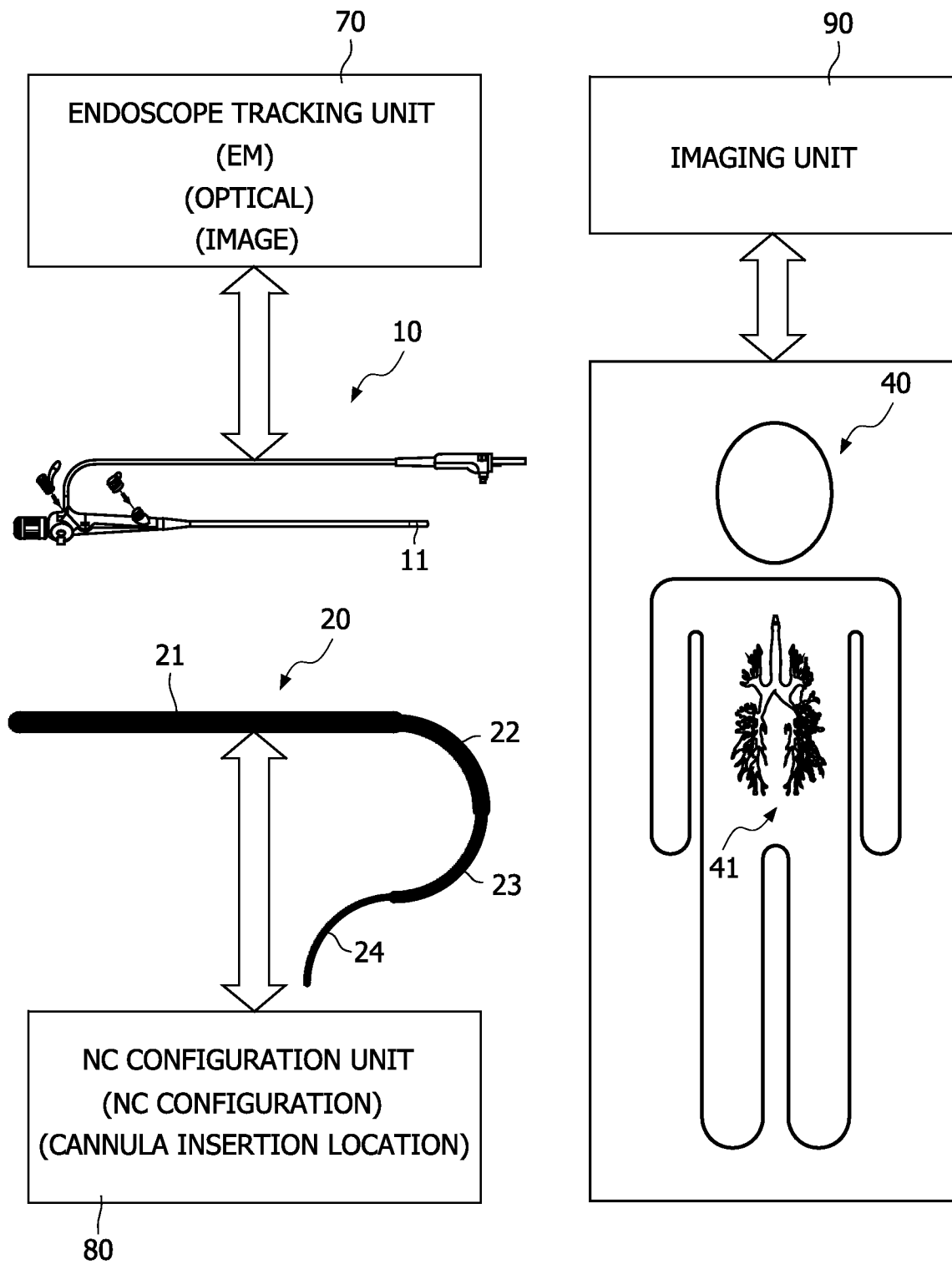


FIG. 7

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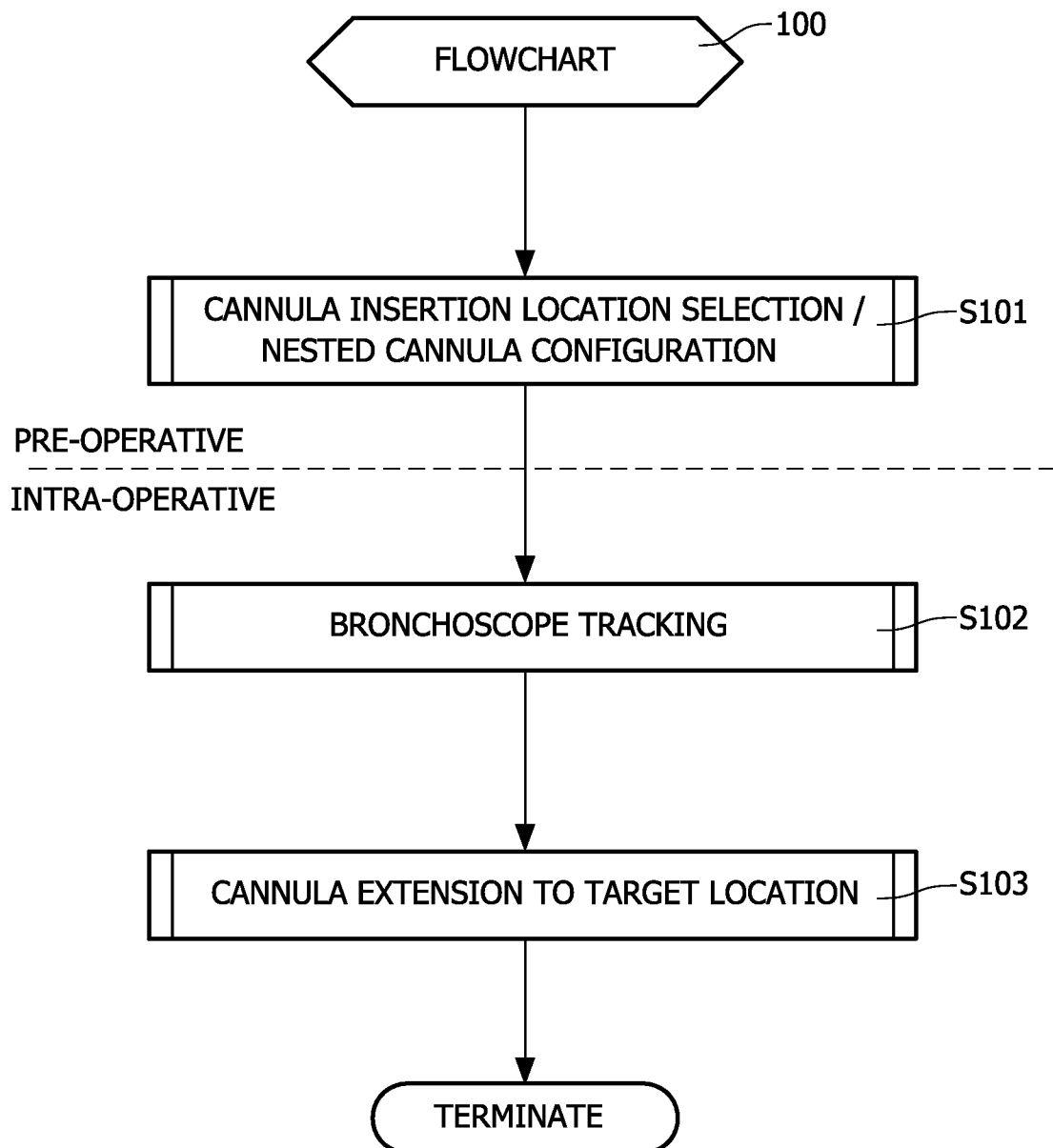


FIG. 8A

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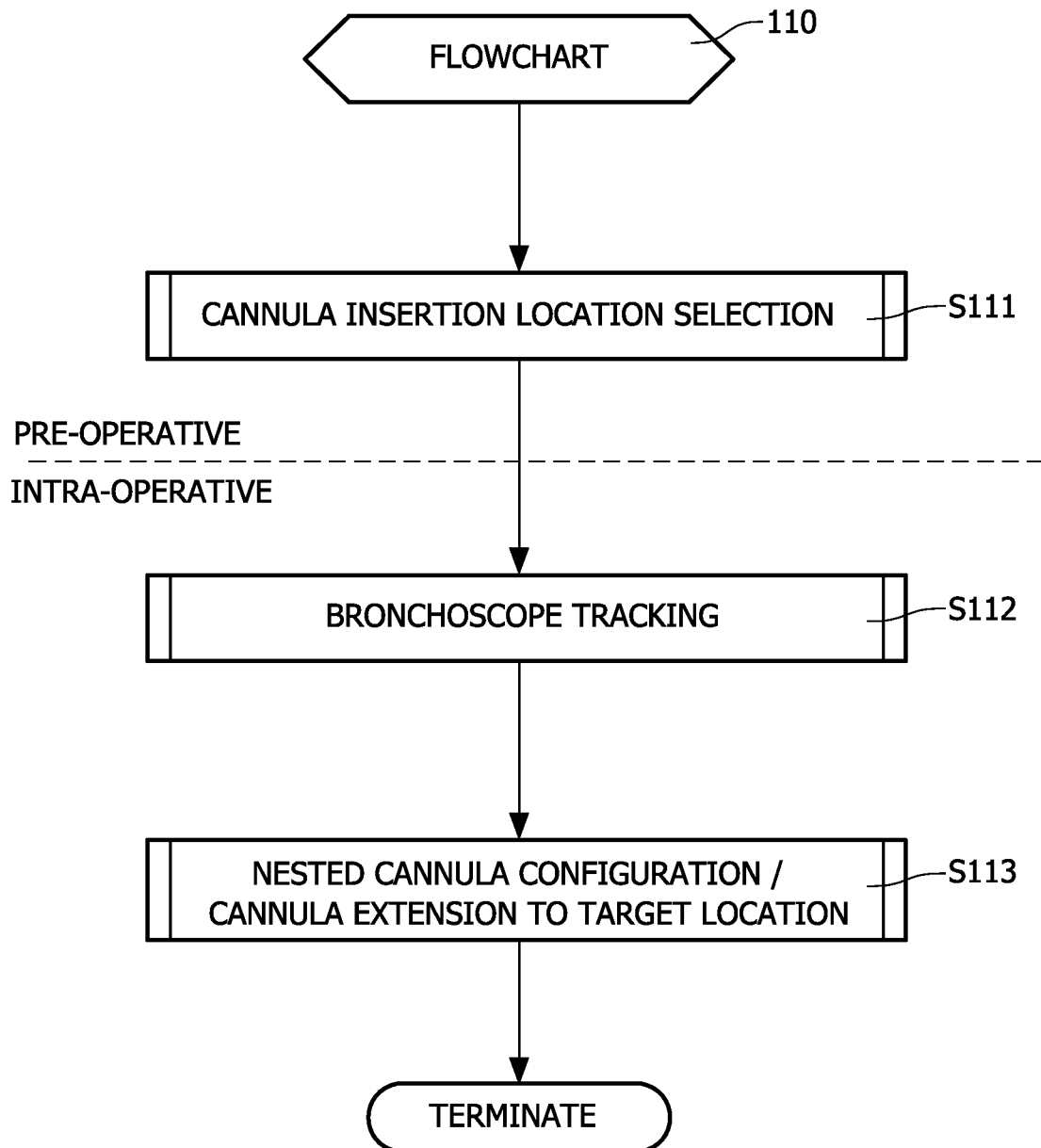


FIG. 8B

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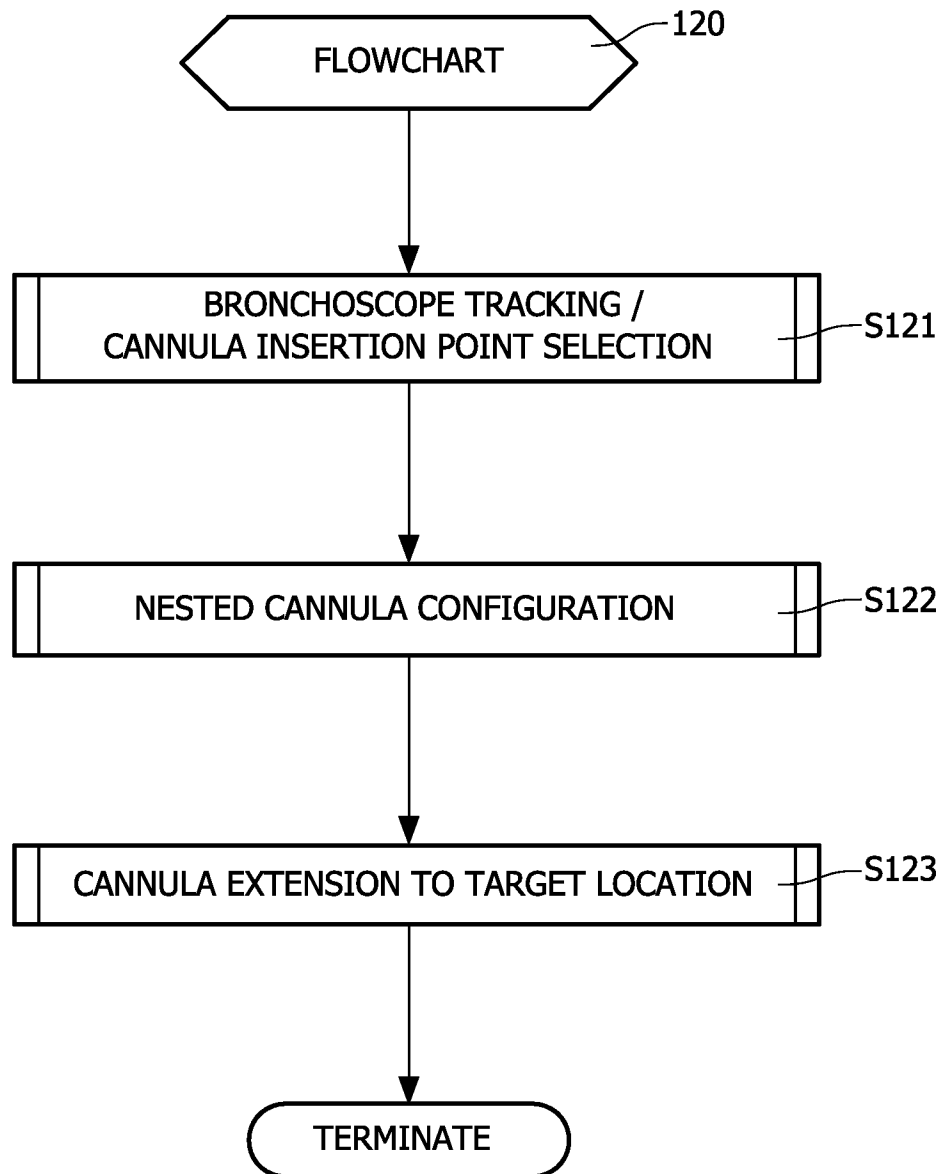


FIG. 8C

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2009/054991

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B17/34 A61B17/00 A61B19/00
ADD. A61B1/018 A61B1/267 A61M25/00

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)

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 practical, 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	DE 42 23 897 A1 (DAUM WOLFGANG [DE] DAUM GMBH [DE]) 27 January 1994 (1994-01-27) column 1, line 2 - column 2, line 18; claims 1-4; figures 1-3 -----	7-15
A	US 2006/184016 A1 (GLOSSOP NEIL D [CA]) 17 August 2006 (2006-08-17) paragraph [0003] - paragraph [0031]; figures 1-10 paragraph [0043] - paragraph [0107] -----	7-15
A	WO 2007/059233 A2 (UNIV JOHNS HOPKINS [US]) 24 May 2007 (2007-05-24) paragraph [0003] - paragraph [0021]; figures 1-6 paragraph [0035] - paragraph [0053] paragraph [0061] - paragraph [0092] ----- -/--	7-15

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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"E" earlier document but published on or after the international filing date

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"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

18 February 2010

Date of mailing of the international search report

25/02/2010

Name and mailing address of the ISA/

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Authorized officer

Neef, Tatjana

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2009/054991

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/032230 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; TROVATO KAREN I [US]) 20 March 2008 (2008-03-20) cited in the application page 1, line 4 - page 4, line 29; figures 1-9 page 5, line 23 - page 9, line 5 page 10, line 8 - page 18, line 18	7-15
A	US 5 788 713 A (DUBACH MARK [US] ET AL) 4 August 1998 (1998-08-04) column 5, line 46 - column 61, line 21; figures 1-10	7-15
A	WO 2008/111070 A2 (TOLKOWSKY DAVID [IL]) 18 September 2008 (2008-09-18) page 1, line 17 - page 13, line 14; figures 1-7 page 15, line 15 - page 28, line 2 page 34, line 1 - page 65, line 29	7-15
A	WO 98/29032 A1 (BIOSENSE INC [US]; BEN HAIM SHLOMO [IL]) 9 July 1998 (1998-07-09) page 1, line 11 - page 6, line 8; figures 1-2 page 7, line 1 - page 9, line 7	7-15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2009/054991

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.: 1-6
because they relate to subject matter not required to be searched by this Authority, namely:
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

Information on patent family members

International application No

PCT/IB2009/054991

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
DE 4223897	A1	27-01-1994	NONE	
US 2006184016	A1	17-08-2006	CA 2588002 A1 EP 1838378 A2 WO 2006078678 A2	27-07-2006 03-10-2007 27-07-2006
WO 2007059233	A2	24-05-2007	CA 2630061 A1 EP 1973595 A2 JP 2009515657 T US 2009171271 A1	24-05-2007 01-10-2008 16-04-2009 02-07-2009
WO 2008032230	A1	20-03-2008	EP 2066245 A1 US 2009248045 A1	10-06-2009 01-10-2009
US 5788713	A	04-08-1998	AU 3146495 A EP 0774929 A1 JP 10503105 T WO 9603087 A1	22-02-1996 28-05-1997 24-03-1998 08-02-1996
WO 2008111070	A2	18-09-2008	EP 2117436 A2	18-11-2009
WO 9829032	A1	09-07-1998	AT 371405 T AT 261700 T AT 289182 T AU 735196 B2 AU 5338798 A AU 741737 B2 AU 5338898 A CA 2247942 A1 DE 69728142 D1 DE 69728142 T2 DE 69732523 D1 DE 69732523 T2 DE 69738092 T2 DK 1491139 T3 DK 893967 T3 DK 901341 T3 EP 0893967 A1 EP 0901341 A1 ES 2291814 T3 ES 2216180 T3 ES 2236836 T3 HK 1072534 A1 WO 9829033 A1 IL 126015 A IL 126016 A	15-09-2007 15-04-2004 15-03-2005 05-07-2001 31-07-1998 06-12-2001 31-07-1998 09-07-1998 22-04-2004 20-01-2005 24-03-2005 16-02-2006 21-05-2008 02-01-2008 21-06-2004 30-05-2005 03-02-1999 17-03-1999 01-03-2008 16-10-2004 16-07-2005 18-07-2008 09-07-1998 06-07-2003 24-06-2003
WO 9829032	A1		JP 2000508223 T JP 3949729 B2 JP 2000508224 T JP 3949730 B2 PT 1491139 E PT 893967 E PT 901341 E	04-07-2000 25-07-2007 04-07-2000 25-07-2007 25-09-2007 30-07-2004 29-04-2005