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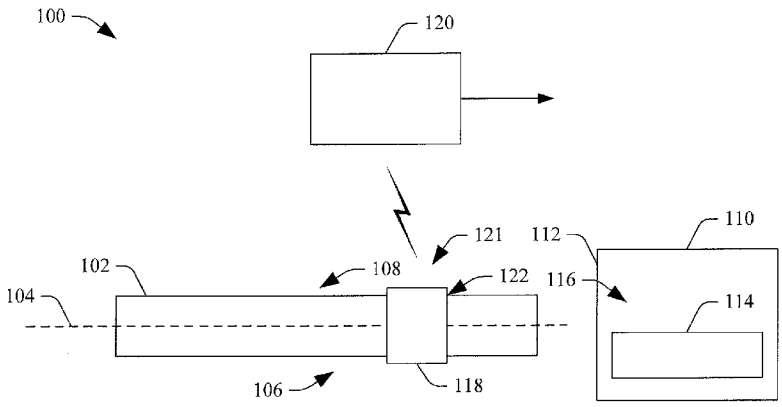

FIGURE 1

(57) Abstract: A system (100) includes an elongate instrument (102) having a long axis (104). The elongate instrument includes a first end portion (106; 202) along the long axis. The elongate instrument further includes a second end portion (108; 208) along the long axis, opposing the first end portion. The elongate instrument further includes an annular location determining device (118) disposed to surround a perimeter of a surface (122; 210) of a sub-region (124; 212) of the first end portion about the long axis. The annular location determining device generates a signal indicative of a three dimensional location of the annular location determining device, which indicates of a three dimensional location of the first end portion.

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INSTRUMENT ANNULAR LOCATION SENSOR

TECHNICAL FIELD

The following generally relates to determining a location of an instrument in three dimensional space and more particularly to an instrument with an annular location sensor that generates information indicative of a location of the instrument in three dimensional space, and is described with particular application to ultrasound (US) imaging; however, the following is also amenable to other medical and/or non-medical imaging modalities.

BACKGROUND

An ultrasound imaging apparatus has included a transducer array that transmits an ultrasound beam into an examination field of view. As the beam traverses structure (e.g., an object or subject, an instrument, etc.) in the field of view, sub-portions of the beam are attenuated, scattered, and/or reflected off the structure, with some of the reflections (echoes) traversing back towards the transducer array. The transducer array receives and processes the echoes, and generates one or more images of the subject or object and/or instrument. Ultrasound imaging has been used to guide medical procedures such as biopsies, ablations, laparoscopic, and/or other medical and/or non-medical procedures.

With medical procedures such as biopsies, ablations, laparoscopic, and/or other medical and/or non-medical procedures in which an instrument is inserted into a closed container where its location in the container is not readably discernable within the human, it is often desirable to monitor and/or track the location of the instrument in the container. One approach to monitoring and/or tracking the location of the instrument in the container has been to place one or more sensors on a side and/or handle of the instrument and employ a monitoring and/or tracking system the receives a signal from the sensor(s), processes the signal, and determines the location of the instrument in the container based on a result of the processing.

Unfortunately, such a sensor(s) is not well-suited for tracking the instrument when the instrument bends in a direction orthogonal to the sensor. As such, there is a need for an alternative approaches for monitoring and/or tracking the location of such an instrument in a container.

SUMMARY

Aspects of the application address the above matters, and others.

In one aspect, a system includes an elongate instrument having a long axis. The elongate instrument includes a first end portion along the long axis. The elongate instrument further includes a second end portion, opposing the first end portion. The elongate instrument further includes an annular location determining device disposed to surround a perimeter of a surface of a sub-region of the first end portion about the long axis. The annular location determining device generates a signal indicative of a three dimensional location of the annular location determining device, which indicates of a three dimensional location of the first end portion.

In another aspect, a method includes receiving a signal from an annular location determining device surrounding a long axis of a first end portion of an elongate instrument. The annular location determining device is inside of a closed container and the signal provides information of a three dimensional location of the annular location determining device. The method further includes processing the signal and determining the three dimensional location of first end portion in the closed container. The method further includes determining if the first end portion is at a region of interest in the closed container based on the three dimensional location. The method further includes providing first feedback indicating the first end portion is at the region of interest in the closed container in response to determining the first end portion is at the region of interest, and second feedback indicating the first end portion is at the region of interest in the closed container in response to determining the first end portion is at the region of interest.

In another aspect, a system includes a medical instrument including a tip and an annular location determining device that generates a signal with information indicative of a 3D location of the tip inside of a subject. The system further includes an ultrasound imaging device that generates an image and processes the signal, and displays the image with a graphical representation of at least the tip of medical instrument superimposed thereover.

Those skilled in the art will recognize still other aspects of the present application upon reading and understanding the attached description.

BRIEF DESCRIPTION OF THE DRAWINGS

The application is illustrated by way of example and not limited by the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figure 1 schematically illustrates a system with an elongate instrument with an annular location determining device disposed about a long axis of the instrument;

Figure 2 schematically illustrates an example in which the elongate instrument includes a needle and the annular location determining device surrounds an entirety of a perimeter of the needle;

Figure 3 schematically illustrates the example in which the annular location determining device disposed proximate a tip of the instrument;

Figure 4 schematically illustrates the example in which the annular location determining device disposed distal to a tip of the instrument;

Figure 5 schematically illustrates the example in which the annular location determining device disposed proximate a mid-region of the instrument;

Figure 6 schematically illustrates an example in which the annular location determining device does not surround the entirety of the perimeter of the needle;

Figure 7 schematically illustrates an example in which the annular location determining device includes two sub-devices that surround the perimeter of the needle;

Figure 8 schematically illustrates an example in which the annular location determining device includes a plurality of segments sequentially aligned around the perimeter of the needle;

Figure 9 schematically illustrates an example in which the annular location determining device is part of a sheath that removably installs over the elongate instrument;

Figure 10 schematically illustrates an example the elongate instrument in connection with an imaging apparatus;

Figure 11 schematically illustrates a first example the imaging apparatus;

Figure 12 schematically illustrates a second example the imaging apparatus; and

Figure 23 illustrates an example method in accordance with the elongate instrument with the annular location determining device as described herein.

DETAILED DESCRIPTION

Figure 1 schematically illustrates a system 100, which includes, at least, an elongate instrument 102 having a long axis 104 and including a first end portion 106 and a second end portion 108, which are located at opposing ends along the long axis 104. The instrument 102 is shown in connection with a container 110, which has a surface 112 and internal structure 114, and is closed in that an inside 116 of the container 110 is not readily visible from outside of the container 110 to the human eye.

The instrument 102, generally, can be any instrument in which one of the end portions 106 or 108 is configured for insertion into the container 110, it is desired to track and/or monitor the location and/or movement of the instrument 102 in the container 110, and the instrument 102 is not visible to the human eye when the instrument 102 is inside of the container 110. Examples of such an instrument for a medical application include, but are not limited to, a biopsy needle, an ablation catheter, and a laparoscopic probe.

For explanatory purposes, Figure 2 shows an example in which the first end portion 106 includes an elongate needle 202 with a shaft 204 and a tip 206. The second end portion 108 (not shown) may include a handle, an instrument actuation mechanism, etc. For sake of brevity, other example instruments are not shown, but one of ordinary skill in the art, based at least in view of the description herein, would understand that the instrument can be another medical instrument such as an ablation catheter, a laparoscopic probe, etc., and/or a non-medical instrument.

Returning to Figure 1, the instrument 102 includes a location determining device ("LDD") 118 such as a sensor, a detector, and/or the like. The illustrated device 118 has an annular or closed-ring shape and completely surrounds a perimeter 122 of a sub-portion of the first end portion 106 about the long axis 104 of the instrument 102. The illustrated device 118 completely surrounds a middle region 121 of the end portion 106. In a variation, the device 118 is an open ring that surrounds less than the entire perimeter, e.g., from 50% (or 180 degrees) to less than 100% (or 360 degrees), such as 99.9%.

An example is shown in connection with Figure 2. In Figure 2, the device 118 is disposed proximate or adjacent to a surface 210 of a sub-portion 212 of the shaft 204 closer to the tip 206 than the second end portion 108. In other embodiments, the device 118 is disposed even closer to the tip 206 (e.g., at the tip 206), closer to the second end

portion 108 than the tip 206, at a mid-region 208 of the first end portion 106, e.g., respectively as shown in Figures 3, 4 and 5.

Other locations for the device 118 are also contemplated herein. In Figures 2, 3, 4 and 5, the location determining device 118 is shown raised above the surfaces 122 and 210. In a variation, the device 118 can be even with the surfaces 122 and 210 and/or recessed within the surfaces 122 and 210. In addition, the instrument 102 may have more than one location determining device 118. It is also to be appreciated that the geometry and relative size of the device 118 is for explanatory purposes and is not limiting.

Figure 6 shows an embodiment in which the device 118 does not completely surround (or only partially surrounds) the surface 210. Figure 7 shows an embodiment in which the device 118 includes multiple sub-devices 118_1, ..., 118_N, where N is a positive integer greater than two. In this example, N = 2, and each sub-device is hemispherical in shape. In Figure 8, the device 118 includes a plurality of linear segments 118_1, ..., 118_M, where M is a positive integer greater than two, sequentially arranged about the surface 210 to form a ring.

Returning to Figure 1, the device 118 can include an electric/electronic, a magnetic, an optical sensor and/or detector, a combination thereof, and/or other sensor and/or detector. Such devices may route signals therefrom through a physical communication path from the device 118, through the instrument 102, and to another device. Alternatively, the device 118 and/or the instrument 102 may include a wireless communication interface through which the signals are routed off the instrument 102. In either case, the signal from the device 118 will include location information.

In the illustrated example, the device 118 is built into and is part of the instrument 102. In a variation, the device 118 can be a separate component that attaches to the instrument 102. For example, in one non-limiting instance, the device 118 is part of a sheath or the like that installs over the first end portion 106. In one instance, the sheath is disposable. In another instance, the sheath is washable, disinfectable, and/or sterilizable, and re-usable. Figure 9 shows an example in which the device 118 is part of a sheath 902.

Returning to Figure 1, the illustrated device 118 generates a signal that includes information indicative of a three dimensional location of the device 118 and hence the first end portion 106. This includes the location of the first end portion 106 in three dimensional space, even in the event of bending of the first end portion 106 as the first end

portion 106 passes through the surface 112 of the container 110 and/or the structure 114 within the container 110.

An instrument position determiner 120 receives the signal from the device 118 and determines, from the signal, the location and/or orientation of the device 118 in three dimensional space and, hence, the first end portion 106 in three dimensional space. The instrument position determiner 120 generates an output signal indicative of the location and/or orientation the first end portion 106 in three dimensional space. The output signal can be conveyed to a tracking system, a monitoring system, a robotic system, an imaging system, and/or other system.

Examples of suitable position determiner systems are described in U.S. patent application serial number 12/703,706, filed February 10, 2010, and entitled "Ultrasound Systems Incorporating Position Sensors and Associated Method,", and U.S. patent application serial number 12/775,403, filed May 6, 2010, and entitled "Freehand Ultrasound Imaging Systems and Methods for Guiding Elongate Instruments," both which are incorporated herein by reference in their entireties. Other approaches are also contemplated herein.

Figure 10 shows an example with the instrument 102 described in connection with Figure 2 in connection with an imaging apparatus 1000 for a biopsy procedure.

For this example, the tip 206 of the needle 202 is to be navigated or moved into an object or region of interest 1002 (e.g., tissue, fluid, etc.) of a patient 1004, which serves as the container 110 in this example. In this example, the needle 202, under guidance of images generated by the imaging apparatus 1000, is passed through the surface 112 and moved to tissue of interest 1002.

The imaging apparatus 1000 can be ultrasound (US), magnetic resonance (MR), computed tomography (CT), and/or other imaging apparatus, e.g., that generates imaging data which can be used to visually observe the needle 202 during an imaging-guided procedure such as a biopsy, a surgical, and/or other procedure. That is, an image generated will visually show the needle 202 and hence its location, if the needle 202 is within an imaging field of view 1006.

In one instance, the imaging apparatus 1000 receives the signal from the instrument position determiner 120 and displays the image with a graphical representation of the first end portion 106 superimposed thereover. The resulting image facilitates a user

with navigating the first end portion 106 to the structure 114 in the container 110. In Figure 10, this is equivalent to the image facilitating the tip 206 of the needle through the surface 112 of the patient 104 to the object of interest 1002. Examples of such representations are described in the '706 patent application and the '403 patent application. Other approaches are also contemplated herein.

Figures 11 and 12 illustrate examples of the system 100 in which the imaging apparatus 1000 includes an US imaging device. The instrument 102 is not visible, not installed, etc. in Figures 11 and 12.

In Figure 11, the imaging system 1000 includes a console 1102 and a separate US transducer probe 1004 that interfaces therewith. The ultrasound transducer probe 1104 includes a transducer array with a plurality of transducer elements 1106. The transducer array can be linear, curved, and/or otherwise shaped, fully populated, sparse and/or a combination thereof, etc. The transducer elements 1106 can be operated in 2D and/or 1D mode. The transducer elements 1106 transmit ultrasound signals and receive echo signals.

Transmit circuitry 1112 selectively actuates or excites one or more of the transducer elements 1106. More particularly, the transmit circuitry 1112 generates a set of pulses (or a pulsed signal) that are conveyed to the transducer elements 1106. The set of pulses actuates a set of the transducer elements 1106, causing the transducer elements 1106 to transmit ultrasound signals into an examination or scan field of view.

Receive circuitry 1114 receives a set of echoes (or echo signals) generated in response to the transmitted ultrasound signals. The echoes, generally, are a result of the interaction between the emitted ultrasound signals and the object (e.g., flowing blood cells, organ cells, etc.) in the scan field of view. The receive circuit 1114 may be configured for spatial compounding, filtering (e.g., FIR and/or IIR), and/or other echo processing.

A beamformer 1116 processes the received echoes. In B-mode, this includes applying time delays and weights to the echoes and summing the delayed and weighted echoes. A scan converter 1118 scan converts the data for display, e.g., by converting the beamformed data to the coordinate system of a display or display region used to visually present the resulting data.

A user interface (UI) 1120 include one or more input devices (e.g., a button, a knob, a slider, etc., touchscreen and/or physical mechanical device) and/or one or more

output devices (e.g., a liquid crystal display, a light emitting diode, etc.), which allows for interaction with the system 100.

A display 1022 visually displays the US imaging data. A controller 1124 controls the various components of the imaging system 1000. For example, such control may include actuating or exciting individual or groups of transducer elements 1106 of the transducer array for B-mode, C-plane, etc.

The US probe 1104 and the display 1022 are physically separate electromechanical components with respect to the console 1102. The US probe 1104 and the display 1022 communicate with the console 1102 through communications paths 1126 and 1128. The communications paths 1126 and 1128 can be wired (e.g., a physical cable and connectors) and/or wireless.

Figure 12 illustrates a variation of the US imaging system 1000. In this example, the console 1102 includes a single housing 1202. The single housing 1202 houses and physically supports the transducer elements 1106, the transmit circuitry 1112, the receive circuitry 1114, the beamformer 1116, the scan converter 1118 and the controller 1124, all of which are inside the single housing 1202, which is the physical mechanical casing of the console.

The user interface 1120 and/or the display 1122 can be part of the housing 1202. For example, the display 1122, in one instance, is a sub-portion of one of the sides of the housing 1202. The user interface 1120 may include physical mechanical controls at other locations on the housing 1202. The transducer elements 1106 are disposed in the housing 1202 behind an ultrasound window and emits ultrasound signals and receives echoes there through.

In Figure 12, the US imaging system 1000 may be a hand-held ultrasound apparatus, which uses internally located power, e.g., from a power source such as a battery, a capacitor, etc. to power the components therein, and/or power from an external power source. An example of a hand-held device is described in US 7,699,776 to Walker et al., entitled "Intuitive Ultrasonic Imaging System and Related Method Thereof," and filed on March 14, 2003, which is incorporated herein in its entirety by reference.

An example of hand-held ultrasound apparatus with an internal instrument guide is described in serial number 13/017,344 to O'Connor, entitled "Ultrasound imaging apparatus," and filed on January 31, 2011, and an example with an external instrument

guide is described in US 8,226,562 to Pelissier, entitled "Hand-Held Ultrasound System Having Sterile Enclosure," and filed on August 7, 2008, both of which are incorporated herein in their entirety by reference.

The imaging systems in Figure 11 and 12 can be employed with an instrument guide, which holds the instrument 102. The instrument guide may be attached to the imaging systems 1000, separate therefrom, and/or internal to the imaging systems 1000. Furthermore, the instrument 102 can be utilized without the instrument guide, for example, free hand and/or by an electro-mechanical device such as a robotic arm.

Figure 13 illustrates an example method for recording a location and an orientation of an interventional instrument at a point in time of a predetermined interventional event.

It is to be understood that the following acts are provided for explanatory purposes and are not limiting. As such, one or more of the acts may be omitted, one or more acts may be added, one or more acts may occur in a different order (including simultaneously with another act), etc.

At 1302, a region of interest is identified in a cavity.

At 1304, an instrument with an annular location determining device is positioned in a cavity.

At 1306, the annular location determining device transmits a signal indicative of a three dimensional location of the instrument in the cavity.

At 1308, the signal is received by an instrument location determiner.

At 1310, the instrument position determiner processes the signal, generating a location signal, which identifies the three dimensional location of the instrument in the cavity.

At 1312, it is determined whether the instrument is at the region of interest based on the identified the three dimensional location.

In response to determining the first end portion is not at the region of interest, at 1314, first feedback (e.g., visual, audible, etc.) indicating the first end portion is not at the region of interest in the closed container is provided, at 1316, the instrument is re-positioned in response to the instrument not being at the region of interest, and acts 1306 to 1312 are repeated.

In response to determining the first end portion is at the region of interest, at 1318, second feedback (e.g., visual, audible, etc.) indicating the first end portion is at the region

of interest in the closed container is provided, and, at 1320, the instrument is actuated to perform a function.

The methods described herein may be implemented via one or more processors executing one or more computer readable instructions encoded or embodied on computer readable storage medium which causes the one or more processors to carry out the various acts and/or other functions and/or acts. Additionally or alternatively, the one or more processors can execute instructions carried by transitory medium such as a signal or carrier wave.

The application has been described with reference to various embodiments. Modifications and alterations will occur to others upon reading the application. It is intended that the invention be construed as including all such modifications and alterations, including insofar as they come within the scope of the appended claims and the equivalents thereof.

CLAIMS

What is claimed is:

1. A system (100), comprising:

an elongate instrument (102) having a long axis (104), the elongate instrument including:

a first end portion (106; 202) along the long axis;

a second end portion (108; 208) along the long axis, opposing the first end portion;

an annular location determining device (118) disposed to surround a perimeter of a surface (122; 210) of a sub-region (124; 212) of the first end portion about the long axis,

wherein the annular location determining device generates a signal indicative of a three dimensional location of the annular location determining device, which indicates of a three dimensional location of the first end portion.

2. The system of claim 1, wherein the annular location determining device includes a closed ring that surrounds an entirety of the perimeter about the sub-region.

3. The system of claim 1, wherein the annular location determining device includes an open ring that does not surround an entirety of the sub-region.

4. The system of any of claims 1 to 3, wherein the annular location determining device includes at least two sub-portions (118_1, ..., 118_N) that surround the perimeter of the sub-region.

5. The system of any of claims 1 to 3, wherein the annular location determining device includes a plurality of linear segments sequentially disposed about the surface of the sub-region.

6. The system of any of claims 1 to 5, wherein the annular location determining device is disposed at a first region of the first end portion.

7. The system of claim 6, wherein the annular location determining device includes a tip (206) and an opposing region affixed to the second end portion, and the annular location determining device is at a first distance from the tip and a second distance from the second end portion, and the first distance is less than the second distance.

8. The system of claim 6, wherein the annular location determining device includes a tip and an opposing region affixed to the second end portion, and the annular location determining device is at a first distance from the tip and a second distance from the second end portion, and the first distance is greater than the second distance.

9. The system of claim 6, wherein the annular location determining device includes a tip and an opposing region affixed to the second end portion, and the annular location determining device is at a first distance from the tip and a second distance from the second end portion, and the first distance is equal to the second distance.

10. The system of any of claims 1 to 9, wherein the annular location determining device is part of sheath removably installable over the first end portion.

11. The system of any of claims 1 to 9, wherein the annular location determining device physically is part the first end portion of the elongate instrument.

12. The system of any of claims 1 to 11, further comprising:

an instrument position determiner (120) that determines a position of the first end portion based on the signal indicative of the three dimensional location of the annular location determining device.

13. The system of any of claims 1 to 12, wherein the instrument is one of a biopsy needle, an ablation catheter, or a laparoscopic device.

14. The system of any of claims 1 to 13, further comprising:

an imaging device (1000) that generates an image and displays the image with a graphical representation of the first end portion overlaid of the image at a position based on the signal.

15. A method, comprising:

receiving a signal from an annular location determining device surrounding a long axis of a first end portion of an elongate instrument, wherein the annular location determining device is inside of a closed container and the signal provides information of a three dimensional location of the annular location determining device;

processing the signal and determining the three dimensional location of first end portion in the closed container;

determining if the first end portion is at a region of interest in the closed container based on the three dimensional location; and

providing first feedback indicating the first end portion is at the region of interest in the closed container in response to determining the first end portion is at the region of interest, and second feedback indicating the first end portion is at the region of interest in the closed container in response to determining the first end portion is at the region of interest.

16. The method of claim 15, further comprising:

re-positioning the first end portion in response to the first feedback.

17. The method of any of claims 15 to 16, further comprising:

actuating the elongate instrument to perform a first function in response to the second feedback.

18. The method of claim 17, wherein the first function is acquire a sample of tissue of interest at the region of interest.

19. The method of claim 17, wherein the first function is ablate tissue of interest at the region of interest.

20. A system (100), comprising:

a medical instrument (102) including a tip (206) and an annular location determining device (118) that generates a signal with information indicative of a 3D location of the tip inside of a subject; and

an ultrasound imaging device (1000) that generates an image, processes the signal, and displays the image with a graphical representation of at least the tip of medical instrument superimposed thereover.

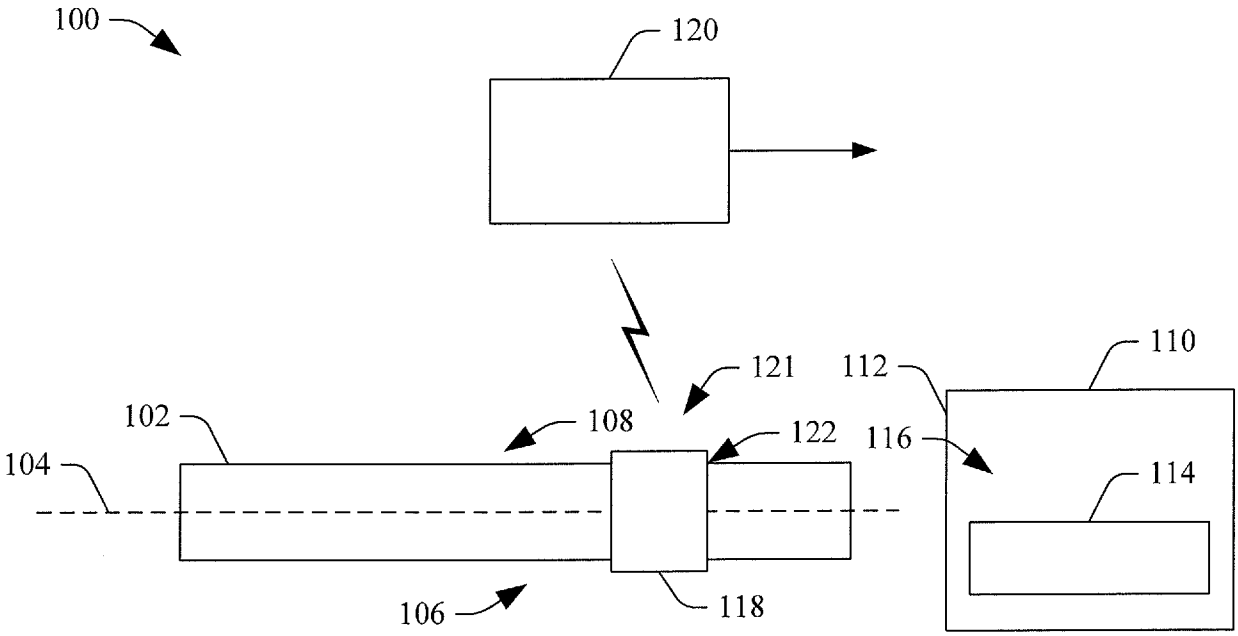

FIGURE 1

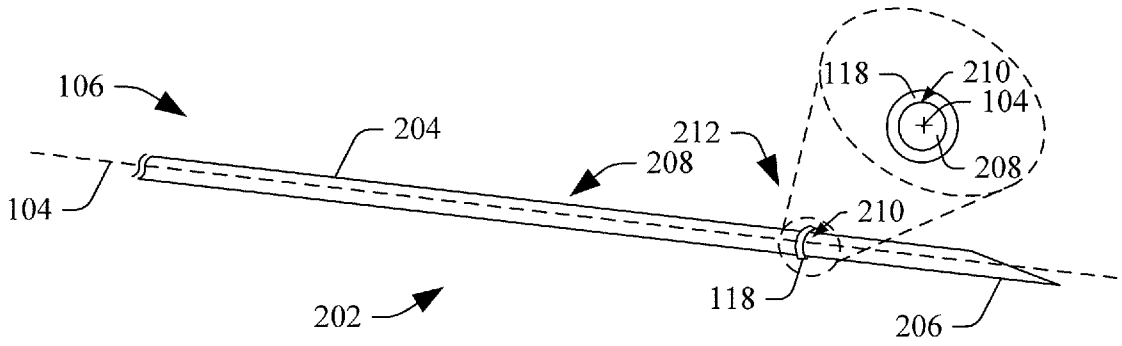

FIGURE 2

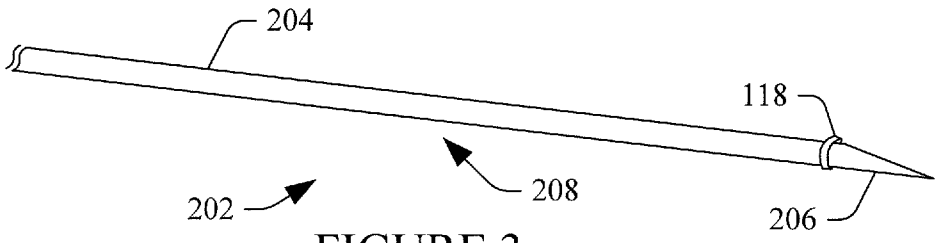

FIGURE 3

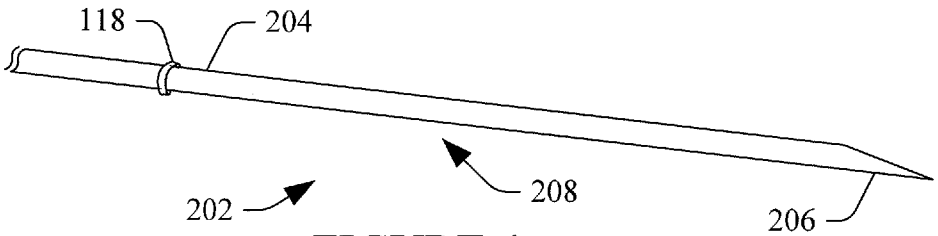

FIGURE 4

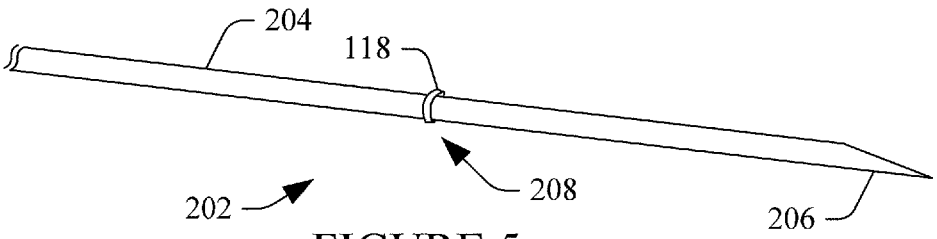

FIGURE 5

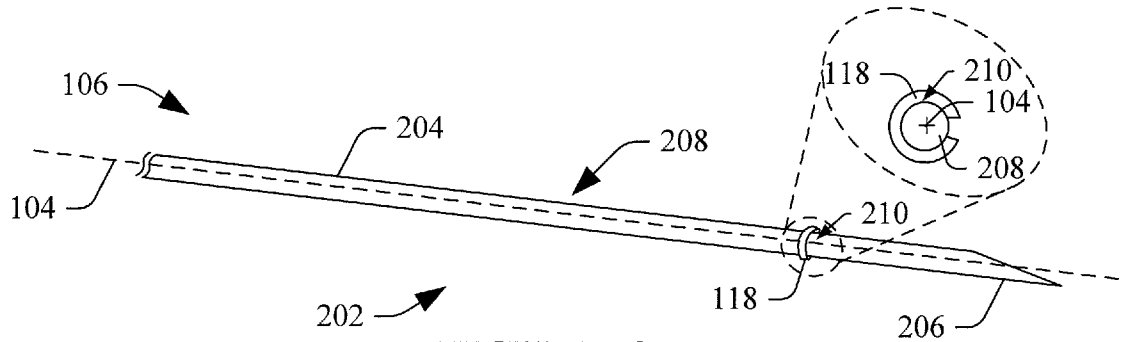

FIGURE 6

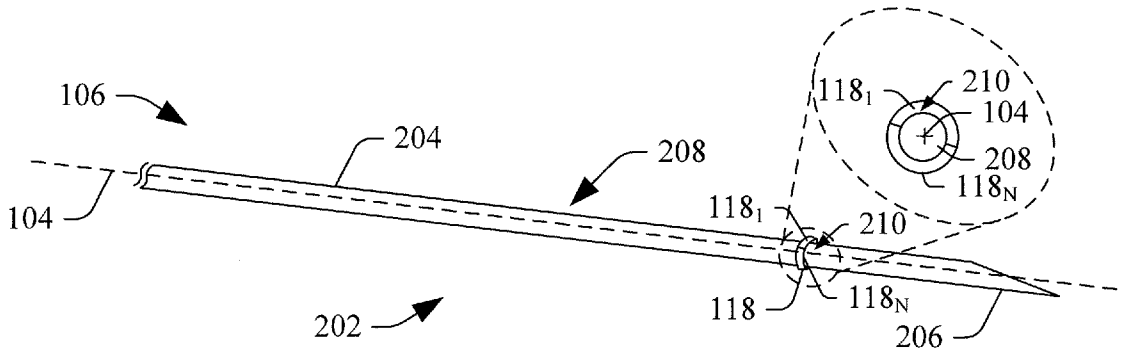

FIGURE 7

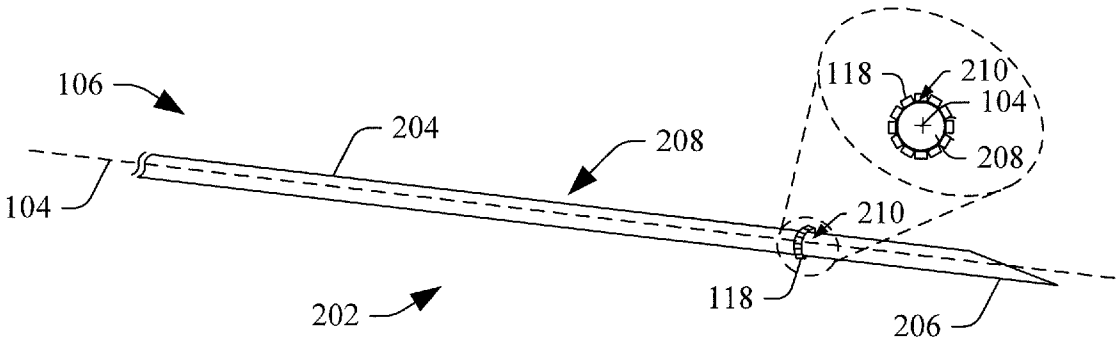

FIGURE 8

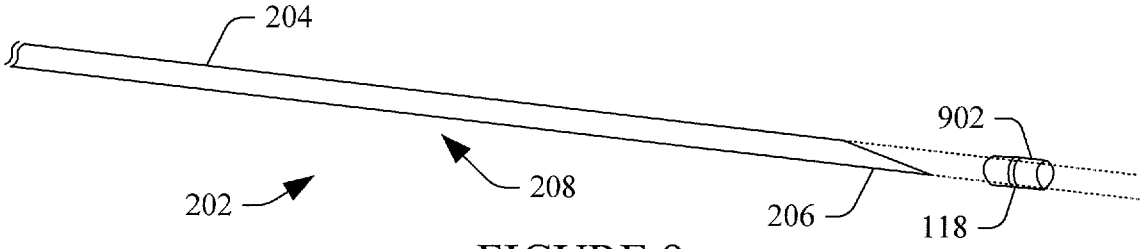

FIGURE 9

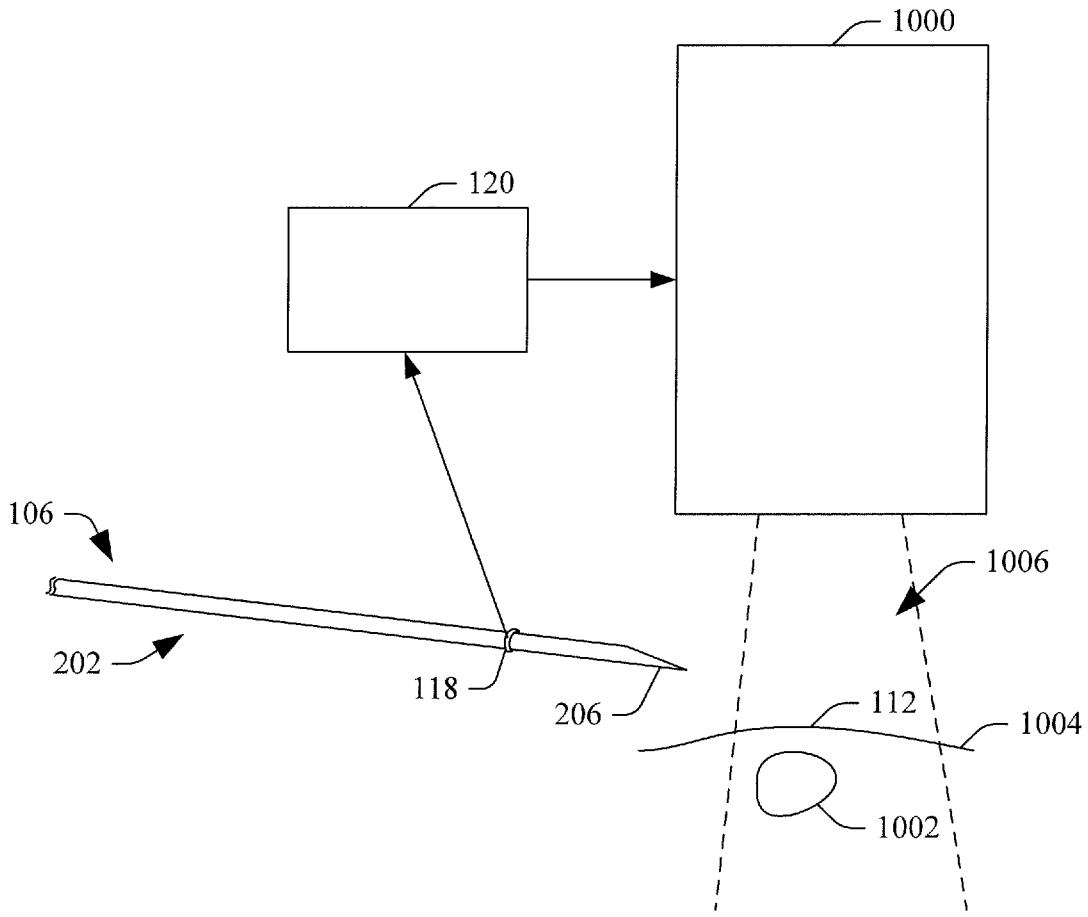

FIGURE 10

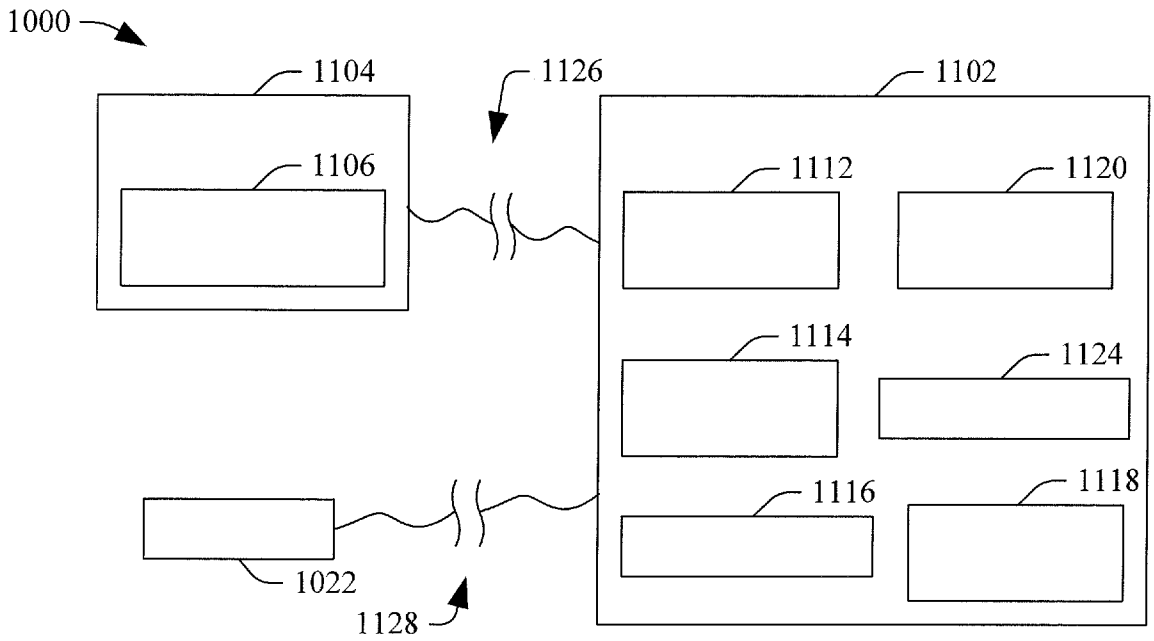

FIGURE 11

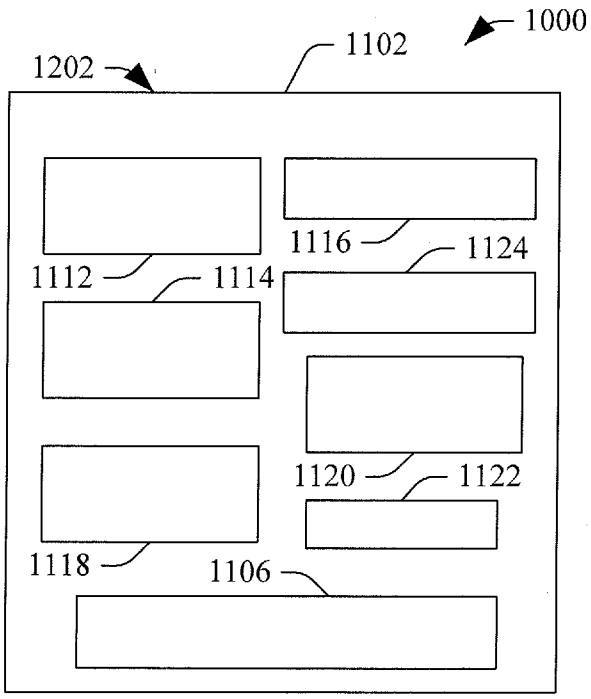

FIGURE 12

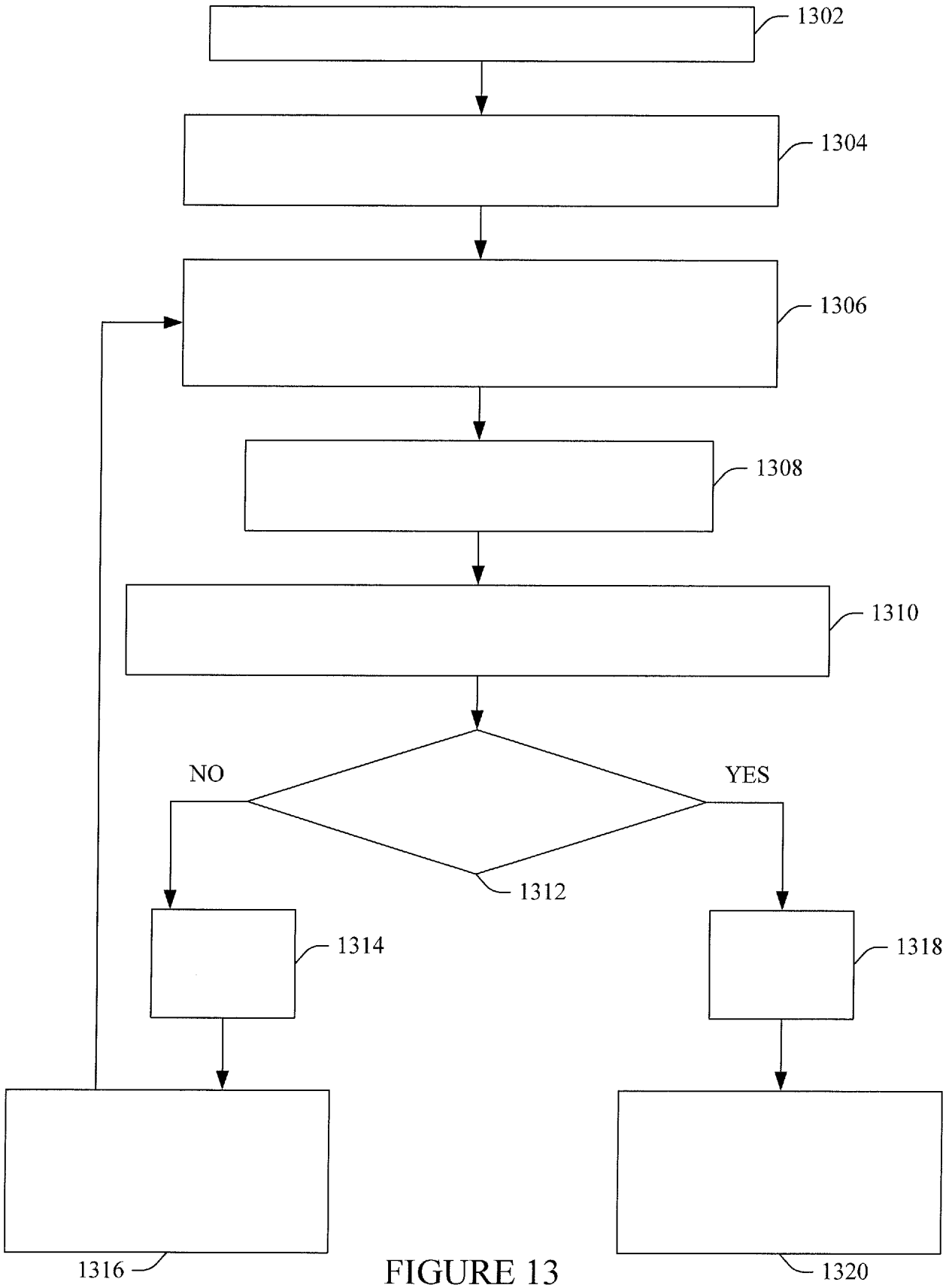

FIGURE 13

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/048185

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B19/00
ADD. A61B17/34

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 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	WO 03/039370 A1 (COMPUTERIZED MED SYST INC [US]) 15 May 2003 (2003-05-15) paragraphs [0037] - [0044], [0052] - [0054], [0075], [0076]; figures 7-13	1-14,20
X	WO 2010/104850 A1 (MEDTRONIC XOMED INC [US]; JACOBSEN BRAD [US]; MOWLAI-ASHTIANI ALI [US]) 16 September 2010 (2010-09-16) paragraphs [0032], [0050] - [0053], [0058] - [0061]; figures 1-3	1-4, 6-14,20
X	US 2014/012130 A1 (JACOBSEN BRAD [US] ET AL) 9 January 2014 (2014-01-09) paragraphs [0040] - [0062], [0068] - [0071]; figures 1-12	1-14

-/--

[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
28 November 2014	08/12/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Maier, Christian

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/048185

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. [X] Claims Nos.: 15-19
because they relate to subject matter not required to be searched by this Authority, namely:

see FURTHER INFORMATION sheet PCT/ISA/210

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/US2014/048185

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97/29684 A1 (BIOSENSE INC [US]; ACKER DAVID E [US]; MILLET MARCUS J [US]; FENSTER M) 21 August 1997 (1997-08-21) page 2, lines 6-36 page 25, line 5 - page 27, line 14 figures 10,11 -----	1-9, 11-13

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2014/048185

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 03039370 A1	15-05-2003	CN 1612713 A	04-05-2005
		EP 1460938 A1	29-09-2004
		US 2003112922 A1	19-06-2003
		WO 03039370 A1	15-05-2003
WO 2010104850 A1	16-09-2010	EP 2405846 A1	18-01-2012
		US 2010234724 A1	16-09-2010
		US 2013317355 A1	28-11-2013
		WO 2010104850 A1	16-09-2010
US 2014012130 A1	09-01-2014	NONE	
WO 9729684 A1	21-08-1997	AU 720441 B2	01-06-2000
		AU 2131497 A	02-09-1997
		DE 69734714 D1	29-12-2005
		DE 69734714 T2	20-07-2006
		EP 0910278 A1	28-04-1999
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		IL 125754 A	01-12-2002
		JP 3964462 B2	22-08-2007
		JP 2000506409 A	30-05-2000
		US 6253770 B1	03-07-2001
		WO 9729684 A1	21-08-1997

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 15-19

Pursuant to Article 17(2)(a)(i) PCT, this Authority is not required to search the subject-matter of claims 15-19, since the method defined in independent claim 15 represents a method for treatment of the human or animal body by surgery, as it encompasses a surgical step, see dependent claims 17,19 (Rule 39.1(iv) and Rule 43bis PCT).

专利名称(译)	仪表环形位置传感器		
公开(公告)号	EP3171807A1	公开(公告)日	2017-05-31
申请号	EP2014752480	申请日	2014-07-25
申请(专利权)人(译)	ANALOGIC CORPORATION		
当前申请(专利权)人(译)	ANALOGIC CORPORATION		
[标]发明人	OCONNOR JOHN P		
发明人	O'CONNOR, JOHN, P.		
IPC分类号	A61B34/00 A61B17/34		
CPC分类号	A61B34/20 A61B8/0841 A61B8/483 A61B10/02 A61B18/1492 A61B34/30 A61B2017/3413 A61B2018/00577 A61B2034/2063 A61B2090/378 A61B2090/3983		
外部链接	Espacenet		

摘要(译)

系统（100）包括具有长轴（104）的细长器械（102）。细长器械包括沿长轴的第一端部（106; 202）。细长器械还包括沿着长轴的第二端部（108; 208），与第一端部相对。细长器械还包括环形位置确定装置（118），其设置成围绕长轴围绕第一端部的子区域（124; 212）的表面（122; 210）的周边。环形位置确定装置产生指示环形位置确定装置的三维位置的信号，其指示第一端部的三维位置。