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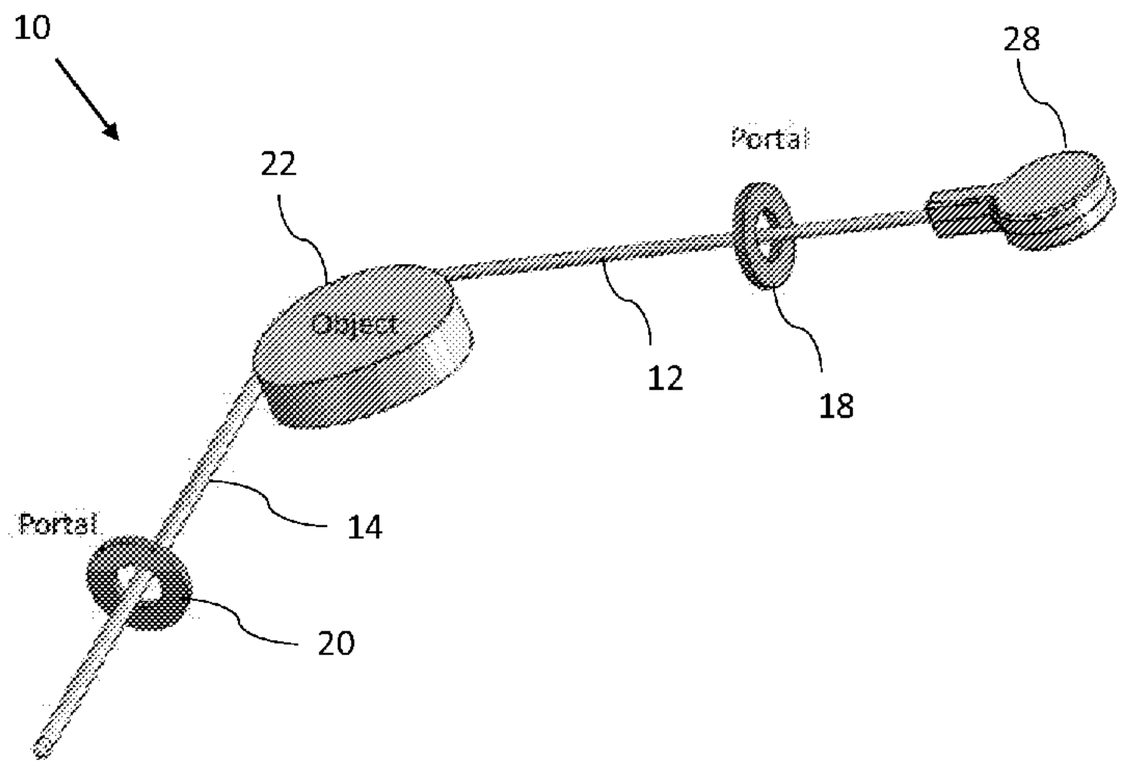

FIG. 2

(57) Abstract: A surgical measuring device for accurately and intraoperatively measuring an anatomic feature of interest. The device includes a first rigid member connected to a second rigid member. A flexible reference tool is connected to and between the first rigid member and the second rigid member. In a first configuration, the flexible reference tool has an exposed length between the first and second rigid members. A measurement interpretation mechanism is connected to the flexible reference tool and indicates a measurement of the exposed length of the flexible reference tool.

[Continued on next page]

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INTRA-ARTICULAR MEASURING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to and the benefit of U.S. Provisional Patent Application Number 62/934,750, filed on November 13, 2019 and entitled "Intraoperative Measuring Device" and U.S. Provisional Patent Application 62/958,051, filed on January 7, 2020 and entitled "Intra-articular Measuring Device," the entireties of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a surgical measuring device and, more particularly, to a surgical measuring device for accurately and intraoperatively measuring an anatomic feature of interest.

2. Description of Related Art

[0003] Certain arthroscopic surgical procedures require accurate measurements to be obtained of key anatomical features. The measurements may support the assessment or evaluation of an injury, or support a key procedural step in corrective surgical techniques. In the case of an arthroscopic repair, one of the most difficult tasks is to easily and reliably measure distances to estimate the length required for repairs. The measured distances are critical to construction of a graft that is dimensioned to match the patient's anatomic defect. For example, the measurement of the anatomical rim of the acetabulum during labral reconstruction is required to prepare an appropriately sized graft. The success of the procedure depends on the accuracy of the measurement, which is affected by both the skill of the operator and the precision of the measuring tool.

[0004] Existing intra-articular measuring tools on the market are often made of rigid or semi-flexible materials, and this limits the ability of the tools to follow the contours of anatomical features. The resultant mismatch between the geometry of the measuring tool and the anatomical feature of interest must then be bridged by the experience and skill of the surgeon.

[0005] Therefore, there exists a need for a measuring device with a flexible component that can support more accurate intra-articular measurements of anatomical features.

[0006] The term "suture" as used herein may be any type of filamentous material such as a biocompatible or bioabsorbable filament, ribbon, tape, woven or non-woven material.

[0007] Description of the Related Art Section Disclaimer: To the extent that specific patents/publications/products are discussed above in this Description of the Related Art Section or elsewhere in this disclosure, these discussions should not be taken as an admission that the discussed patents/publications/products are prior art for patent law purposes. For example, some or all of the discussed patents/publications/products may not be sufficiently early in time, may not reflect subject matter developed early enough in time and/or may not be sufficiently enabling so as to amount to prior art for patent law purposes. To the extent that specific patents/publications/products are discussed above in this Description of the Related Art Section and/or throughout the application, the descriptions/disclosures of which are all hereby incorporated by reference into this document in their respective entirety(ies).

BRIEF SUMMARY OF THE INVENTION

[0008] Embodiments of the present invention are directed to an intraoperative measuring device. The device includes a first rigid member connected to a second rigid member. A flexible reference tool is connected to and between the first rigid member and the second rigid member. In a first configuration, the flexible reference tool has an exposed length between the first and second rigid members. A measurement interpretation mechanism is connected to the flexible reference tool and indicates a measurement of the exposed length of the flexible reference tool.

[0009] According to another aspect, the present invention is a method for intraoperatively measuring an anatomical feature. The method includes the steps of: (i) providing an intraoperative measuring device comprising a first rigid member connected to a second rigid member, a flexible reference tool connected to and between the first rigid member and the second rigid member, and a measurement interpretation mechanism connected to the flexible reference tool; (ii) pulling the second rigid member away from the first rigid member, exposing a length of the flexible reference tool; (iii) wrapping the exposed length of the flexible reference tool around the anatomical feature; (iv) positioning the first rigid member and the second rigid member at separate points on the anatomical feature; (v) tensioning the flexible reference tool; and (vi) determining, based on the measurement interpretation mechanism, a measurement of the exposed length of the flexible reference tool.

[0010] According to an alternative method for intraoperatively measuring an anatomical feature, the method includes the steps of: (i) providing an intraoperative measuring device comprising a first rigid member and a separate second rigid member, a flexible reference tool connected to the first rigid member, the flexible reference tool terminating in an exposed suture loop, a measurement interpretation mechanism connected to the flexible reference tool, and a distal hook connected to the second rigid member; (ii) grabbing the exposed suture loop of the first rigid member with the distal hook of the second rigid member; (iii) pulling the second rigid member away from the first rigid member, exposing a length of the flexible reference tool; (iv) positioning the first rigid member and the second rigid member at separate points on the anatomical feature; (v) tensioning the flexible reference tool; and (vi) determining, based on the measurement interpretation mechanism, a measurement of the exposed length of the flexible reference tool.

[0011] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0012] The present invention will be more fully understood and appreciated by reading the following Detailed Description in conjunction with the accompanying drawings. The accompanying drawings illustrate only typical embodiments of the disclosed subject matter and are therefore not to be considered limiting of its scope, for the disclosed subject matter may admit to other equally effective embodiments. Reference is now made briefly to the accompanying drawings, in which:

[0013] FIG. 1 is a perspective view of a measuring device in a closed configuration, according to an embodiment;

[0014] FIG. 2 is a perspective view of the measuring device in use in an open configuration, according to an embodiment;

[0015] FIG. 3 is a top view of the measuring device in use in the open configuration, according to an embodiment;

[0016] FIG. 4 is a close-up, top view of a measurement interpretation mechanism of the measuring device, according to an embodiment;

[0017] FIG. 5 is a top view of a measurement interpretation mechanism of the measuring device, according to an alternative embodiment;

[0018] FIG. 6 is a top view of a first rigid member of the measuring device, according to an embodiment;

[0019] FIG. 7 is a side view of a second rigid member of the measuring device, according to an alternative embodiment;

[0020] FIG. 8 is perspective and top views schematic representations of a measuring device, according to an alternative embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0021] Aspects of the present invention and certain features, advantages, and details thereof, are explained more fully below with reference to the non-limiting examples illustrated in the accompanying drawings. Descriptions of well-known structures are omitted so as not to unnecessarily obscure the invention in detail. It should be understood, however, that the detailed description and the specific non-limiting examples, while indicating aspects of the invention, are given by way of illustration only, and are not by way of limitation. Various substitutions, modifications, additions, and/or arrangements, within the spirit and/or scope of the underlying inventive concepts will be apparent to those skilled in the art from this disclosure.

[0022] Referring now to the figures, wherein like reference numerals refer to like parts throughout, FIG. 1 is a perspective view of a measuring device 10 in a closed (second) configuration, according to an embodiment. The measuring device 10 comprises a first hollow, rigid member 12 and a second hollow, rigid member 14. The first and second rigid members 12, 14 are connected to a flexible reference tool 16 (FIG. 3). Specifically, the flexible reference tool 16 is directly connected to and between the first rigid member 12 and the second rigid member 14. In the closed configuration shown in FIG. 1, the first rigid member 12 is extended into a lumen (not shown) of the second rigid member 14.

[0023] In the closed configuration, as shown in FIG. 1, the measuring device 10 is inserted into an intra-articular space through a first portal 18 (FIG. 2). From the closed configuration, the (now-distal) second rigid member 14 is partially pushed through a second portal 20 (FIG. 2). After the measuring device 10 is within the joint (i.e., intra-articular space), the first and second rigid members 12, 14 are pulled apart, i.e., away from each other, to expose the flexible reference tool 16 (FIG. 3).

[0024] Turning now to FIG. 2, there is shown a perspective view of the measuring device 10 in use in an open (first) configuration, according to an embodiment. With the first rigid

member 12 extending through the first portal 18 and the second rigid member 14 extending through the second portal 20, the reference tool 16 (FIG. 3) can be placed along any anatomical feature 22. The flexibility of the reference tool 16 allows the reference tool 16 to closely follow the curvature and any irregularities in the perimeter of the anatomical feature 22.

[0025] Referring now to FIG. 3, there is shown a top view of the measuring device 10 in use in the open configuration, according to an embodiment. The measuring device 10 includes a tension mechanism (not shown) that maintains the flexible reference tool 16 under tension during usage in the open configuration. A distal end 24 of the first rigid member 12 and a distal end 26 of the second rigid member 14 are positioned and placed at deliberate points along the anatomical feature 22. At the deliberate points, the tension in the reference tool 16 allows only the necessary length of the reference tool 16 to spool out. Therefore, the exposed length of the reference tool 16 closely matches (or is approximately equal to) the length of the anatomical feature 22 of interest.

[0026] In FIG. 3, the reference tool 16 closely approximates the arc length from point A to point B on the anatomical feature 22 of interest. Point A represents the deliberate placement point of the distal end 24 of the first rigid member 12 and point B represents the deliberate placement point of the distal end 26 of the second rigid member 14 on the anatomical feature 22. In the depicted embodiment, the reference tool 16 is a length of suture; however, any other flexible material can be used.

[0027] Turning now to FIG. 4, there is shown a close-up, top view of a measurement interpretation mechanism 28 of the measuring device 10, according to an embodiment. The measuring device 10 additionally includes a measurement interpretation mechanism 28. The measurement interpretation mechanism 28 provides a means to interpret the measurement of the reference tool 16 around the anatomical feature 22 as a known quantity. In an embodiment, the measurement interpretation mechanism 28 is one or more reference features along the length of the reference tool 16. In particular, the reference features 28 are placed at specific intervals along the reference tool 16.

[0028] In the embodiment shown in FIG. 4, the reference features 28 are knots along the length of the reference tool 16. In the embodiment wherein the reference tool 16 is a length of suture, the reference features 28 are knots formed in the suture at regular intervals. However, in alternative embodiments, the reference features 28 are markings or any other component that visually indicates the locations of the nodes of the intervals. By laying the reference tool 16

along an anatomical feature 22 of interest, the user may estimate the approximate length of the anatomical feature 22 by quantifying the reference features 28.

[0029] Referring now to FIG. 5, there is shown a top view of the measurement interpretation mechanism 28 of the reference tool 16, according to an alternative embodiment. In the depicted embodiment, the measurement interpretation mechanism 28 is a spool 30 in a circular housing 32 connected to the first rigid member 12 (also shown in FIGs. 1-2). The reference tool 16 (e.g., suture) is wrapped around and connected to the spool 30. The circular housing 32 comprises a viewing window 34 showing at least a portion of an interior dial 36 connected to the spool 30. In use, the reference tool 16 is pulled out from the spool 30 as the reference tool 16 wraps around the anatomical feature 22, causing the dial 36 to rotate. Rotation of the dial 36 is visible to the user via the viewing window 34. The dial 36 has indicators 38, such as line markings, to quantify the amount of the reference tool 16 that has spooled out, i.e., the amount of reference tool 16 extending around the perimeter of the anatomical feature 22.

[0030] Turning now to FIGs. 6-7, there are shown components of a multi-component embodiment of the measuring device 100. In the depicted embodiment, the measuring device 100 is composed of two separate components, a first rigid member 102 (FIG. 6) and a second rigid member 104 (FIG. 7). The first and second rigid members 102, 104 are connected (at least temporarily) in a first configuration and separate in a second configuration.

[0031] FIG. 6 shows a top view of a first rigid member 102, according to an embodiment. The first rigid member 102 has a proximal measurement interpretation mechanism 128 connected to a hollow shaft 114. The hollow shaft 114 houses the flexible reference tool 116. In the depicted embodiment, flexible reference tool 116 terminates in a suture loop 120 extending distally from the hollow shaft 114. The flexible reference tool 116 is connected to the measurement interpretation mechanism 128.

[0032] In an alternative embodiment, the measurement interpretation mechanism 128 is not connected to the first rigid member 102 and instead is one or more knots along the reference tool 116. Accordingly, the measurement interpretation mechanism 128 can be any of those described above with reference to FIGs. 4 and 5. In the embodiment shown in FIG. 6, the measurement interpretation mechanism 128 comprises the spool 30 in the circular housing 32, as described above and shown in FIG. 5. The circular housing 32 may comprise a viewing window 34 and interior dial 36, as detailed above, for the purpose of quantifying the amount of the reference tool 116 that has spooled out.

[0033] FIG. 7 shows a side view of the second rigid member 104, according to an embodiment. The exemplary second rigid member 104 shown in FIG. 7 has a proximal handle 106 connected to a shaft 108. The shaft 108 extends to a distal hook 110 (similar to a crochet hook). The hook 110 in FIG. 7 has a rounded distal tip 112 that prevents trauma or damage at the surgical site.

[0034] In use, the first and second rigid members 102, 104 are passed into the intra-articular space separately. Then, the first and second rigid member 102, 104 are linked together internally to achieve the same functionality as the embodiment of the measuring device 10 described above and shown in FIGs. 1-5. Specifically, once the first and second rigid members 102, 104 are in the intra-articular space, the distal hook 110 of the second rigid member 104 is used to grab the suture loop 120 of the reference tool 116 of the first rigid member 102, temporarily connecting the first and second rigid members 102, 104. With the suture loop 120 secured within the distal hook 110, the second rigid member 104 (and/or first rigid member 102) can be maneuvered to pull the reference tool 16 around the anatomical feature 122 of interest. The measurement interpretation mechanism 128 can then be used to determine the amount of the reference tool 116 surrounding the anatomical feature 122 (i.e., the exposed length of the reference tool 116), which may then be quantified to determine the size of the anatomical feature 122.

[0035] Turning now to FIG. 8, there are shown perspective and top views schematic representations of a measuring device 200, according to an alternative embodiment. The measuring device 200 comprises a shaft 202 extending to a measurement interpretation mechanism 204. In some embodiments, a handle 206 is attached to a proximal end 208 of the shaft 202. The measuring device 200 can be sized and configured to fit within a cannula.

[0036] The measurement interpretation mechanism 204 in the depicted embodiment is a rotating feature. The rotating feature 204 can be a wheel or have any other suitable geometric shapes, such as a disc, sphere, square, rectangle, polygon, or cube, for example. An outer surface 210 of the rotating feature 204 can be smooth, or feature spikes, ridges, cross-hatching or other traumatic or atraumatic features 212 to properly grip and assess the distance traveled around an anatomical feature. Additionally, the rotating feature 204 may comprise one or more markings 214 to indicate the distance traveled.

[0037] The rotating feature 204 may also include one or more treads or belts to measure around the anatomical feature. The rotating feature 204 can be solid or fenestrated. A fenestrated rotating feature 204 enables visualization of the anatomical feature and/or can aid

in recording the distance traveled. In some embodiments, the measuring device 200 comprises a feedback mechanism 216. The feedback mechanism 216 is operatively connected to the rotating feature 204 such that rotating feature 204 communicates tactile feedback of the distance traveled via the feedback mechanism 216. The feedback mechanism 216 (or a second feedback mechanism 218) may provide audible feedback (e.g., clicks) to communicate the distance traveled by the rotating feature 204.

[0038] It is contemplated that the measuring device 200 may have a display and/or indicator 220 for showing the distance traveled by the rotating feature 204. This may be done mechanically or electromechanically via the Hall effect or other means or optically using LED sensors or other means in combination or separate from the features of the rotating feature 204 provided above.

[0039] In use, the rotating feature 204 is placed directly on the anatomical feature (e.g., tissue). The rotating feature 204 is moved along the anatomical feature, causing the rotating feature 204 to rotate. The number of rotations of the rotating feature 204 can be quantified to determine the size of the anatomical feature.

[0040] It should be understood that the values used above are only representative values, and other values may be in keeping with the spirit and intention of this disclosure.

[0041] While several inventive embodiments have been described and illustrated herein with reference to certain exemplary embodiments, those of ordinary skill in the art will readily envision a variety of other means and/or structures for performing the function and/or obtaining the results and/or one or more of the advantages described herein, and each of such variations and/or modifications is deemed to be within the scope of the inventive embodiments described herein (and it will be understood by one skilled in the art that various changes in detail may be effected therein without departing from the spirit and scope of the invention as defined by claims that can be supported by the written description and drawings). More generally, those skilled in the art will readily appreciate that all parameters, dimensions, materials, and configurations described herein are meant to be exemplary and that the actual parameters, dimensions, materials, and/or configurations will depend upon the specific application or applications for which the inventive teachings is/are used. Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific inventive embodiments described herein. It is, therefore, to be understood that the foregoing embodiments are presented by way of example only and that, within the scope of the appended claims and equivalents thereto; inventive embodiments may

be practiced otherwise than as specifically described and claimed. Further, where exemplary embodiments are described with reference to a certain number of elements it will be understood that the exemplary embodiments can be practiced utilizing either less than or more than the certain number of elements.

[0042] All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0043] All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms.

[0044] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. The term "connected" is to be construed as partly or wholly contained within, attached to, or joined together, even if not directly attached to where there is something intervening.

[0045] As used herein in the specification and in the claims, the phrase "at least one," in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase "at least one" refers, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, "at least one of A and B" (or, equivalently, "at least one of A or B," or, equivalently "at least one of A and/or B") can refer, in one embodiment, to at least one, optionally including more than one, A, with no B present (and optionally including elements other than B); in another embodiment, to at least one, optionally including more than one, B, with no A present (and optionally including elements other than A); in yet another embodiment, to at least one, optionally including more

than one, A, and at least one, optionally including more than one, B (and optionally including other elements); etc.

[0046] It should also be understood that, unless clearly indicated to the contrary, in any methods claimed herein that include more than one step or act, the order of the steps or acts of the method is not necessarily limited to the order in which the steps or acts of the method are recited.

[0047] Approximating language, as used herein throughout the specification and claims, may be applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related. Accordingly, a value modified by a term or terms, such as "about" and "substantially", are not to be limited to the precise value specified. In at least some instances, the approximating language may correspond to the precision of an instrument for measuring the value. Here and throughout the specification and claims, range limitations may be combined and/or interchanged; such ranges are identified and include all the sub-ranges contained therein unless context or language indicates otherwise.

[0048] The recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein.

[0049] All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to better illuminate embodiments of the invention and does not impose a limitation on the scope of the invention unless otherwise claimed.

[0050] No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

[0051] In the claims, as well as in the specification above, all transitional phrases such as "comprising," "including," "carrying," "having," "containing," "involving," "holding," "composed of," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of" and "consisting essentially of" shall be closed or semi-closed transitional phrases, respectively, as set forth in the United States Patent Office Manual of Patent Examining Procedures, Section 2111.03.

[0052] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the spirit and scope of

the invention. There is no intention to limit the invention to the specific form or forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention, as defined in the appended claims. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

CLAIMS

What is claimed is:

1. An intraoperative measuring device, comprising:

a first rigid member connected to a second rigid member;

a flexible reference tool connected to and between the first rigid member and the second rigid member;

wherein in a first configuration, the flexible reference tool has an exposed length between the first and second rigid members; and

a measurement interpretation mechanism connected to the flexible reference tool, the measurement interpretation mechanism indicating a measurement of the exposed length.

2. The device of claim 1, wherein the measurement interpretation mechanism is one or more reference features on the flexible reference tool.

3. The device of claim 2, wherein the one or more reference features are knots in the flexible reference tool.

4. The device of claim 1, wherein the measurement interpretation mechanism is a spool connected to the first rigid member.

5. The device of claim 4, wherein the spool is connected to a dial having one or more indicators.

6. The device of claim 5, wherein rotation of the spool rotates the dial.

7. The device of claim 6, wherein the spool is within a circular housing.

8. The device of claim 7, wherein the circular housing has a viewing window showing at least a portion of the dial.

9. The device of claim 1, wherein in a second configuration, at least a portion of the first rigid member extends within a lumen of the second rigid member.

10. The device of claim 1, wherein the flexible reference tool is a length of suture.

11. The device of claim 1, wherein the second rigid member has a distal hook connected to a suture loop extending from the flexible reference tool.

12. The device of claim 12, wherein the flexible reference tool is connected within the first rigid member.

13. The device of claim 13, further comprising a spool connected to the first rigid member and the flexible reference tool.

14. A method for intraoperatively measuring an anatomical feature, comprising the steps of:

providing an intraoperative measuring device comprising a first rigid member connected to a second rigid member, a flexible reference tool connected to and between the first rigid member and the second rigid member, and a measurement interpretation mechanism connected to the flexible reference tool;

pulling the second rigid member away from the first rigid member, exposing a length of the flexible reference tool;

wrapping the exposed length of the flexible reference tool around the anatomical feature;

positioning the first rigid member and the second rigid member at separate points on the anatomical feature;

tensioning the flexible reference tool; and

determining, based on the measurement interpretation mechanism, a measurement of the exposed length of the flexible reference tool.

15. The method of claim 14, further comprising the step of inserting the first and second rigid members through a first portal at a surgical site.

16. The method of claim 15, further comprising the step of pulling the second rigid member through a second portal at the surgical site.

17. The method of claim 14, wherein the measurement interpretation mechanism is a spool connected to the flexible reference tool and the first rigid member.

18. A method for intraoperatively measuring an anatomical feature, comprising the steps of:

providing an intraoperative measuring device comprising a first rigid member and a separate second rigid member, a flexible reference tool connected to the first rigid member, the flexible reference tool terminating in an exposed suture loop, a measurement interpretation mechanism connected to the flexible reference tool, and a distal hook connected to the second rigid member;

grabbing the exposed suture loop of the first rigid member with the distal hook of the second rigid member;

pulling the second rigid member away from the first rigid member, exposing a length of the flexible reference tool;

positioning the first rigid member and the second rigid member at separate points on the anatomical feature;

tensioning the flexible reference tool; and

determining, based on the measurement interpretation mechanism, a measurement of the exposed length of the flexible reference tool.

19. The method of claim 18, further comprising the step of inserting the first rigid member through a first portal at a surgical site and inserting the second rigid member through a second portal at the surgical site.

20. The method of claim 18, wherein the measurement interpretation mechanism is a spool connected to the flexible reference tool and the first rigid member.

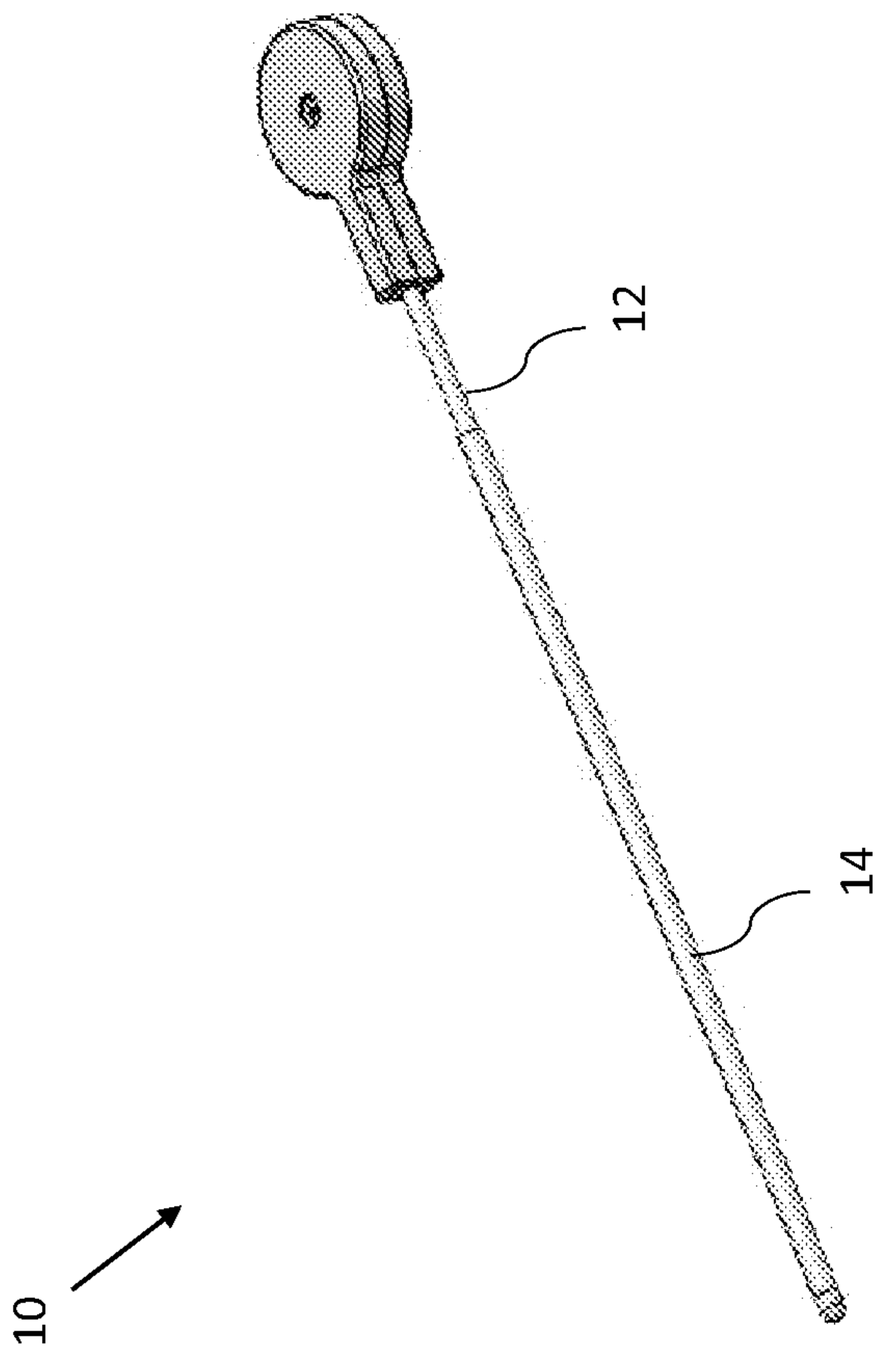

FIG. 1

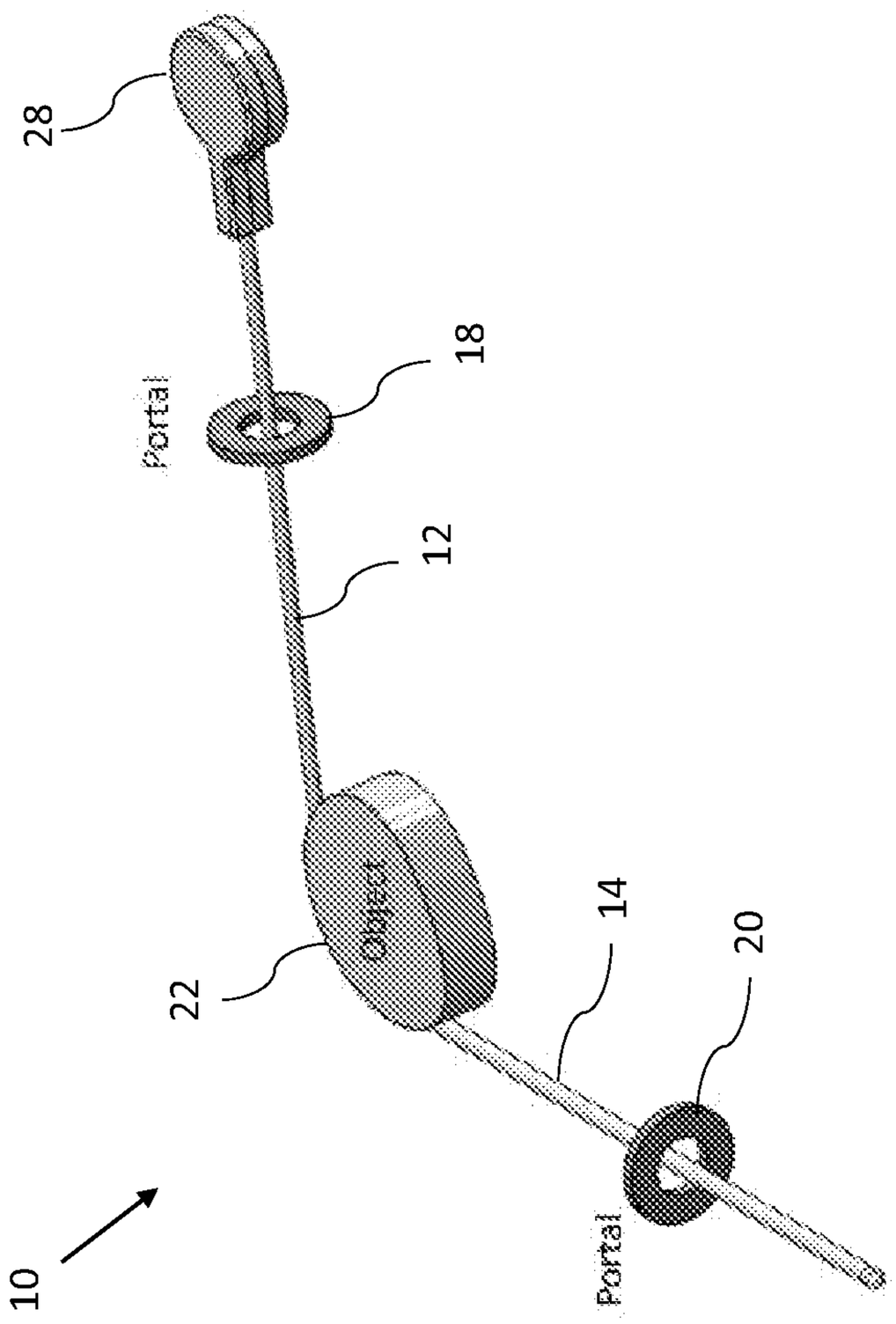

FIG. 2

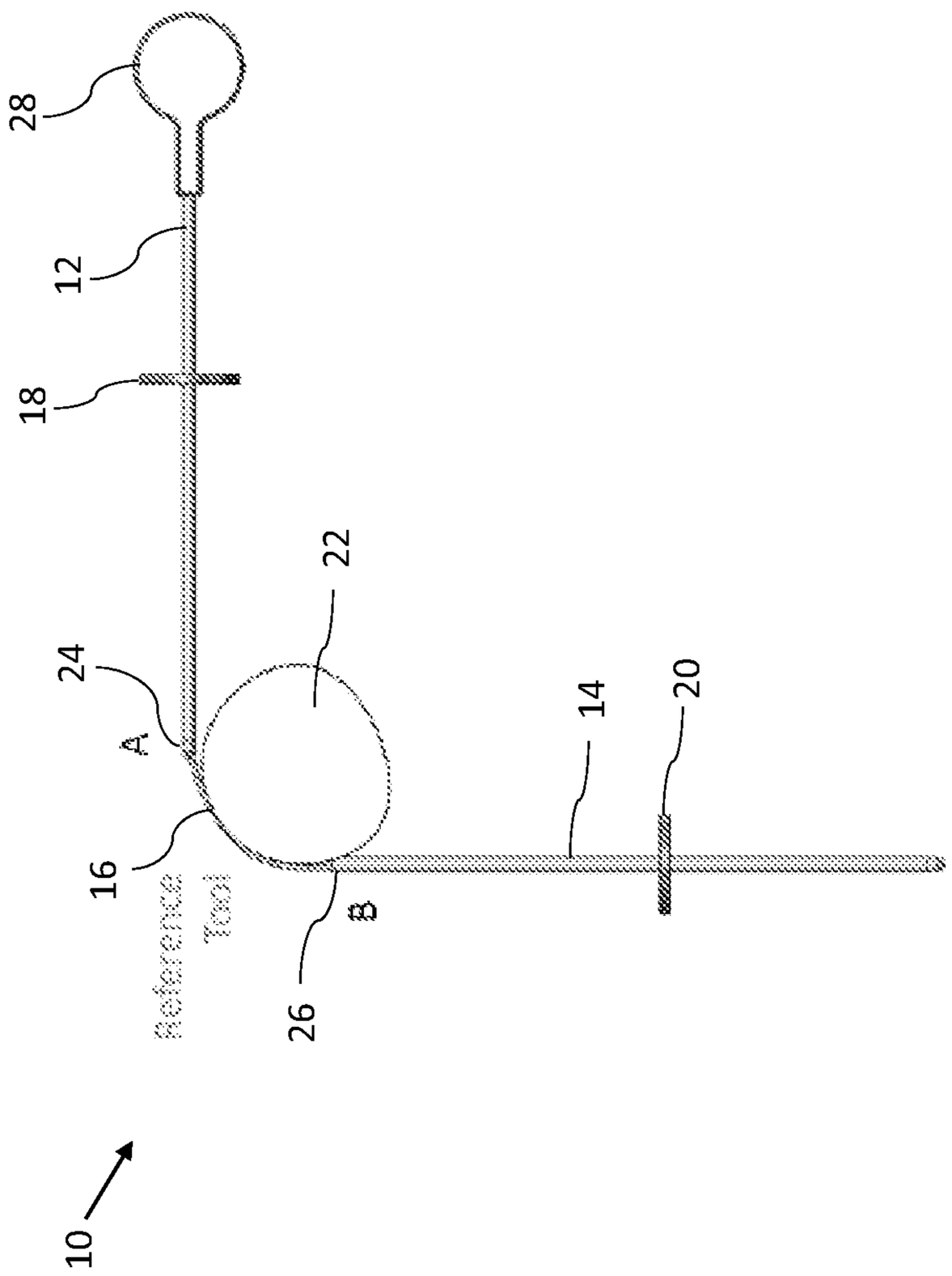

FIG. 3

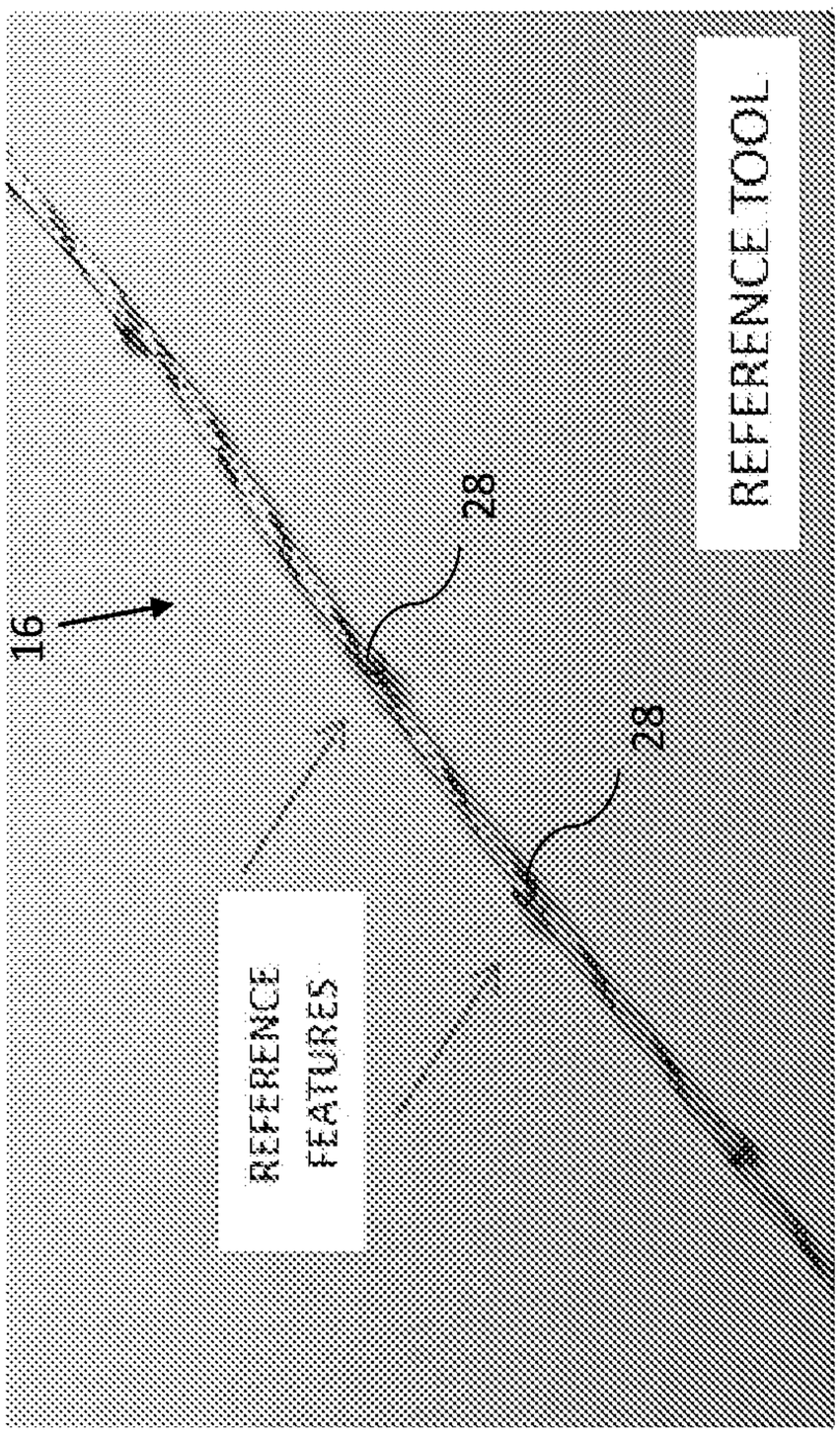

FIG. 4

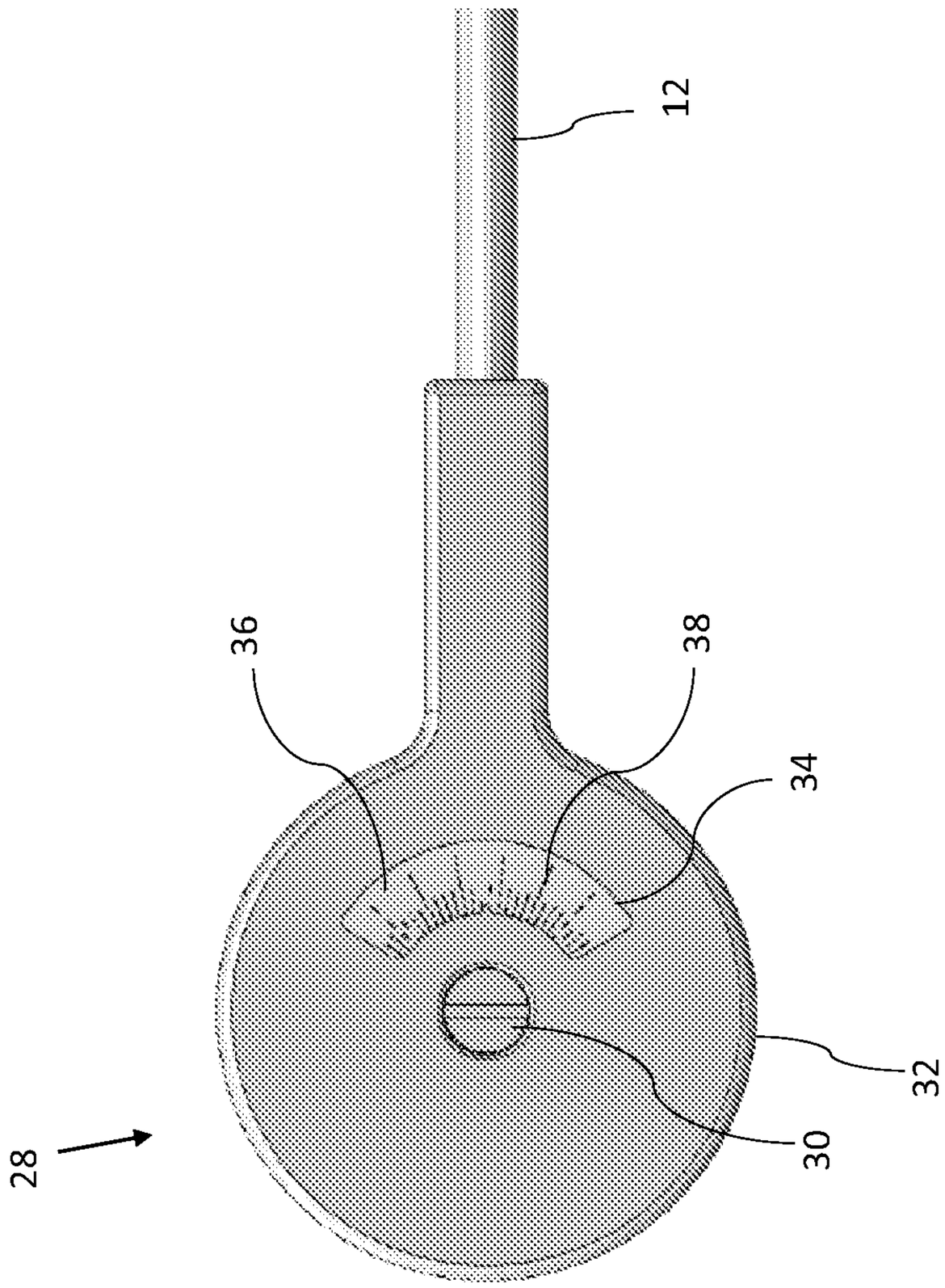

FIG. 5

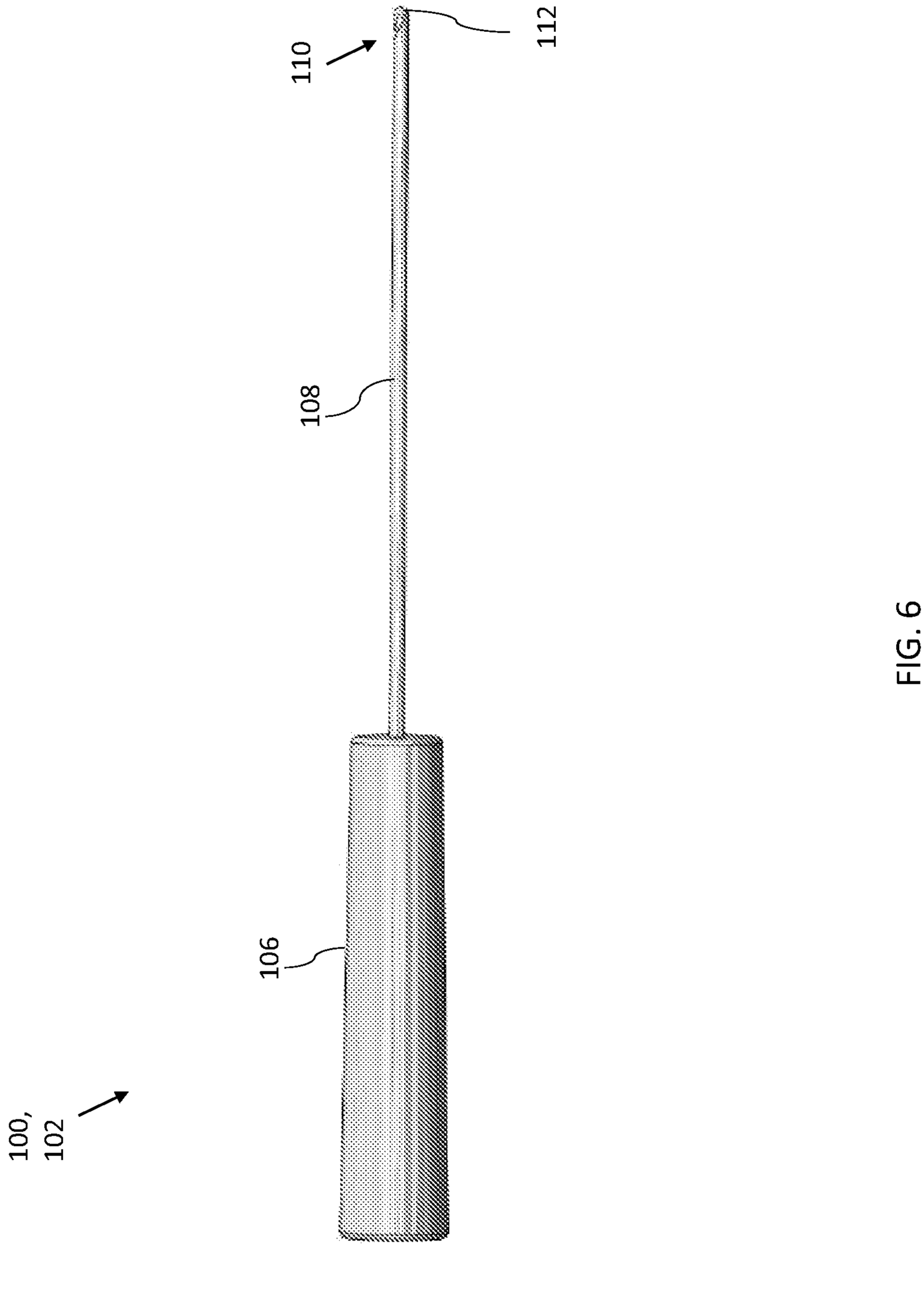

FIG. 6

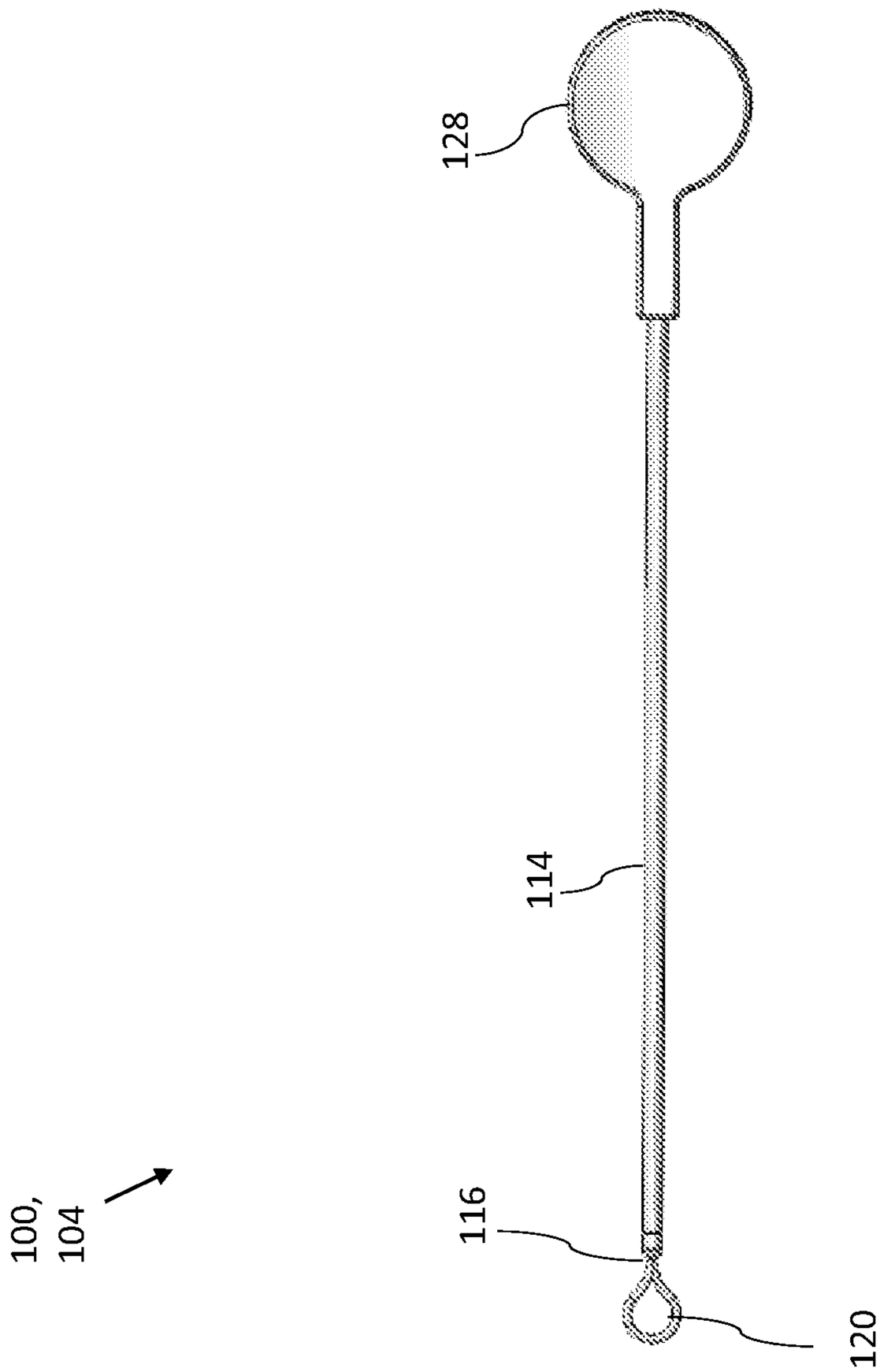

FIG. 7

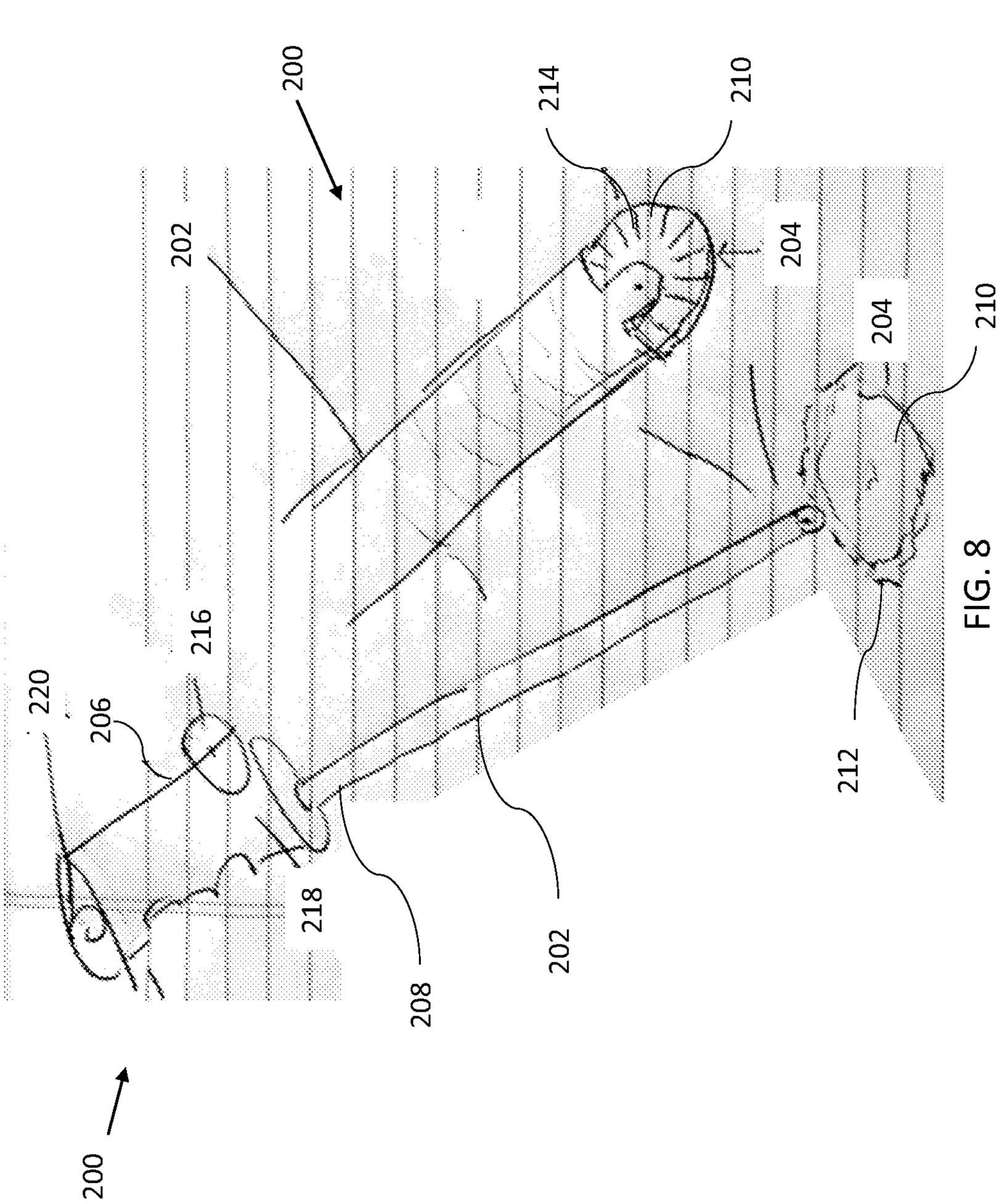

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/060523

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/107 A61B90/00
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)
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, INSPEC, 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 2016/270694 A1 (TANG JOSEPH [CN] ET AL) 22 September 2016 (2016-09-22) the whole document	1-13
X	US 2003/181920 A1 (HAWKINS J RILEY [US] ET AL) 25 September 2003 (2003-09-25) the whole document	1-13
A	US 2012/203237 A1 (BRYAN JASON A [US] ET AL) 9 August 2012 (2012-08-09) the whole document	1-13

☐ 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	Date of mailing of the international search report
29 January 2021	10/02/2021

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	Abraham, Volkhard

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2020/060523

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016270694 A1	22-09-2016	NONE	
US 2003181920 A1	25-09-2003	NONE	
US 2012203237 A1	09-08-2012	EP 2663246 A1	20-11-2013
		US 2012203237 A1	09-08-2012
		WO 2012097040 A1	19-07-2012

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 14-20

According to Article 17(2)(a)(i) PCT and Rule 39.1(iv) PCT no international search is required to be carried out on claims 14-20 of the present application, because the subject-matter of these claims relates to a method for treatment of the human or animal body by surgery. The claimed methods are performed during surgery and include the step of inserting measurment instruments through portals at a surgical site.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/060523

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.: 14-20
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.