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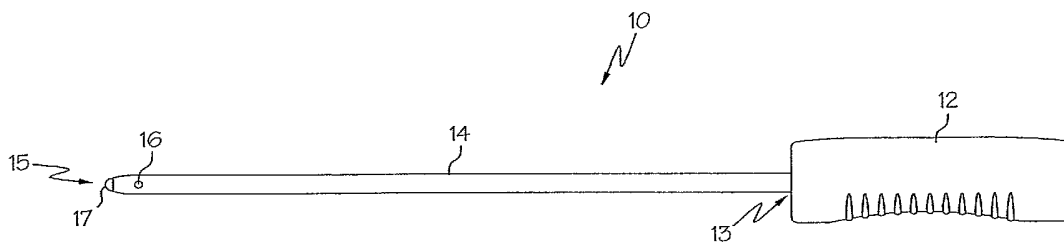
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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: LIGHTED DISSECTOR AND METHOD FOR USE



(57) Abstract: A surgical dissector comprising an elongate shaft having a proximal end and a distal end. A blunt dissection tip is positioned on the distal end of the elongate shaft. A light source emits a diffuse visible energy, such as white light, from the blunt tip. The shaft may take a variety of shapes, including being rigid, flexible, malleable, straight, bent, curved, articulated, and/or segmented. In addition, the shaft may include one or more functional components. The dissector can be used to locate the dissector tip by observing the visible energy passing through tissue. In addition, the visible energy passing through tissue may be used to differentiate tissue.

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APPLICATION FOR PATENT

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*for*

LIGHTED DISSECTOR  
AND  
METHOD FOR USE

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## BACKGROUND

The present invention relates to surgical tools, and more specifically to surgical dissectors. In the broadest sense, dissectors are used to cut apart or separate tissue. For instance, during an operation dissectors can be used to separate different structures along natural lines by dividing the connective tissue framework. Dissectors can take a wide variety of shapes and sizes. For example, some dissecting surfaces are blunt (e.g., rounded, fanned, or the like) while other dissectors have sharpened surfaces (e.g., needles, lances, blades, and the like). No one, however, has previously made or used dissector in accordance with the present invention.

## BRIEF SUMMARY

One example of the invention a surgical dissector comprising an elongate shaft having a proximal end and a distal end. A blunt dissection tip is positioned on the distal end of the elongate shaft. A light source emits a visible energy, such as a diffuse and/or unfocused white light, from the blunt tip. The shaft may take a variety of shapes, including being rigid, flexible, malleable, straight, bent, curved, articulated, and/or segmented. In addition, the shaft may include one or more functional components.

Another example of the invention is a method of separating a first tissue from a second tissue. A blunt tipped dissector is positioned near the first and second tissues. The first and second tissues are separated by moving the blunt tipped dissector between the first and second tissues, wherein the first or second tissues obstruct the operator's sight of the dissector tip. A diffuse light is emitted from the dissector tip while positioned between the first and second tissues. The tip of the dissector is visually located by observing the light passing through the obstructing tissue.

Yet another example of the invention is a method of separating a first tissue from a second tissue. A blunt tipped dissector is positioned near the first and second tissues. The first and second tissues are separated by moving the blunt tipped dissector between the first and second tissues. A diffuse light is emitted from the blunt tip of the dissector while positioned between the first and second tissues. Tissue is differentiated by observing the light passing through the first or second tissues.

1       The foregoing brief description of certain examples of the invention should not  
2 be used to limit the scope of the present invention. Other examples, features,  
3 aspects, embodiments, and advantages of the invention will become apparent to  
4 those skilled in the art from the following description, which is by way of illustration,  
5 one of the best modes contemplated for carrying out the invention. As will be  
6 realized, the invention is capable of other different and obvious aspects, all without  
7 departing from the invention. Accordingly, the drawings and descriptions should be  
8 regarded as illustrative in nature and not restrictive.

#### 9 10                               BRIEF DESCRIPTION OF DRAWINGS

11       While the specification concludes with claims which particularly point out and  
12 distinctly claim the invention, it is believed the present invention will be better  
13 understood from the following description taken in conjunction with the  
14 accompanying drawings, in which like reference numerals identify the same  
15 elements and in which:

16       Fig. 1 illustrates an example of a dissector;

17       Fig. 2 illustrates another example of a dissector; and

18       Fig. 3 illustrates a partial cross-sectional view of a portion of the dissector  
19 shown in Fig. 2.

#### 20 21                               DETAILED DESCRIPTION

22       Fig. 1 illustrates an example of a dissector 10. The dissector 10 includes and  
23 elongate shaft 14 having a proximal end 13 and a distal end 15. A handle 12 is  
24 connected to the shaft 14 at the proximal end 13. In the present example, the shaft  
25 14 is made from stainless steel, but numerous other materials known in the art may  
26 also be employed. The shaft 14 and has a circular cross section along its length and  
27 the distal end 15 is a blunt and rounded tip, which tip may be smooth or rough. Any  
28 portion of the shaft 14 can be used for dissecting tissue. It should be appreciated,  
29 however, that variable cross-sectional shapes are also contemplated, such as a  
30 fanned or flatted portions. In addition, the distal end 14 could have numerous other  
31 geometries, such as a Y-shaped tip.

32       As shown in this example, the shaft is substantially straight; however, the  
33 shaft 14 can take a variety of alternative shapes. For instance, the shaft 14 could be  
34 bent, curved, arced, undulated, helical, twisted, and the like. Further, the shaft 14

1 could be moveable, such as having one or more articulated joints or multiple  
2 segments. In addition, the shaft 14 could be rigid, flexible or malleable, either along  
3 its entire length or only along a portion. The shaft 14 includes an optional hole 16 so  
4 that sutures or other devices may be attached. In an alternative embodiment, the  
5 distal end 15 includes a step or barb onto which an elastomeric tube could be  
6 connected. The shaft 14 may also include one or more functional components to  
7 facilitate dissection, such as a grasper, an inflatable balloon, an expanding cage or  
8 arm, retractors, an ultrasonic emitter, a retractable sharpened surface, an endoscope, a  
9 port for water jet dissection, a guide wire, a oxygen content sensor, a working lumen,  
10 a fixed or rotating knurled ball, or other components known in the art. The functional  
11 components can be integral to the dissector 10 or could be separable, such as  
12 removable or interchangeable tips.

13 A light source 17 is positioned at the distal end 15 of the shaft 14. The light  
14 source 17 emits a visible energy. In the present example the visible energy is a  
15 diffuse and substantially unfocused. The wavelength of the visible energy may vary,  
16 including for instance being substantially white, green, red, or other color. The light  
17 source 17 in this example takes the form of an light emitting diode (LED) positioned  
18 on the distal tip of the shaft 14. Alternative lights sources may also be used,  
19 including without limitation incandescent, fluorescent, laser, infrared and the like. The  
20 visible energy can originate directly from the light source 17 or can originate from a  
21 position remote to the distal end 15 (e.g., in the shaft 14, handle 12, or external to  
22 the dissector). For instance, the light can be delivered to the distal end 15 via fiber  
23 optics or a light pipe. While the light source 17 in the present example emits light  
24 from a point positioned on or near the distal end 15, it is also contemplated that light  
25 could be emitted from multiple points or from an area, such as along a segment of  
26 the shaft 14.

27 The visible energy has sufficient luminous intensity to pass through tissue.  
28 Suitable luminous intensity will vary depending upon the tissue being dissected.  
29 Some exemplary ranges of luminous intensity include between about 20 lux and  
30 about 50,000 lux, 300 lux and about 1500 lux, between about 500 lux and about  
31 1500 lux, and between about 700 lux and about 1300 lux. Note that these ranges are  
32 merely illustrative and not limiting. The light source 17 here is powered by a battery  
33 positioned in the handle 12, but it could be powered using different configurations  
34 such as a remote tethered power source.

One illustrative use of the dissector 10 is to separate two adjacent tissues. The distal end 15 is positioned at the junction of the two tissues. As the shaft is moved between the tissues, the two tissues separate and become dissected. By laterally moving the shaft, a wider dissection can be achieved. In many cases, one or both of the tissues being dissected may obstruct the surgeon's line of sight, such that they cannot visually identify the location of the distal end 15. In such situations, the locating the distal end 15 can be located by observing the diffuse visible energy passing through the obstructing tissue. Accordingly, the operator will have better control and accuracy while dissecting. In addition, by observing the visible energy passing through the tissue the surgeon can differentiate between different tissues. The light source 17 can continuously emit, periodically emit (e.g., a slow or rapid sequence such as with a strobe), or selectively emit the visible energy (e.g., activate the light source only when desired). Being able to locate the distal end 15 which would otherwise be visually obstructed and/or being able to differentiate tissue is particularly useful when dissecting fragile tissue or near sensitive organs.

In addition to transillumination of tissue, the visible energy can be used to directly illuminate a surgical area. For instance, a surgeon may desire to illuminate a surgical field. In one variation, the shaft 14 has a lumen and the distal end 15 is transparent. In such embodiment, an endoscope can be threaded through the lumen and the surgeon may visualize a patient's anatomy from the perspective of the distal end 15 while being illuminated by the light source 17.

Fig. 2 illustrates another example of a dissector 20. The dissector 20 comprises an elongate shaft 26 with a handle 22 connected to the proximal end of the shaft 26. The shaft 26 is articulated and includes an arcuate and elongate segment 30 distal the joint 28 and a substantially straight segment proximal the joint 28. The segment 30 has blunt and rounded distal end 32, and includes an optional suture hole 36. The segment 30 pivots about a joint 28. In the present example, the segment 30 pivots about a single axis of rotation, but more complicated joints may also be employed. A knob 24 is positioned on handle 22 that actuates and controls the position of the segment 30 by manually rotating the knob 24. The present figure illustrates two exemplary angular positions. The segment 30 shown in solid is positioned in a "straight" or "back" position where the distal end 32 is substantially aligned with the axis of the shaft 26 (i.e., at 0°). As shown in phantom, the segment 30 is in a "bent" or "forward" position where the distal end 32 is positioned

1 at about 75° from the axis of the shaft 26. The segment 30 can pivot to any position  
2 between the extremes of 0°-75°. Alternatively, the segment 30 can be pivoted  
3 outside that range (i.e., less than 0° and/or greater than 75°). For instance, one  
4 embodiment pivots between -30° and 140°.

5 A light source 34 emits visible energy from the distal end 32 of the segment  
6 30. The light source 34 in this example emits a substantially unfocused and diffuse  
7 light. While a variety of different light sources 34 may be employed, the present  
8 embodiment uses a model NSPW500BS white LED produced by NICHIA positioned  
9 on the distal end 32. A battery in the handle 22 powers the light source 34.

10 Fig. 3 illustrates a partial cross-sectional view of the dissector 20. The light  
11 source 34 is partially encased within the segment 30 wall and is exposed to define  
12 the blunt tip geometry of the distal end 32. A connection rod 25 is positioned in the  
13 shaft 26 and connects to the proximal end of the segment 30 with a pin 27 offset  
14 from the axis of rotation of the joint 28. The other end of the rod (not shown) is  
15 connected to a worm screw that engages a threaded nut connected to the knob 24.  
16 Accordingly, the operator can manually rotate the knob 24 which axially moves the  
17 rod 25, which in turn pivots the segment 30. One advantage of this embodiment is  
18 that the after the surgeon releases the knob 24, the angular position of the segment  
19 30 relative the shaft 26 remains secure and relatively rigid. While the present  
20 actuation arrangement has certain advantages, other actuation arrangements known  
21 in the art may also be used, including without limitation scissors-type handles, rolling  
22 wheels, slide levers, spring mechanisms.

23 While the geometry of the arcuate segment 30 may vary significantly based  
24 on the targeted anatomy, the following describes the geometry of present example.  
25 The segment 30 in the present example has a smooth outer surface and a  
26 substantially circular cross-sectional shape that tapers slightly toward the distal end  
27 32. The nominal diameter is about 3/16 inch, but a variety of other diameters may be  
28 used, including without limitation diameters ranging from 0.5 to 0.075 inches. The  
29 length of the segment 30 measured from the distal end 32 to the joint 28 ranges from  
30 about 2 to 2.5 inches, but the length may be extended outside this range depending  
31 upon the intended medical procedure. For instance, the length may also be between  
32 about 0.5 to 4 inches. The arcuate shape of the segment 30 in this example includes  
33 an arc portion 46, a proximal linear portion 44, and a distal linear portion 42. The  
34 radius of the arc portion 46 shown here is about 1 inch and swept about 90°;

1 however, other arc geometries may be used, including without limitation arc radii  
2 ranging from 0.25 to 3 inches and swept 30° to 180°. The proximal linear portion 44  
3 here is about 0.5 inches long and the distal linear portion is about 0.25 inches long.  
4 The dimensional range of the linear portions 42, 44 may also be varied substantially.  
5 Naturally, the foregoing geometries are merely illustrative and should not be  
6 considered limiting.

7 The dissector 20 of the present example is well-suited for separating and/or  
8 isolating a variety of tissues, during both open and/or minimally invasive procedures.  
9 Some exemplary procedures include, without limitation:

- 10 - Isolate pulmonary arteries and branches;
- 11 - Isolate pulmonary veins and branches;
- 12 - During billiary surgery with gall bladder, separating the vein from artery  
13 and/or separating the bile duct from the vascular pedicle;
- 14 - Isolate aorta, such as for retroperiteneal isolation of thoracic or abdominal  
15 aorta;
- 16 - Isolate renal pedicle;
- 17 - Isolate illiac vessel;
- 18 - Isolate femoral artery from vein;
- 19 - Isolate arch vessels;
- 20 - Isolate carotids;
- 21 - Isolate rectum from pelvic floor through peritoneum; and
- 22 - Isolate other tubular structures from connective tissue.

23 The following describes an exemplary procedure using the dissector 20 to  
24 separate the left or right pair of pulmonary veins adjacent the left atrium. The  
25 procedure may be performed during open or minimally invasive surgery. With the  
26 segment 30 in a substantially straight position, the distal end 32 of the segment 30 is  
27 positioned adjacent the junction of one of the pulmonary veins (superior or inferior)  
28 and the left atrium. The distal end 32 is advanced around the posterior of the pair of  
29 pulmonary veins while simultaneously changing the angular position of the segment  
30 30 in the forward direction. The distal end 32 continues to advance until it emerges  
31 beyond the other adjacent pulmonary vein (the inferior or superior, as the case may  
32 be). The advancement of the distal end separates the pair of pulmonary veins from  
33 the pericardial reflections, thus creating a path between the pulmonary veins and the  
34 pericardium. The path can be widened by gently rotating back and forth the handle

22 while the segment 30 is in an articulated position, which will sweep the segment 30 and further separating the tissue and widen the path.

If the light source 34 is used, it has several useful benefits during the procedure. One benefit is to illuminate the surgical area during the initial approach and positioning of the distal end 32. Another benefit is to locate the distal end 32 during the procedure. While advancing, the distal end 32 is often obstructed from sight by the surrounding tissue. The light emitting from the light source 34 passes through the obstructing tissue and the surgeon can visually locate the distal end 32 by observing such light. Still another benefit of the light source 34 is to differentiate between the various tissue. By observing light passing through tissue, the surgeon can discern if the distal end is approaching or contacting targeted or untargeted tissue. Accordingly, the surgeon has greater control and accuracy while dissecting the area.

One reason to dissect the pulmonary veins is as part of a procedure to treat atrial fibrillation. After the distal end 32 emerges beyond both pulmonary veins, further advancement and articulation will expose the distal end 32. A guide is then attached to the segment 30. For example, the guide may take the form of a suture or umbilical tape threaded through the hole 36. In another example, the guide may be a flexible catheter (such as a BARDIA urethral catheter) fitted over the distal end 32. The segment 30 is then reversed back through the path while pivoting the segment 30 in the backward direction, thus threading the guide through the path resulting in a sling around the pulmonary veins. The guide is then attached to one jaw of a clamping ablation device (including without limitation the devices disclosed in U.S. Patent 6,517,536). By pulling the other end of the guide, the jaw can be accurately positioned in the path and the pulmonary veins are interposed between the ablation jaws. The jaws can then be closed and the targeted tissue ablated.

Having shown and described various embodiments of the present invention, further adaptations of the methods and systems described herein can be accomplished by appropriate modifications by one of ordinary skill in the art without departing from the scope of the present invention. Several of such potential modifications have been mentioned, and others will be apparent to those skilled in the art. Accordingly, the scope of the present invention should be considered in terms of the following claims and is understood not to be limited to the details of structure and operation shown and described in the specification and drawings.

## CLAIMS

1. A surgical dissector, comprising:
  - a) an elongate shaft having a proximal end and a distal end;
  - b) a blunt dissection tip positioned on the distal end of the elongate shaft;  
and
  - c) a light source emitting a visible energy from the blunt tip.
2. The surgical dissector of claim 1, wherein the diffuse visible energy is diffuse.
3. The surgical dissector of claim 1, further comprising functional component means on the shaft.
4. The surgical dissector of claim 1, wherein the shaft has a circular cross-section at the tip.
5. The surgical dissector of claim 1, wherein the shaft is rigid.
6. The surgical dissector of claim 1, wherein the shaft is articulated.
7. The surgical dissector of claim 1, wherein the shaft is curved.
8. The surgical dissector of claim 1, wherein the diffuse visible energy has sufficient luminous intensity to pass through tissue.
9. The surgical dissector of claim 8, wherein the luminous intensity is greater than about 300 lux.
10. The surgical dissector of claim 9, wherein the luminous intensity is less than about 1500 lux.
11. The surgical dissector of claim 1, wherein the visible energy is white light.
12. The surgical dissector of claim 1, wherein the light is an LED.

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13. A method of separating a first tissue from a second tissue using the surgical dissector of claim 1, comprising the steps of:

- a) positioning blunt dissection tip near the first and second tissues;
- b) separating the first and second tissues by moving blunt dissection tip between the first and second tissues, wherein the first or second tissues obstruct the operator's sight of the dissection tip; and
- c) visually locating the tip by observing the diffuse visible energy passing through the obstructing tissue.

14. The method of claim 13, further comprising the step of differentiating tissue by observing the diffuse visible energy passing through the first or second tissues.

15. A method of separating a first tissue from a second tissue, comprising the steps of:

- a) positioning a blunt tipped dissector near the first and second tissues;
- b) separating the first and second tissues by moving the blunt tipped dissector between the first and second tissues, wherein the first or second tissues obstruct the operator's sight of the dissector tip;
- c) emitting a diffuse light from the dissector tip while positioned between the first and second tissues; and
- d) visually locating the tip of the dissector by observing the light passing through the obstructing tissue.

16. The method of claim 15, further comprising the step of differentiating tissue by observing the light passing through the first or second tissues.

17. A blunt tipped dissector for performing the method of claim 15.

18. The method of claim 15, wherein the steps are performed sequentially.

19. A method of separating a first tissue from a second tissue, comprising the steps of:

- a) positioning a blunt tipped dissector near the first and second tissues;

- 1           b)     separating the first and second tissues by moving the blunt tipped  
2                 dissector between the first and second tissues;  
3           c)     emitting a diffuse light from the blunt tip of the dissector while  
4                 positioned between the first and second tissues; and  
5           d)     differentiating tissue by observing the light passing through the first or  
6                 second tissues.

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8   20.    A blunt tipped dissector for performing the method of claim 19.

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10 21.    The method of claim 19, wherein the steps are performed sequentially.

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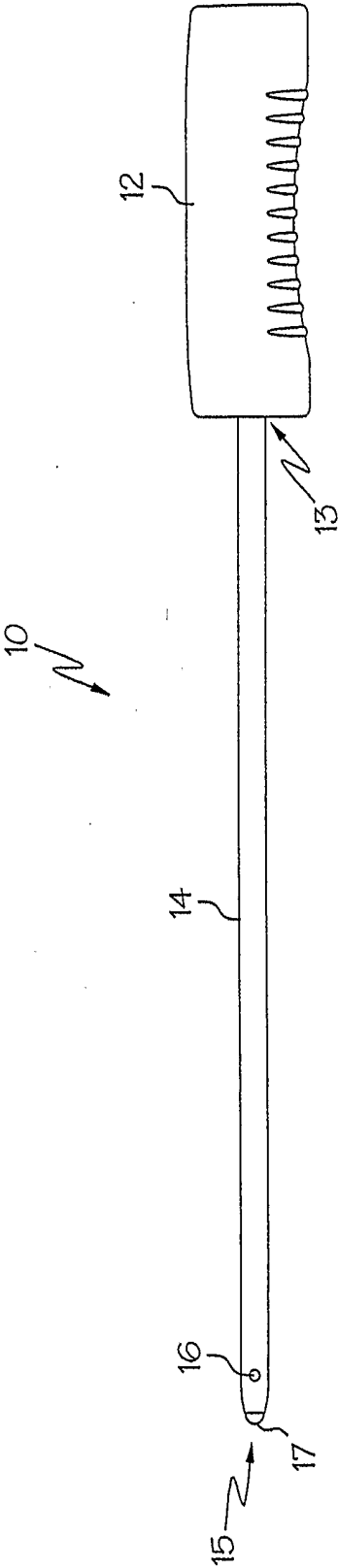


FIG. 1

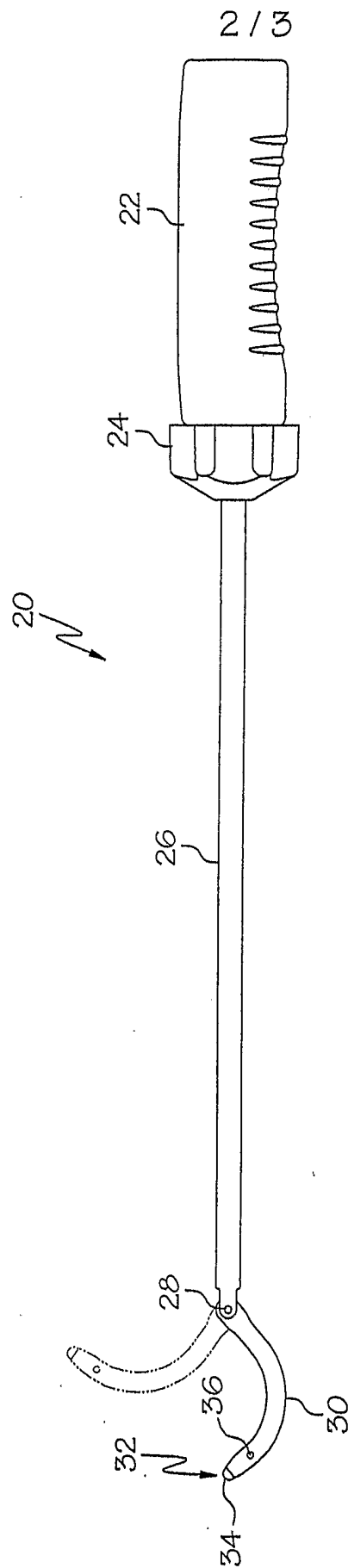


FIG. 2

3 / 3

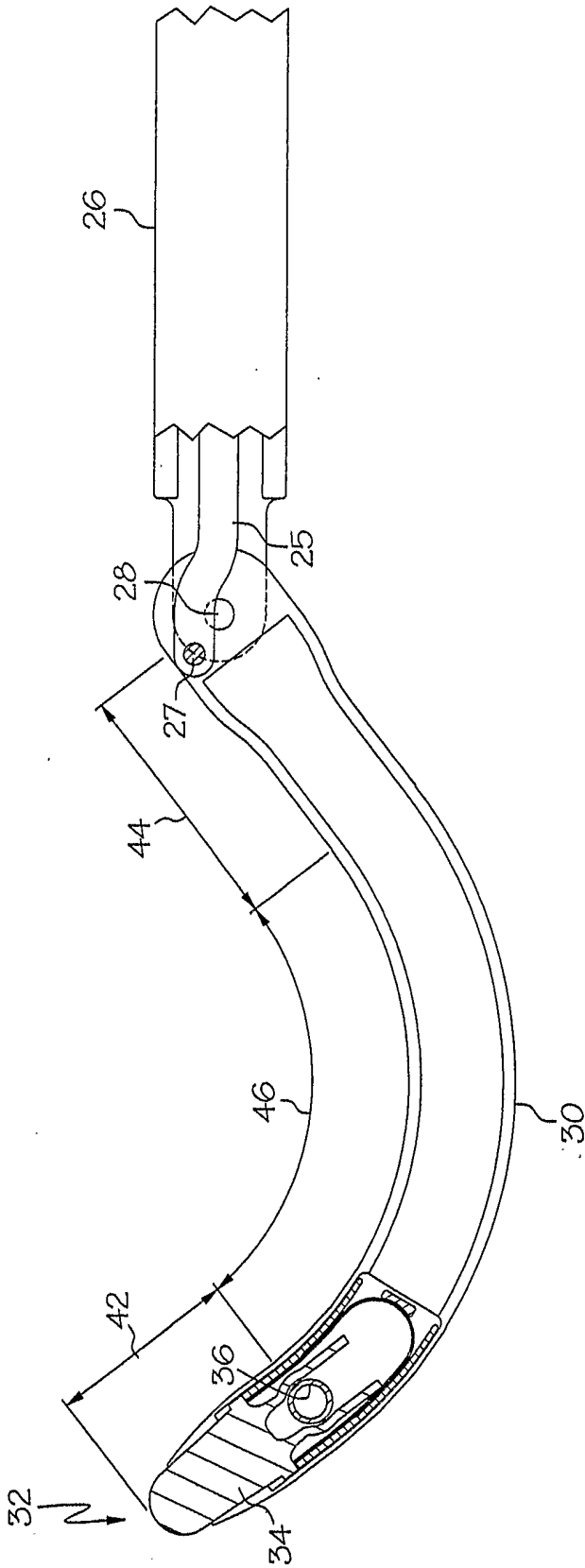


FIG. 3

## INTERNATIONAL SEARCH REPORT

 International Application No  
 PCT/US2005/004491

 A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 A61B17/00

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)  
 IPC 7 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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 522 788 A (KUZMAK ET AL) 4 June 1996 (1996-06-04) column 4, line 14 - line 18; figures 1-3 column 5, line 22 - line 27 column 5, line 56 - line 59 column 6, line 58 - line 62	1,3-8
Y		2,11,12
Y	US 2002/009275 A1 (WILLIAMS JEFFREY B ET AL) 24 January 2002 (2002-01-24) paragraph '0103!; figure 4b paragraph '0106!	2,11,12
A		1
X	US 5 928 138 A (KNIGHT ET AL) 27 July 1999 (1999-07-27) column 4, line 54 - line 67; figure 1 ----- -/--	1,5,8

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

☒ Patent family members are listed in 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 document 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.

\*&amp;\* document member of the same patent family

Date of the actual completion of the international search

9 May 2005

Date of mailing of the international search report

24/05/2005

Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2005/004491

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 203 557 B1 (CHIN ALBERT K) 20 March 2001 (2001-03-20) column 1, line 19 - line 25 column 3, line 52 - line 60; figure 1 column 5, line 19 - line 22 -----	1,4,5,8
X	WO 95/10982 A (CORREA, MARCO, AURELIO, MOURA DE FARIA) 27 April 1995 (1995-04-27) abstract; figure -----	1,5,8
A	US 5 797 959 A (CASTRO ET AL) 25 August 1998 (1998-08-25) column 3, line 67 - column 4, line 9; figure 1 column 3, line 19 - line 24 column 7, line 45 - line 56; figures 14,15 -----	1,5-7

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2005/004491

## Box 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.: 13-21  
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 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 fee, this Authority did not invite payment of any additional fee.
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.
- ☐ No protest accompanied the payment of additional search fees.

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