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(54) Title: INDUSTRIAL OR MEDICAL TOOL WITH STEERING CABLES

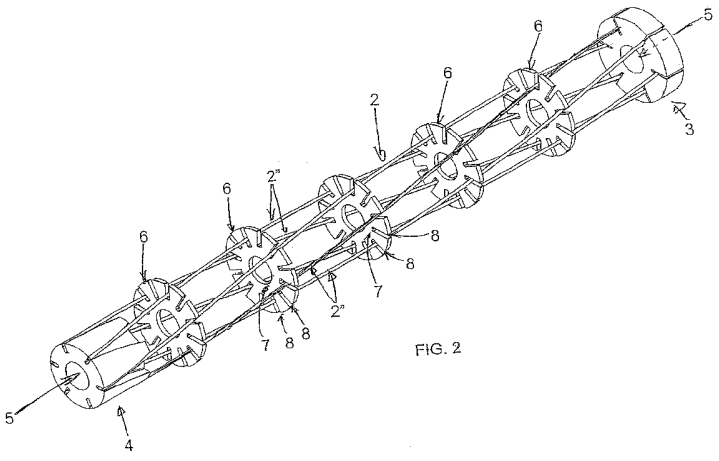


FIG. 2

(57) Abstract: Instrument provided with cables extending between a first portion and a second portion of the instrument at opposite sides of its longitudinal axis and disposed at predefined angles with respect to said axis, which instrument has one or more sets of cables, each set of cables comprising in combination a first cable running parallel to the longitudinal axis, a second cable running at a first predefined angle with respect to said longitudinal axis, and a third cable running at a second predefined angle with respect to said longitudinal axis and having a sign that is opposite to the sign of the first predefined angle so as to arrange that the second and third cables cross each other. The instrument is preferably a joystick or a surgical instrument, such as a laparoscopic tool.

WO 2015/105421 A1

Industrial or medical tool with steering cables

The invention relates to an instrument provided with cables extending in a first portion and in a second portion of the instrument, which first and second portions are provided distant from each other at the instrument's extremities.

Within the meaning of this description cables should be understood to embrace all types of long, thin and flexible wires of any suitable thickness or function, such as tubes, glass fibers, electrical wires, coax cables, etc.

The instrument of the invention may be an industrially applicable instrument or a medical device, such as a surgical tool. The tool may be an instrument for minimally invasive surgery, for example intended for laparoscopic surgery, neurosurgery or endo-nasal skull base surgery; a flexible endoscope like a gastroscope or a colonoscope, an instrument for single port surgery or Natural Orifice Translumenal Endoscopic Surgery (NOTES) or a catheter wherein each said instrument may have flexible or rigid parts.

US 2008/0097152 discloses a braided device for use with an endoscope, in the form of a braided flexible tube having cables disposed alongside the tube, which cables are capable upon their retraction of bending the braided tube at a region along its length and holding it at a desired orientation. The braided device has a handle for controlling the steering of the device and locking it in the desired orientation.

US 2010/0010309 discloses an endoscope bend tube including a plurality of node rings which are arranged in line, wherein contact portions at which neighboring ones of the node rings are put in contact are provided between the neighboring node rings, and the plurality of node rings are coupled to be pivotable about pivotal center axes which correspond to pivotal centers of the contact portions. The endoscope bend tube includes an operation wire, a coupling wire, and a coupling wire hold portion, wherein in a case where the endoscope bend tube is in a non-bent state, lead out ends of the coupling wire which are opposed between a pair of the neighboring node rings, are disposed at such positions that a line segment connecting the lead out ends is halved by a plane including a

center axis in a longitudinal direction of the bend tube and a pivotable center axis of the pair of the node rings.

Although endoscopes and other instruments for minimally invasive surgery are known already for several decades, the developments of the latest years focus on steerable, flexible or articulated devices as is exemplified by US 2008/0097152. The application of devices that are steerable implies that the devices are to a certain degree flexible. This flexibility goes at the expense however of the device's rigidity and stiffness. There is however from a surgical point of view a preference for a tool that is easy to steer but at the same time relatively stiff at least at its tip, i.e. at the distal portion of the instrument.

Another notable need is to avail of an instrument that can follow complex trajectories as they occur for instance in the arteries of a patient.

It is an object of the invention to provide an instrument, for instance a surgical tool or a catheter, which can be embodied with a relatively stiff second portion.

It is another object of the invention to provide such an instrument which is uncomplicated to manufacture, and which can therefore be provided at relatively low cost even when, in case the instrument is for instance a minimally invasive surgical tool, its dimensions are at the lower end of what is technically feasible.

It is still another object of the invention to provide a suitable alternative for existing steerable devices with improved steering capabilities and with the capability to follow complex (multiple) curves.

These and other objects and advantages of the invention are promoted with an instrument having the features of one or more of the appended claims.

In a first aspect of the invention the instrument has one or more sets of cables extending in at least one of said first and second portions, wherein at least one of said sets of cables provided in the first and/or second portions comprises in combination a first cable running predominantly parallel to the longitudinal axis of the instrument, a second cable running at a first predefined angle with respect to said longitudinal axis, and/or a third cable running at a second

predefined angle with respect to said longitudinal axis and having a sign that is opposite to the sign of the first predefined angle. In other words: the instrument has one or more sets of cables in at least one of its first and second portions that are provided distant from each other at the extremities of the instrument, wherein at least one of said sets of cables comprises in combination a first cable running predominantly parallel to the longitudinal axis, a second cable oblique with reference to said longitudinal axis and at least in part circumferentially rotating clockwise (or counterclockwise) around said longitudinal axis, and/or a third cable oblique with reference to said longitudinal axis and at least in part circumferentially rotating counterclockwise (or clockwise or at least rotating in an opposite direction as does the second cable) around said longitudinal axis, wherein the second cable and third cable are free from any kinks. Particularly the feature that the second cable and a third cable are free from kinks is essential to the invention. It is possible to apply such a single set of cables, or to apply multiple coaxial sets of cables.

The inventors have found that this construction results in very desirable steering characteristics of the instrument, wherein the instrument can remain flexible between the first portion and second portion, whereas the instrument's second portion, usually the tip, will exhibit high rigidity and stiffness. Also the instruments torsional stiffness is at a relatively high-level in comparison with prior art devices.

In a particular embodiment it is beneficial that the second and third cables cross each other, although this is not essential. Particularly in very minute applications it is found beneficial that the second and third cables do not cross but only extend till the point where they would otherwise cross each other. At this point of their extremities the second and third cables may jointly connect with the first straight cable to connection rings. These connection rings than delimit the first portion and the second portion of the instrument as meant in the preamble.

A notable aspect of a further embodiment of the instrument according to the invention further differentiating it from the prior art, is that the second and third cables are

free from portions extending parallel to the longitudinal axis. Again this feature is not essential, particularly not in the previously meant embodiment relating to very minute applications wherein the second and third cables do not cross but only extend till the point where they would otherwise cross each other.

A preferable aspect of the invention is that within each set of cables the first cable running parallel to the longitudinal axis, the second cable running at the first predefined angle with respect to said longitudinal axis, and the third cable running at the second predefined angle with respect to said longitudinal axis are movable with respect to each other. Or in other words: within each set of cables the first cable running predominantly parallel to the longitudinal axis, the second cable and the third cable circumferentially rotating clockwise and counterclockwise respectively around the longitudinal axis are movable with respect to each other. The said movability may relate to the angle that the respective cables assume with respect to each other, meaning in other words that it may relate to the pitch of rotation of the respective cables with respect to the longitudinal axis being adjustable. On the other hand it may also relate to the possibility that the cables in a set of cables are movable in their longitudinal direction. Particularly the last feature provides the possibility that the joint cables can transfer complicated curves from a first portion to a second portion of the instrument, located at opposite sides of the instrument's longitudinal axis. One thing and another promotes the flexibility of the instrument without compromising the rigidity and stiffness of the instrument at its second portion (the tip).

The results of the invention are achievable with an instrument wherein within the at least one of said set of cables, the second cable and the third cable are displaced rotationally in the first portion and in the second portion over a predefined angle. This can be any angle of a value capable to provide the sought for steering characteristics of the instrument, wherein the instrument can remain flexible, and wherein the instrument's second portion, i.e. the tip, will exhibit high rigidity and stiffness. Preferably for this purpose the angle is equal to or larger than 30° although occasionally

smaller angles may be feasible as well. Although the cables may extend parallel to the longitudinal axis between the first and second portions of the instrument, notable results are achieved when within the at least one set of cables the second cable and the third cable each are displaced rotationally also between the first portion and the second portion over at least 60°, preferably 90°, more preferably 135°, and most preferably 180°, or any multiple thereof. The application of rotational displacements over multiples of 180° is beneficial when it is intended to include high stiffness positions at intermediate locations between the first portion of the second portion of the instrument, and particularly promotes the possibility to transfer S-shaped curves from a first portion to a second portion of the instrument, that are located at opposite sides of the instrument's longitudinal axis.

Suitably in the first portion and/or in the second portion restriction means are provided to restrict sideways displacement of the cables yet enable their longitudinal movement with respect to said means. It is indeed one of the beneficial aspects of the instrument of the invention that it only requires that the cables are fixed to the first portion and the second portion and only need restriction against sideways displacement but not fixing along their longitudinal direction. This reduces the complexity of the construction and the costs that are associated therewith.

The said restriction means can simply be embodied as guide plates that are extending transversely to the longitudinal axis of the instrument, which plates are provided with slits that receive said cables.

The inventors particularly envisage an embodiment in which the restriction means are executed as neighbouring cables or tubes that extend adjacent and along at least part of the length of a first cable running predominantly parallel to the longitudinal axis, a second cable running at a first predefined angle with respect to said longitudinal axis, and a third cable running at a second predefined angle with respect to said longitudinal axis. Or in other words: the restriction means are embodied as neighbouring cables or tubes that extend adjacent and along at least part of the length of a first cable running parallel to the longitudinal axis, a second cable

circumferentially rotating clockwise around with respect to said longitudinal axis, and a third cable circumferentially rotating counterclockwise around said longitudinal axis. Thus all cables are neighbour to similar adjacent cables and each of said cables in a certain orientation, i.e. longitudinally extending, or obliquely extending with either a left turn or a right turn with reference to the longitudinal axis, then forms part of a set of cables according to the invention. Consistent with the law the invention also applies to any situation that there are more (sets of) cables that are applied concentrically to the first, second and third cable. These additional cables may have other angles or pitches of rotation with reference to the predominantly parallel extending first cable then the angles or pitches of rotation of the second and third cable.

The invention will hereinafter be further elucidated with reference to the drawing of some typical examples of an instrument or part of an instrument incorporating the invention.

In the drawing:

- figure 1 shows a minimally-invasive surgical device in which for clarity purposes the first or handle portion and the second portion are shown without cover;
- figure 2 shows a detailed view of elements that embody the invention and are applied in the handle portion and second portion of the minimally-invasive surgical device of figure 1;
- figure 3 shows a detailed view of the elements of figure 2 completed with several additional sets of cables; and
- figure 4 shows another embodiment of an instrument construed according to the invention;
- figure 5 a, b, c show a joystick in a transparent view in which the invention is embodied;
- figure 6 shows a surgical instrument in which the handle portion is provided with a joystick as is shown in figure 5; and
-figures 7 and 8 provide from top to bottom a sectional view, a side view and an isometric view of two further embodiments of an instrument according to the invention.

Whenever in the figures the same reference numerals

are applied, these numerals refer to the same parts.

First making reference to figure 1, an instrument, in particular a minimally-invasive surgical device 1, is shown in which cables 2 extend in a first portion 3 and in a second portion 4 of the instrument 1, which first and second portions 3, 4 are provided distant from each other at the instrument's extremities. The cables 2 are clearly provided at circumferential sides of the instrument's longitudinal axis 5. Care has been taken that the cables 2 are disposed at predefined angles or pitches of rotation with respect to said longitudinal axis 5.

The first portion 3 of the instrument 1 shown in figure 1, mostly the handle portion, depicts the basic configuration in which elements of the instrument 1 that do not immediately relate to the invention are for clarity purposes not shown. It shows a basic configuration of a single set of cables 2 in which a first cable 2' runs parallel to the instrument's longitudinal axis 5 in this first portion 3 of the instrument 1. Further it is shown that there is a second cable or cables 2'' running at a first predefined angle or pitch of rotation with respect to said longitudinal axis 5, and a third cable or cables 2''' running at a second predefined angle or pitch of rotation with respect to said longitudinal axis. The second cable or cables 2'' and the third cable or cables 2''' rotate in opposite directions around the longitudinal axis 5 of the instrument (left and right turns, or in other words clockwise and counterclockwise turns) so as to arrange that the second 2'' and third cables 2''' cross each other. The angle or pitch of rotation may be selected at any suitable value, for instance 30° or any value higher than 30°. Most preferably at least the second portion 4 of the instrument 1 is accordingly arranged with such first, second and third cables as are shown with reference to the first portion 3 of the instrument. The first cable 2', the second cable 2'' and the third cable 2''' are movable with respect to each other in the first portion 3 and/or the second portion 4 to arrange that the joint cables 2', 2'', 2''' can transfer complicated curves from said first portion 3 to said second portion 4 of the instrument, which are located at opposite sides of the instrument's longitudinal axis 5. This means that the angle or pitch

of rotation that the respective cables 2′, 2′′, 2′′′ assume with respect to the longitudinal axis 5 is adjustable and/or that at least one of the said first, second or third cables 2′, 2′′, 2′′′ is movable in its longitudinal direction.

Figure 2 shows for clarity purposes only the second cables 2′′ that run at a first predefined angle or pitch of rotation with respect to the longitudinal axis 5 of the first portion 3 and/or second portion 4 of the instrument. In this figure it is shown that the second cables 2′′ are displaced rotationally in said first portion 3 and/or said second portion 4 over 180°. It can however also be any other value, and even a multiple of 180°. The same applies to the not shown third cables 2′′′.

Figure 2 further shows that in the first portion 3 and/or in the second portion 4 restriction means 6 are provided to restrict sideways displacement of the cables 2 yet enable their longitudinal movement with respect to the restriction means 6. The restriction means 6 are embodied as plates 7 that are extending transversely to the longitudinal axis 5 of the instrument 1, which plates 7 are provided with slits 8 that receive said cables 2. See also figure 3 in which a multiple of sets of cables 2 are applied, each set of cables 2 comprising a parallel cable and two crossing cables that extend helically (‘helically’ being an alternative wording for ‘oblique’ as used herein) in a opposite direction around the longitudinal axis 5 of the instrument 1. Each of the slits 8 of each plate 7 receives a cable parallel to the longitudinal axis of the instrument, and/or two crossing cables. The parallel cable and the two crossing cables are mutually displaceable due to the requirement to provide the possibility of longitudinal movement of said cables.

Figure 4 shows an alternative and advantageous embodiment of an instrument according to the invention, wherein the restriction means 6 are embodied as cables 2′, 2′′, 2′′′ or tubes that extend adjacent and along at least part of the length of a first cable 2′ running parallel to a longitudinal axis, a second cable 2′′ running at a first predefined angle or with a first pitch of rotation around said longitudinal axis, and a third cable 2′′′ running at a second predefined angle or with a second pitch of rotation around said longitudi-

nal axis. Thus all cables are neighbour to similar adjacent cables and each of said cables in a certain orientation, i.e. longitudinally extending, or obliquely (casu quo helically) extending with either a left turn or a right turn with reference to the longitudinal axis, then forms part of a set of cables according to the invention.

Figure 4 further shows that in this embodiment an inner spring 8 and an outer spring 9 may be employed to keep all cables in the assembled condition. This is however obviously exemplary; instead of said inner and outer spring also other measures can be applied to maintain the cables in the assembled condition, such as flexible tubes or sealings, a series of inner and outer rings connected together with hinges, etc. In case it concerns an application with minute dimensions as may be present in catheters, the inner spring could be replaced by a single cable, a glass fiber, an electrical cable or coaxial cable, or by a concentric structure of parallel cables and helical cables as otherwise discussed in this application.

In all previously discussed embodiments of the invention the second 2'' and third oblique cables 2''' are free from portions extending parallel to the longitudinal axis 5 of the first and/or second portions 3, 4. Figures 7 and 8 provide exemplary embodiments of the invention in which the second 2'' and/or third oblique cables 2''' may at least in part extend parallel to the longitudinal axis 5. These embodiments exhibit nevertheless the essence of the invention being that around a longitudinal axis 5 of a first portion 3 and/or of a second portion 4 of the instrument, it has one or more sets of cables 2, each set of cables comprising in combination a first cable 2' running predominantly parallel to the longitudinal axis 5, and a second cable 2'' oblique with reference to said longitudinal axis 5 and at least in part circumferentially rotating clockwise (or counterclockwise) around said longitudinal axis 5 as shown in figure 7. Also an embodiment as shown in figure 8 is possible in which one or more sets of cables 2 are provided, each set of cables comprising in combination a first cable 2' running predominantly parallel to the longitudinal axis 5, a second cable 2'' oblique with reference to said longitudinal axis 5 and at least in part circumferentially rotat-

ing clockwise (or counterclockwise) around said longitudinal axis 5, and a third cable 2''' oblique with reference to said longitudinal axis 5 and at least in part circumferentially rotating counterclockwise (or clockwise but anyway counter to the rotational direction of the second cable) around said longitudinal axis 5. In the first portion 3 and/or in the second portion 4 suitably connection rings may be applied that jointly connect the first straight cable 2', the second oblique cable 2'' and the third oblique cable 2'''. In all embodiments and at all times however the second cable 2'' and the third cable 2''' are free from any kinks.

The foregoing figures elucidate the invention with reference to a minimally invasive surgical device but it can be any surgical instrument, endoscope or catheter with a rigid or flexible shaft, although preferably a laparoscopic instrument.

Figure 5A, 5B and 5C show the application of the invention wherein the instrument is a joystick 9. The helically extending cables 2'' and 2''' that cross each other are clearly recognizable, and extend around the longitudinal axis coinciding with the stick 10 of the joystick 9 when it's in its neutral position. Also the cables 2' that run parallel to said longitudinal axis are clearly shown as are the plates 7 that act as guides for the cables 2', 2'', 2'''.

Figure 6 shows an interesting combination in which a surgical tool 12 is provided at its handle 11 with a joystick 9 as shown in figure 5. The specialty of this construction is that the joystick 9 can be moved back and forth in a plane perpendicular to the plane of the drawing while keeping the stick 10 perfectly parallel to the shaft of the instrument. The parallel orientation of the stick 10 can be maintained independent from the movement of the stick 10 to the left or the right, or backwards or forwards in the longitudinal direction of the instrument shaft. Accordingly the joystick 9 in total assumes the shape of an S-curve and correspondingly also the tip 4 of the instrument assumes a similar S-curve. The instrument and the joystick 9 of the invention therewith exhibit 4 degrees of freedom rather than the usual 2 degrees of freedom. The beauty of this construction is further that a three-dimensional manipulation of the distal tip 4 of the instrument

is carried out by manipulating the joystick 9 merely by a single thumb of the user that holds the handle 11.

Although the invention has been discussed in the foregoing with reference to exemplary embodiments of the apparatus of the invention, the invention is not restricted to these particular embodiments which can be varied in many ways without departing from the gist of the invention. The discussed exemplary embodiments shall therefore not be used to construe the appended claims strictly in accordance therewith. On the contrary the embodiments are merely intended to explain the wording of the appended claims without intent to limit the claims to these exemplary embodiments. The scope of protection of the invention shall therefore be construed in accordance with the appended claims only, wherein a possible ambiguity in the wording of the claims shall be resolved using these exemplary embodiments. The description should in particular not be understood in the sense that what is not shown or described would be disclaimed. On the contrary: everything that is not shown or described falls within the scope of protection of the claims, provided that at least the subject-matter covered by the main claim is applied.

CLAIMS

1. Instrument (1, 9, 12) having a longitudinal axis (5) and provided with cables (2) extending in a first portion (3) and in a second portion (4) of the instrument, which first and second portions (3, 4) are provided distant from each other at the instrument's extremities, **characterized in that** it has one or more sets of cables (2) extending in at least one of said first and second portions (3, 4), wherein at least one of said sets of cables (2) provided in the first and/or second portions (3, 4) comprises in combination a first cable (2') running predominantly parallel to the longitudinal axis (5), a second cable (2'') oblique with reference to said longitudinal axis (5) and at least in part circumferentially rotating clockwise around said longitudinal axis (5), and/or a third cable (2''') oblique with reference to said longitudinal axis (5) and at least in part circumferentially rotating counterclockwise around said longitudinal axis (5), wherein the second cable (2'') and the third cable (2''') are free from any kinks.

2. Instrument (1, 9, 12) according to claim 1, **characterized in that** the second (2'') and third cables (2''') cross each other.

3. Instrument (1, 9, 12) according to claim 1 or 2, **characterized in that** the second (2'') and third (2''') oblique cables are free from portions extending parallel to the longitudinal axis (5).

4. Instrument (1, 9, 12) according to any one of claims 1 - 3, **characterized in that** within each set of cables (2) the first cable (2') running predominantly parallel to the longitudinal axis (5), the second cable (2'') and the third cable (2''') circumferentially rotating clockwise and counterclockwise respectively around the longitudinal axis (5)are movable with respect to each other.

5. Instrument (1, 9, 12) according to any one of claims 1 - 4, **characterized in that t**he first cable (2'), the second cable (2'') and the third cable (2''') are movable with respect to each other in that the pitch of rotation of the respective cables (2', 2'', 2''') with respect to the longitudi-

nal axis (5) is adjustable and/or that at least one of the said cables (2', 2'', 2''') is movable in its longitudinal direction.

6. Instrument (1, 9, 12) according to any one of claims 1 - 5, **characterized in that** within the at least one set of cables (2) the second cable (2'') and the third cable (2''') each are displaced rotationally between the first portion (3) and the second portion (4) over a predefined angle.

7. Instrument (1, 9, 12) according to any one of claims 1 - 6, **characterized in that** within the at least one set of cables (2) the second cable (2'') and the third cable (2''') each are displaced rotationally between the first portion (3) and the second portion (4) over at least 60°, preferably 90°, more preferably 135°, and most preferably 180°, or any multiple thereof.

8. Instrument (1, 9, 12) according to any one of claims 1 - 7, **characterized in that** in said predefined area between the first portion (3) and the second portion (4) restriction means (6) are provided to restrict sideways displacement of the cables (2) yet enable their longitudinal movement with respect to the restriction means (6).

9. Instrument (1, 9, 12) according to claim 8, **characterized in that** the restriction means (6) are embodied as plates (7) that are extending transversely to the longitudinal axis (5) of the instrument, which plates (7) are provided with slits (8) that receive said cables (2).

10. Instrument (1, 9, 12) according to claim 8, **characterized in that** the restriction means (6) are embodied as neighbouring cables (2', 2'', 2''') or tubes that extend adjacent and along at least part of the length of a first cable (2') running parallel to the longitudinal axis, a second cable (2'') circumferentially rotating clockwise around with respect to said longitudinal axis (5), and a third cable (2''') circumferentially rotating counterclockwise around said longitudinal axis (5).

11. Instrument (1, 9, 12) according to any one of the previous claims 1 - 10, **characterized in that** the instrument is a surgical instrument, preferably a laparoscopic instrument or a catheter (1).

12. Instrument (1, 9, 12) according to any one of the

previous claims 1 - 11, **characterized in that** the instrument is a joystick (9) or is embodied as a surgical instrument (12) provided with a joystick (9).

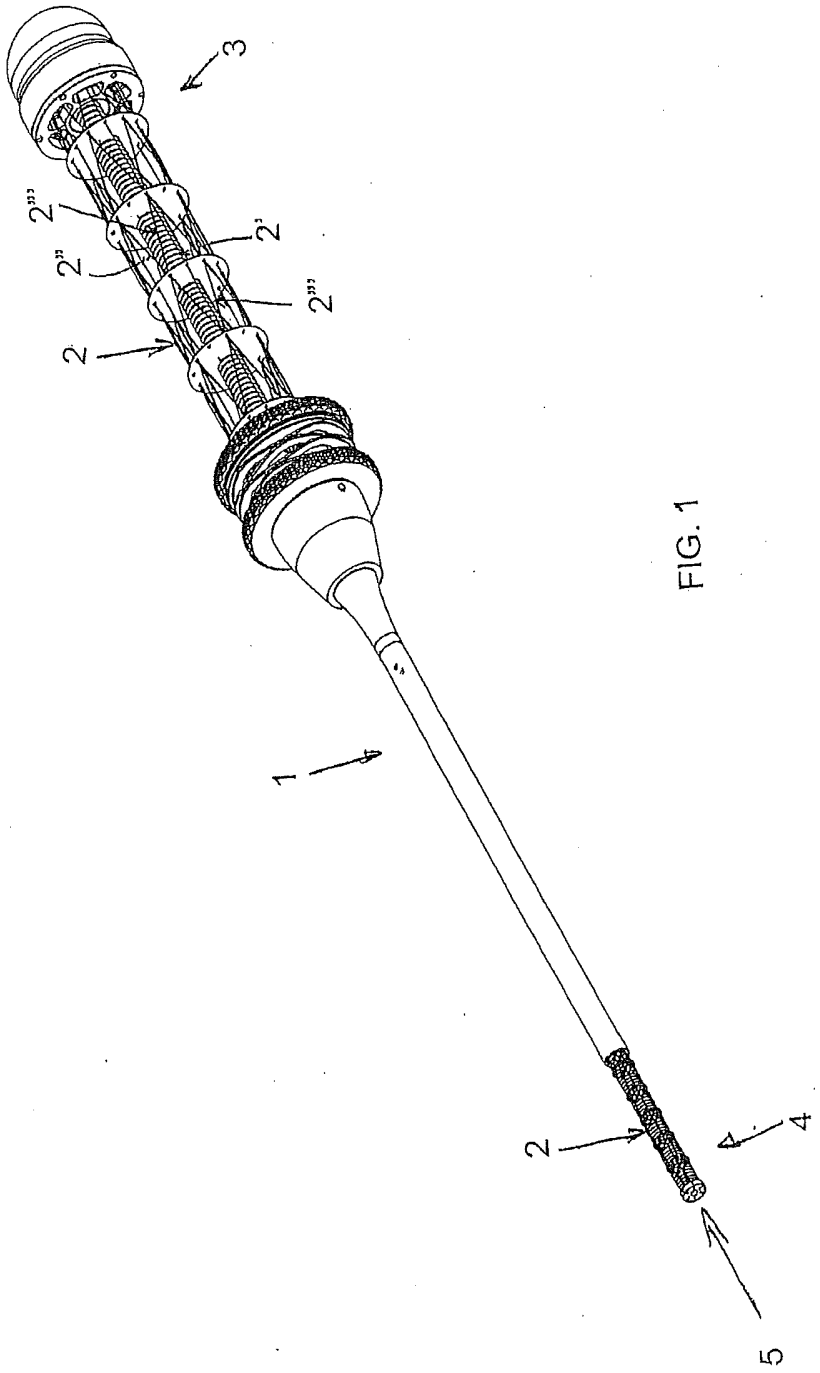


FIG. 1

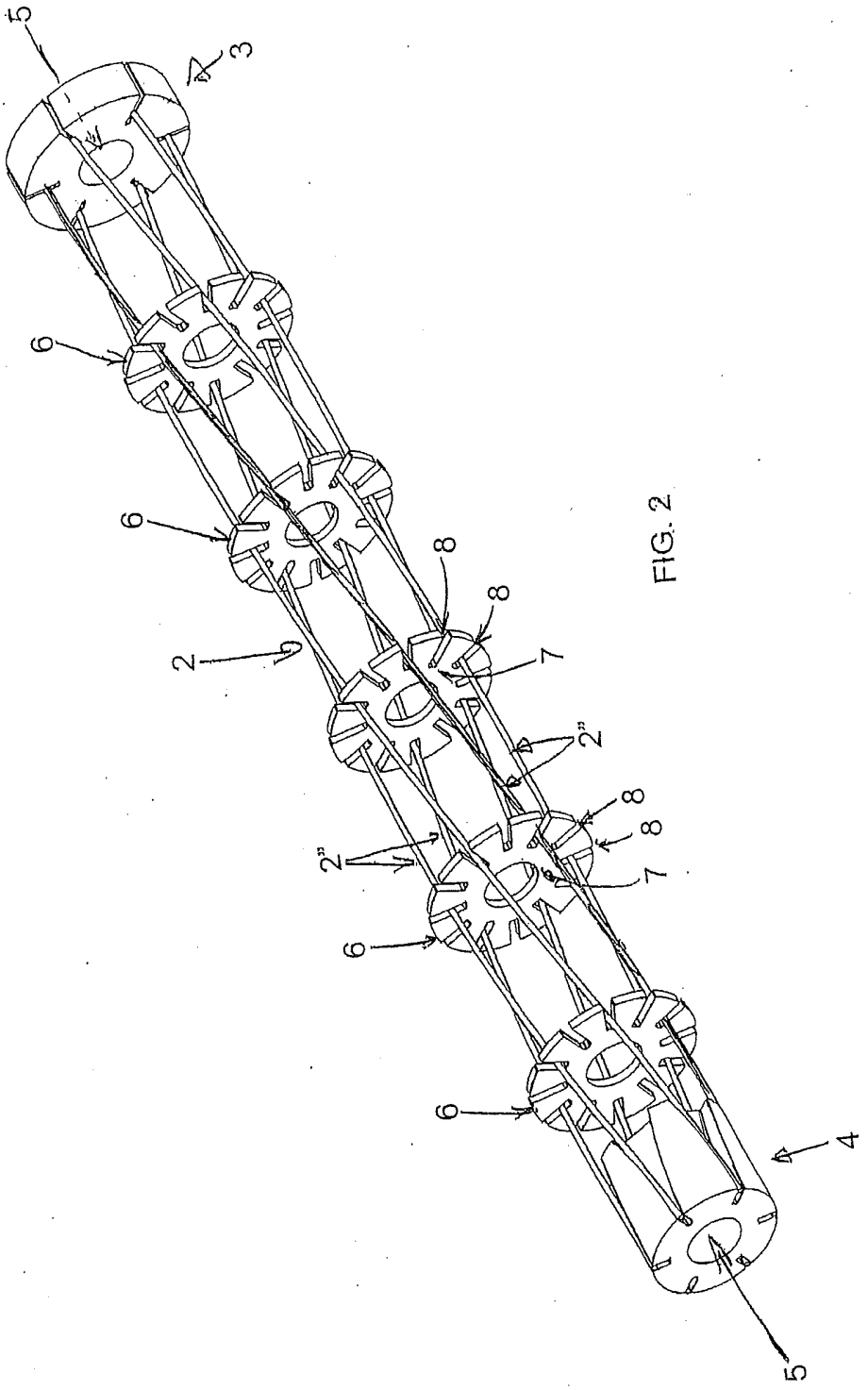


FIG. 2

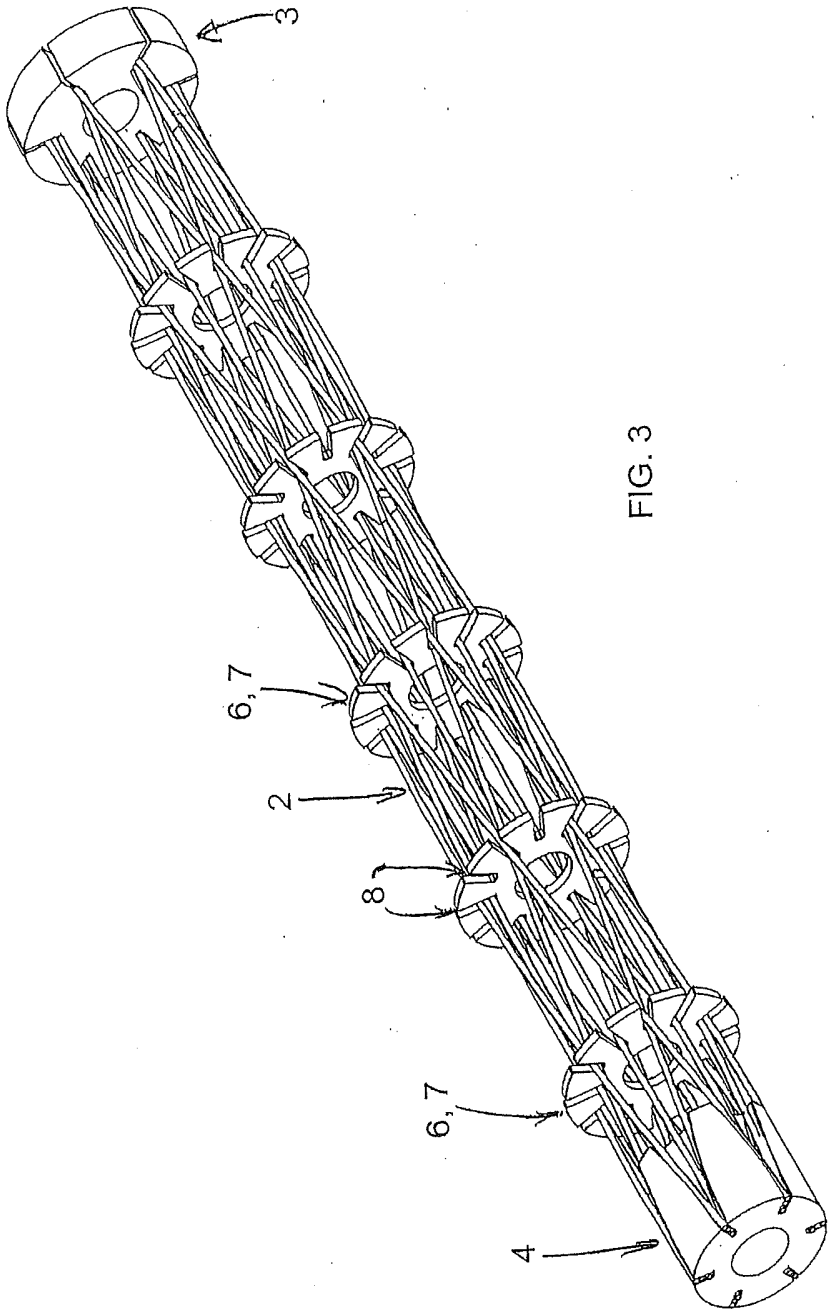


FIG. 3

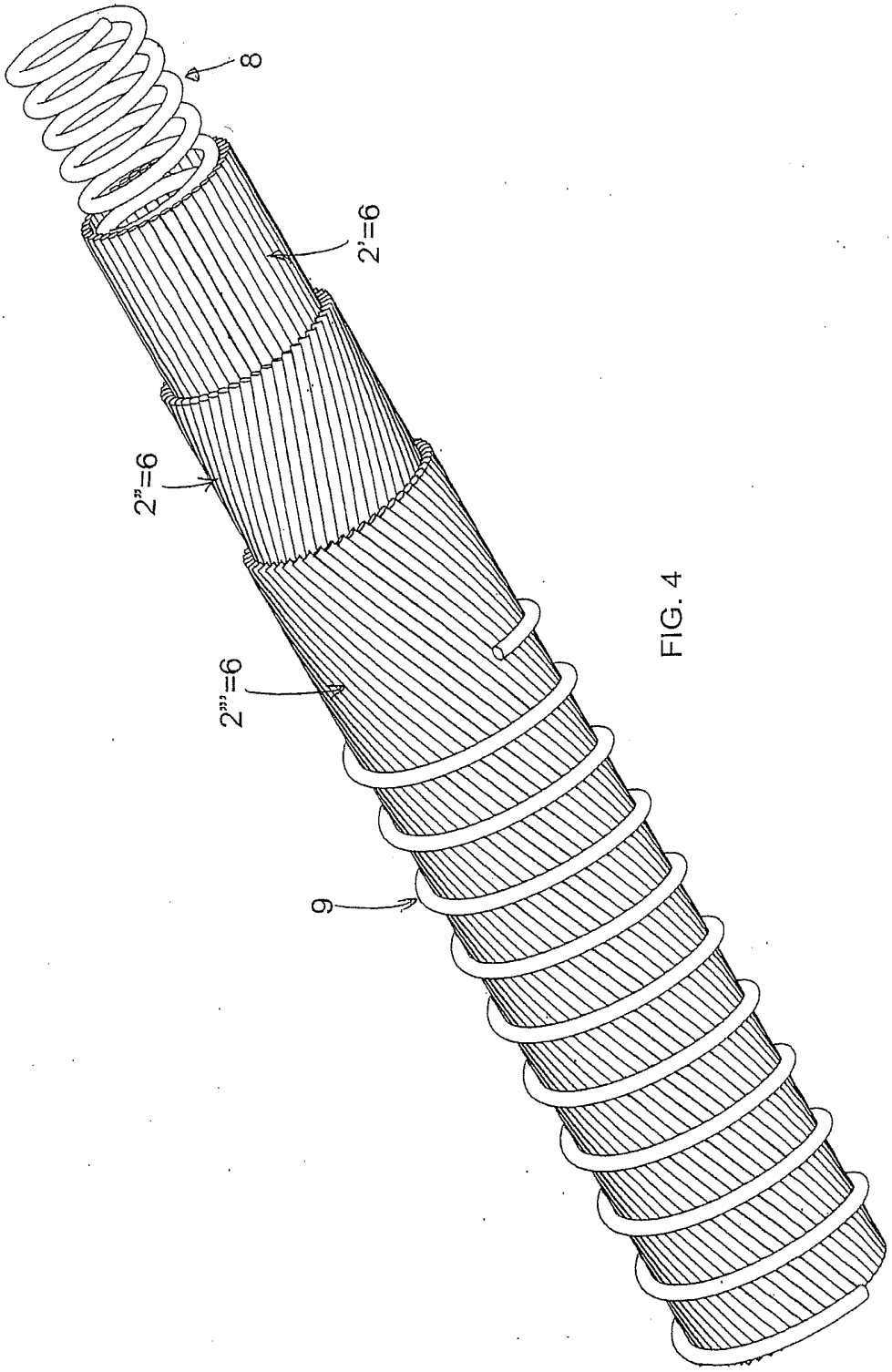
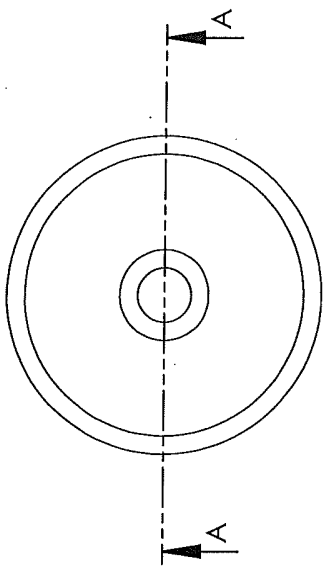
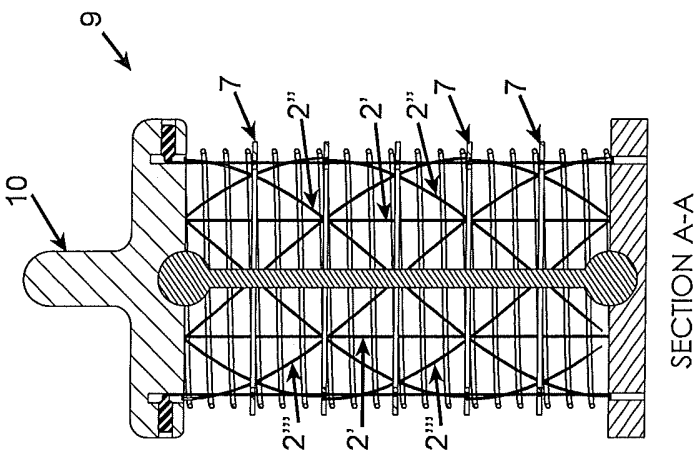


FIG. 4





SECTION A-A

Fig. 5c

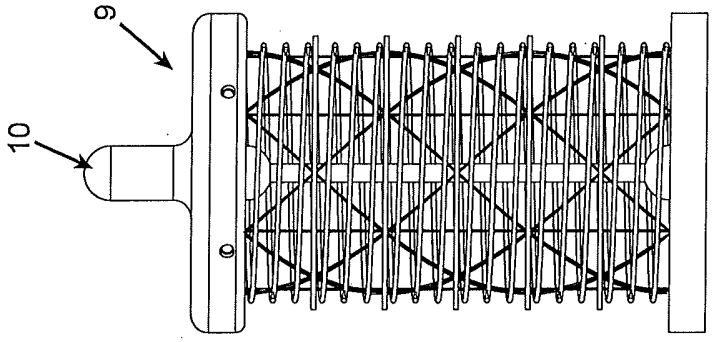


Fig. 5b

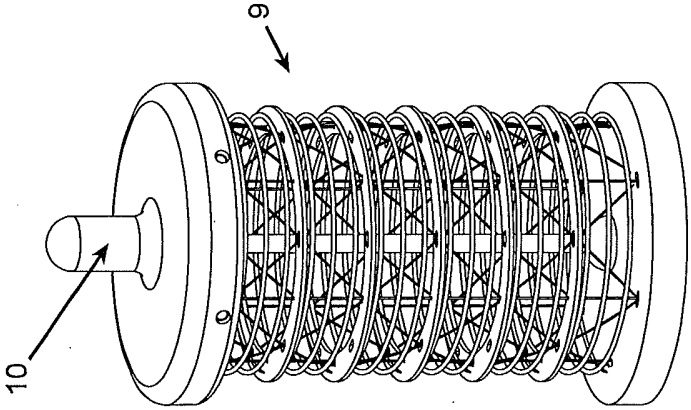


Fig. 5a

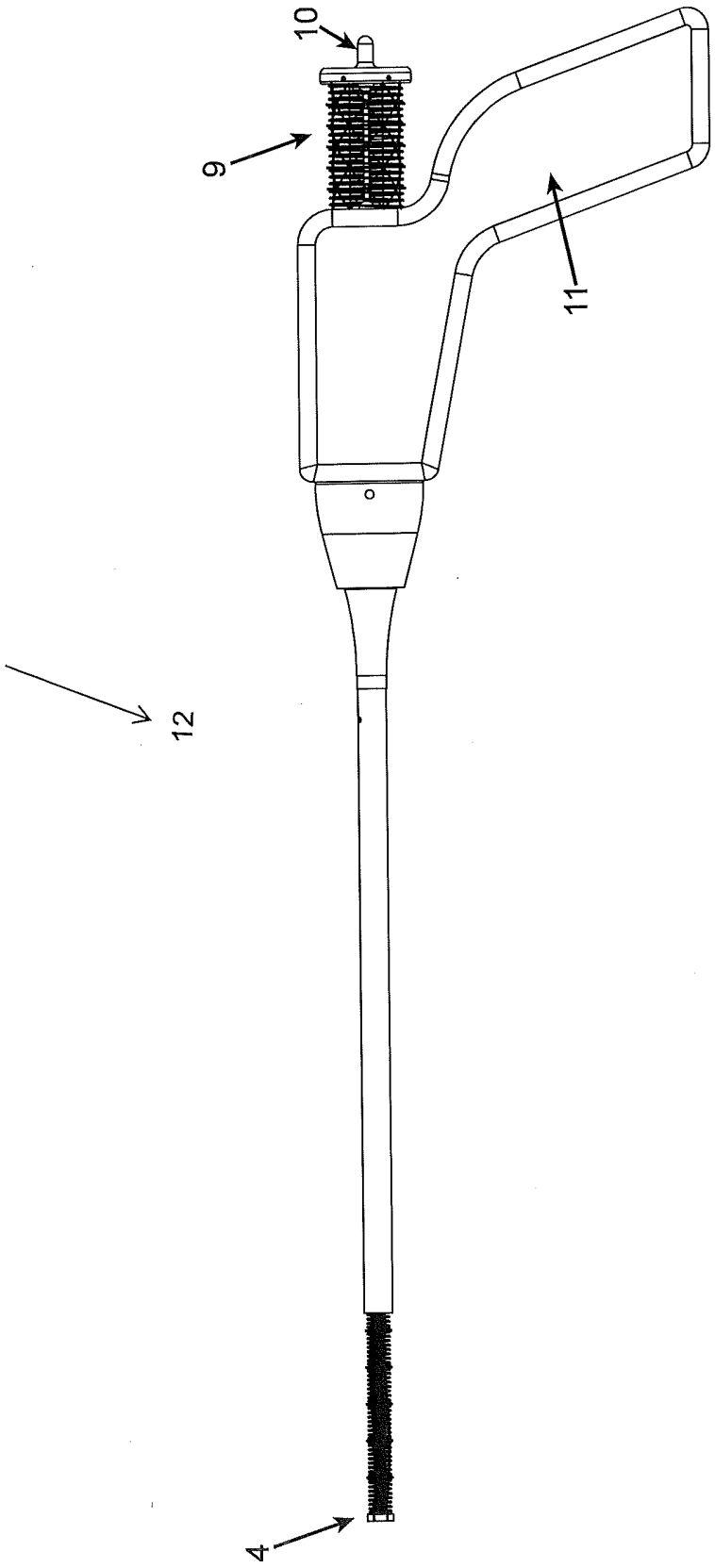


Fig. 6

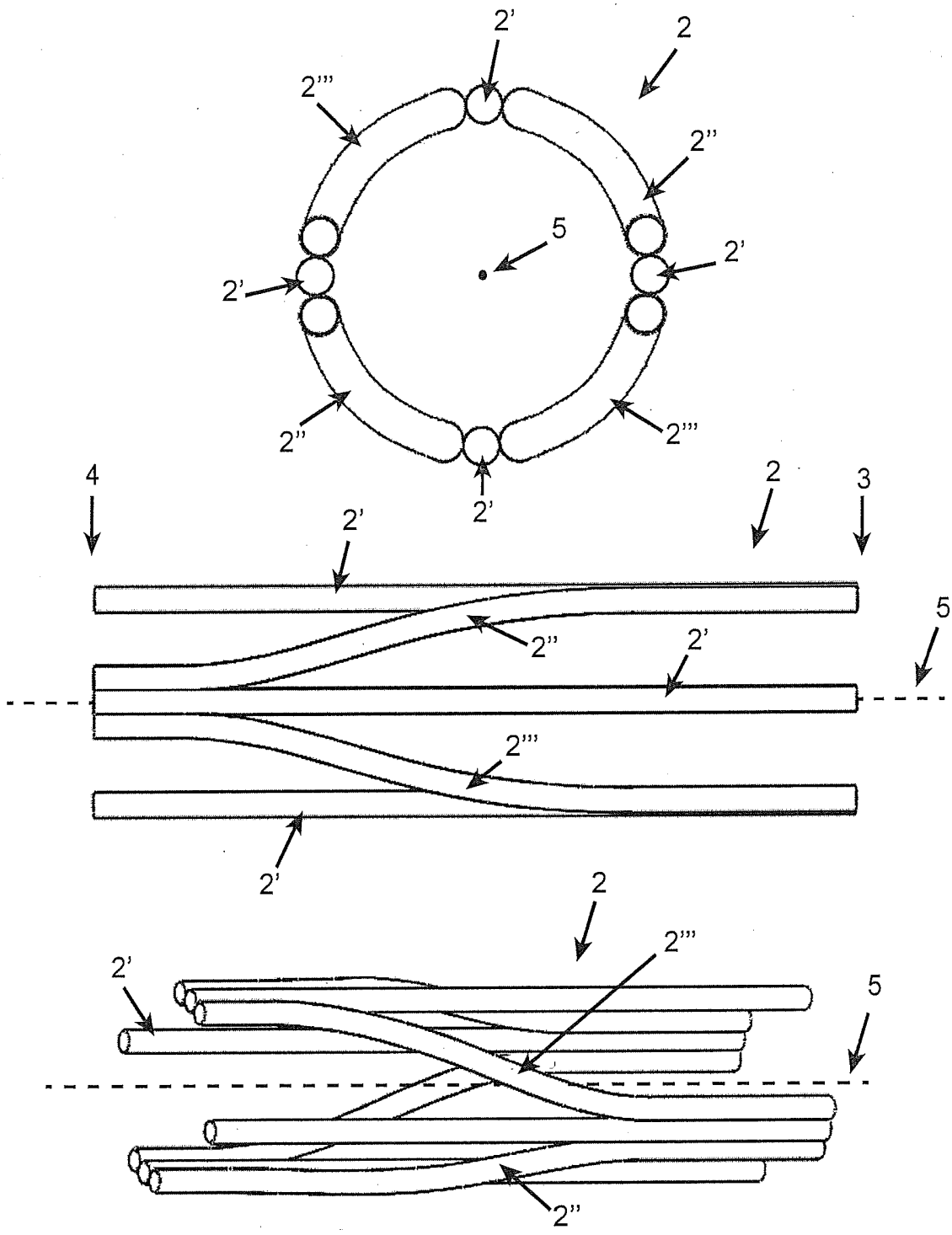


Fig. 7

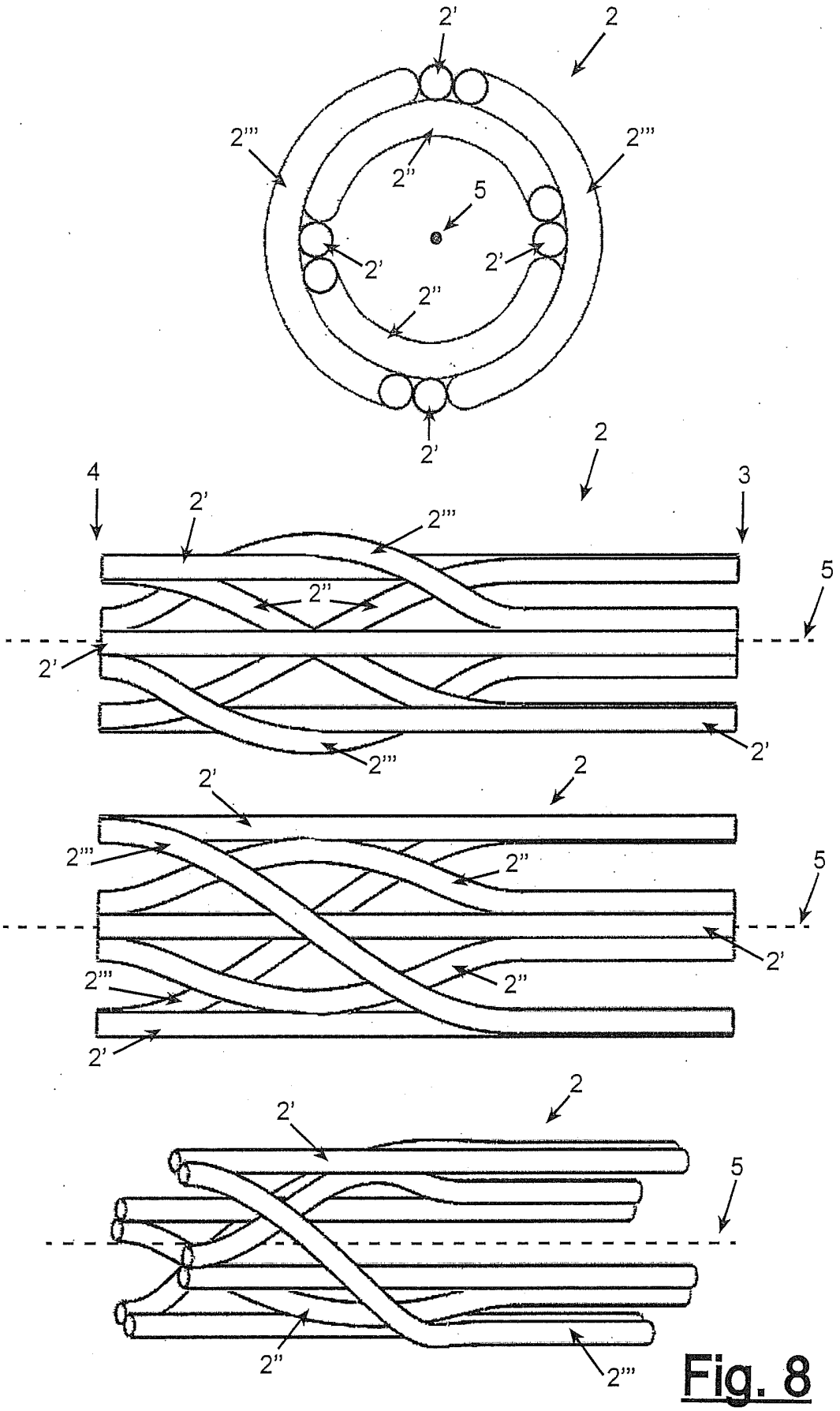


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2015/050011

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B1/005
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/010309 A1 (KITAGAWA) 14 January 2010 (2010-01-14) cited in the application paragraphs [0067] - [0079] -----	1-12
A	WO 2013/184192 A2 (MASSACHUSETTS INST TECHNOLOGY) 12 December 2013 (2013-12-12) paragraph [0062] -----	1-12
A	EP 1 886 617 A1 (ARS CO LTD) 13 February 2008 (2008-02-13) paragraphs [0018], [0027], [0028] -----	1-12

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

☒ See patent family annex.

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"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
5 March 2015	13/03/2015

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	Martelli, Luca

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2015/050011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010010309 A1	14-01-2010	JP 2010017483 A	28-01-2010
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EP 1886617 A1	13-02-2008	CN 101184426 A	21-05-2008
		EP 1886617 A1	13-02-2008
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		WO 2006126265 A1	30-11-2006