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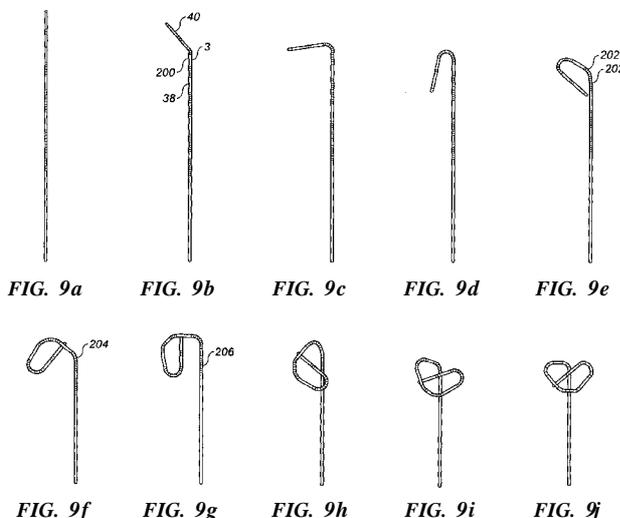
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(54) Title: RETRACTORS



(57) Abstract: Control members (200) and (202) extend through segments (3) in a retractor. When a wire (10) is tightened to urge each of the segments (3) to turn, the segments (3) having the weaker control member (200) move first to cause the distal end to turn before the segments (3) having the stronger control members (202) start to turn.



WO 2011/107800 A1

**RETRACTORS**

The present invention relates to surgical instruments comprising retractors and a method of controlling such instruments. The invention is particularly applicable to endoscopic surgical instruments.  
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EP 0 623 004 discloses a surgical instrument comprising a retractor.

US2006/01 78562 discloses methods and apparatus for obtaining endoluminal access comprising a steerable endoluminal guide having a variable pivot for altering steering dynamics.  
10

US2009/0079821 discloses a steerable structure (21, 27) of the catheter or endoscope type, the structure comprising an elastically or deformable longitudinal body (22, 28) including at least one actuator (16, 38) of material of the shape memory type incorporated longitudinally with the body (22, 28) together with Joule-effect heater means enabling the actuator (16, 38) to be contracted longitudinally in order to cause the longitudinal body (22, 28) to bend.  
15

US 5, 308,342 discloses a catheter composed of an outer coaxial tube or relatively high flexibility and three tandemly disclosed inner coaxial tube segments that vary in stiffness with the stiffest being located at the proximal end of the catheter and the least stiff ending proximal of the proximal end of the catheter.  
20

GB 2 456 165 discloses a shaft 1 for an endoscopic instrument having two series of slots 5 and 6 forming a preferentially flexible portion 2. The series are offset and the length of the slots varies along at least one of the series to vary the flexibility of the shaft.  
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WO 01/23022 discloses an endoscope having an elongated flexible sheath (12). A first sleeve (20) has a passage (24) therethrough which snugly received the sheath (12), the first sheath (12) being slidable from its proximal end to its distal end.  
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It is an object of the present invention to attempt to overcome at least one of the above or other disadvantages.

A surgical instrument comprising a retractor, the retractor including an elongate portion having a first part comprising adjacent pivotally connected segments pivotable from a first configuration to a second, different configuration and a second part comprising adjacent pivotally connected segments, at a different elongate extent along the elongate portion than the first part, pivotable from a first configuration to a second, different configuration in which, in the second configurations, the adjacent segments abut each other to inhibit further movement,  
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at least one of the parts including a control whereby a force required to move the first part from the first configuration towards the second configuration is less than the force required to move the second part from the first configuration towards the second configuration and an actuator arranged to urge the first and second parts from the first to the second position at the same  
5 time.

According to one aspect of the present invention, an instrument, such as a surgical instrument for example, includes an elongate portion arranged, in use, to be inserted through a restricted opening into a body, the elongate portion being movable from a first configuration to a second,  
10 different configuration in which second configuration two parts of the instrument that are spaced from each other in the first configuration at least partially cross each other in second configuration.

The parts may contact each other in the second configuration.  
15

The parts may completely cross each other in the second configuration and may completely cross each other such that the instrument extends over itself.

One of the parts may comprise an end region.  
20

The parts may comprise parts that are spaced from the end region.

There may be at least two pairs of parts that are spaced from each other in the first configuration and at least partially cross each other, at different extents for the pairs, along the  
25 instrument in the second configuration, and going along the elongate extent of the instrument, the first pair may cross on one side of the instrument with the second pair also crossing on that side. There may be at least three pairs of parts that are spaced from each other in the first configuration and that at least partially cross each other at different extents, for the pairs, along the instrument in the second configuration and, going along the extent of the instrument, the  
30 first and second pairs may cross on the same side with the third pair crossing on the opposite side.

The end region may include a portion that is movable to extend up towards the location where the parts cross and down from the location where the parts cross.  
35

The instrument may include a rigid portion, which rigid portion comprises at least one of the parts that at least partially cross each other and a plurality of parts that cross each other may include the rigid portion.

In the first configuration, the instrument extends in a common first direction and in which, in the second configuration part of the instrument extends in a second direction which is opposed to the first direction and in the second direction, the one part of the instrument may be caused to extend back towards another part. In the second configuration two spaced elongate extents of the instruments may both extend at an angle to the first direction.

The instrument may include spaced joint regions that enable the instrument to move from the first to the second configuration and the spaced joint regions may allow the instrument to cross itself at least twice in the second configuration. The joint regions may comprise a plurality of segments movable relative to each other to assist in causing the movement from the first to the second configurations.

The instrument may include first control means arranged to cause the movement from the first to the second configuration.

In the second configuration, the two parts may be biased towards each other at the region where they at least partially cross each other.

The instrument may include a flexible member extending outside of the instrument from the end region to a location spaced from the end region and the flexible member may be arranged to assist in effecting movement from the first to the second configuration and the flexible member may be arranged to be tensioned, initially, as movement from the first configuration commences and subsequently to be slackened. The instrument may include second control means arranged to control the operation of the flexible member. The first and second control means may be arranged to be coordinated to effect the movement from the first to the second configurations.

In the second configuration, one previously spaced part of the instrument may be arranged to be connected to another part of the instrument and one part may comprise the end portion of the instrument. The connection may be arranged to be by means of a plug and socket. The flexible member may be arranged to extend within the instrument and then out of the instrument in the region of where the parts are arranged to be connected and then to extend externally of the instrument to the other part that is to be connected whereby tensioning the flexible member is arranged to assist in effecting the connection.

According to another aspect of the present invention a method of controlling a surgical instrument comprises causing an elongate portion to move from a first configuration in which two parts are spaced from each other to a second configuration in which those parts at least partially cross each other.

The method may comprise causing the instrument to move to a second configuration in which the instrument crosses itself twice.

- 5 The present invention also includes a method of controlling an instrument when the instrument is as herein described.

According to one aspect of the present invention a surgical instrument includes an elongate portion arranged, in use, to be inserted through a restricted opening into a body, the elongate  
10 portion being movable from a first configuration to a second, different configuration in which second configuration two parts of the instrument that are spaced from each other in the first configuration at least partially cross each other in second configuration.

According to a further aspect of the present invention a method of controlling a surgical  
15 instrument comprises causing an elongate portion to move from a first configuration in which two parts are spaced from each other to a second configuration in which those parts at least partially cross each other.

The present invention also includes a method of performing surgery when using the instrument  
20 of the present invention or when controlling the instrument of the present invention.

The first configuration may be a straight configuration.

According to a further aspect of the present invention an instrument includes an elongate  
25 portion movable from a first configuration to a second, different configuration, the instrument including an operative member attached to the elongate portion at a first location and including an extent external to the elongate portion, the operative member, in use, being arranged to exert a force on the elongate portion to at least partially assist in causing the elongate portion to move at least part of the way between the first and second configurations.

30

According to a still further aspect of the present invention a method of operating an instrument includes an elongate portion and an operative member attached to the elongate portion, the operative member including an extent external to the elongate portion the method comprising exerting a force on the elongate portion thereby causing the elongate portion to move from the  
35 first configuration to a second, different configuration.

According to another aspect of the present invention an instrument includes an elongate portion movable from a first configuration to a second, different configuration, the elongate portion comprising a plurality of segments that are connected to each other by a connection

means and that are movable relative to each other whereby the elongate portion can move from the first to the second configuration, the connection means comprising at least one pivot member acting as a hinge between the segments.

5 According to a further aspect of the present invention a method of connecting a plurality of segments of an elongate instrument such that the segments can move from a first configuration to a second, different configuration comprises using a pivot member to act as a hinge between the segments.

10 Any of the aspects of the invention may be combined.

The present invention is also defined in the claims.

The present invention will be now be described, by way of example and with reference to the  
15 accompanying drawings, in which:-

Figure 1 is a side view of a surgical instrument comprising a surgical retractor 1 with an end 2 in a straight configuration;

20 Figure 2 is a view of the end 2 of the retractor shown in Figure 1 in a straight hook configuration;

Figure 3 is a view of an end 2 of a retractor similar to that shown in Figure 1 in an angled hook configuration, and

25 Figure 4 is a schematic perspective view of one of the segments 3 at the end 2 of the retractor shown in Figure 1.

Figure 5 is a front view of a first embodiment of a retractor;

30 Figure 6 is a front view of a second embodiment of a retractor;

Figure 7 is a perspective view of a third embodiment of a retractor;

35 Figures 8a-i are sequential views showing how the configuration of Figure 7 is formed when the wire 10 is pulled;

Figures 9a - i are sequential views showing how the configuration of Figure 7 is formed when the wire 10 is pulled when using control members;

Figure 10 is a longitudinal cross-section of the instrument that can form the shape of Figure 7 and Figure 11 is a detail of that figure;

- 5 Figure 11 is a longitudinal cross sectional view of part of the instrument showing the wire 10 and the control member and Figure 13 is cross-section 22-26 of Figure 25, and

Figure 1 shows a retractor 1 having a handle 6 which is connected to the end 2 via a hollow rod 7. In use, with the end in the configuration shown in the drawing, the end 2 and part of the rod 7 are  
10 fed through a tube in the abdominal wall. The surgeon is then able to manipulate the retractor by the handle 6 and change the configuration of the end 2 into the straight hook shape shown in Figure 2 by rotating a knurled actuating nut 8.

The nut 8 is threadably connected to a screw member 9 whereby, when the nut 8 is rotated in a  
15 clockwise direction, looking from the free end of the handle, the screw member 9 is caused to move translationally away from the end 2. A loop of wire 10 is connected at its free ends to the member 9, and both sides of the loop pass through openings 11 in each segment 3. Accordingly as the wire 10 moves further into the rod 7 the segments are caused to tighten against each other.

20 As the segments 3 bear against each other they are caused to move out of the axial extent of the rod as the end faces 12 of each segment are formed at a slight angle to the perpendicular to the axis of the rod. In Figure 1 the upwardly facing surfaces of each segment are parallel with each other as are the downwardly facing surfaces. Accordingly adjacent faces come into abutment with each other as the wire is tightened, and they take up the configuration shown in Figure 2 in  
25 which a straight, substantially rigid hook which subtends approximately 180° is formed. Accordingly in the position shown in Figure 1, each face extends at an angle of approximately 10° to the axis of the tube.

In order for the segments to take up the shape shown in Figure 3, in which a substantially rigid  
30 hook which subtends approximately 180° in a direction generally at right angles to the axis of the rod, the face of at least one of the segments is angled differently. For instance, when the end 2 is in the relaxed position and extends generally in line with the axis of the rod 7, the uppermost segment faces the rod with a face extending at 45° to the axis of the rod, and the rod may be correspondingly angled at its end. Thus when the wire is tightened, the segment adjacent to the  
35 rod is caused to turn through 90°. The remaining upper and lower faces of the other segments may be parallel to each other in the configuration shown in Figure 1 as previously described.

The hooks shown in Figures 2 and 3 can be used to displace or hold the organs in the required position.

To release the segments from the configuration shown in Figures 2 or 3 the nut 8 is rotated in the  
5 opposite direction to release the tension in the wire. The wire is sufficiently strong, and the distance between the segments sufficiently small for the flexure of the wire to hold the segments generally straight for ease of insertion or removal when the hook configuration is not required. As the wire is threaded through two openings in each segment the strength of the wire and the close  
10 proximity of the segments prevents any significant relative turning of the segments around the longitudinal extent of the end 2.

The face of each segment which is caused to abut against another part of the retractor when in the hook configuration is formed with striations 13 which are parallel to each other and parallel to adjacent striations such that co-operating faces do not tend to slip in a rotational or translational  
15 sense.

With such retractors the remote end includes an exposed end 20. When pushing tissue aside this end can cause trauma to the body, particularly the liver. In addition there is inevitably some flexure in the segments. Such flexure causes the end section to have a reduced effect  
20 on pushing the liver.

Furthermore, whilst it is relatively easy to achieve the configuration shown it can be difficult to effect more complicated configurations.

25 Each of the embodiments of the retractors shown may be operated as described in relation to Figures 1 to 4. Accordingly only the differences will be described. In addition, each retractor is able to have a straight configuration to enable the retractor to be inserted or removed and only the second configurations are shown in which each adjacent segment abuts each other to inhibit further movement or bending.

30

In Figure 5 there are four segments 3 adjacent to the hollow rod 7 and four at each of the further corners. Long segments 22 and 24 extend between the short segments and a longer segment 26 has its tip 20 extending back under the rod 7. Ideally the tip 20 should be concealed in the view shown by the hollow rod.

35

This arrangement has advantages over the segmental arrangements shown in Figures 2 and 3 in that no twisting of the retractor about the shaft 7 occurs if the retractor is urged in a direction

out of the plane shown or into the plane shown. In addition at least part of the tip 20 is concealed by the rod 7 or can trail the rod 7 thus effecting less trauma.

5 Figure 6 has the same general shape of that of Figure 5. However the shaft 7 includes a further control cable 28 that is connected to the tip 30 of the elongate portion. The cable exits the shaft 7 just short of the first series of segments.

10 In use, either before the segments are tensioned by the wires 10 to take up the configuration shown, or after, or during at least part of that tensioning or any combination thereof the control cable 28 is tensioned to draw the tip 30 towards the shaft 7. A recess 32 may be provided in the shaft 7 in which the tip 30 may be drawn into and held by the cable.

15 This configuration allows greater force to be applied with less trauma being provided than that of Figure 5. In addition the retractor can be urged in either direction to equal advantage as the configuration is symmetrical from the front and back.

20 Whilst the angles that the short segment of Figures 5 and 6 allow the retractor to turn are approximately  $45^\circ$ ,  $135^\circ$  and  $135^\circ$  respectively the embodiment of Figure 7 is more complicated.

25 In Figure 7, starting from the rod 7, four short segments 3 allow the next long segment 32 to extend at  $90^\circ$  to the extent of the rod. Then six short segments 3 cause an even longer segment 34 to extend back towards the rod 7 at an angle of  $45^\circ$  to the rod. Then two short segments cause the "shortest" long segment 36 to cross over the rod 7, possibly in contact therewith, before two further short segments cause a further turn of  $45^\circ$  for the next long segment 38. Then eight short segments 3 cause a further turn of  $180^\circ$ . This brings two long segments 40 and 42 back over the rod 7 with the end of the segment 42 being tucked under the long segment 34.

30 The long segments 40 and 42 are connected by angled faces that allow the segment 40 to be inclined upwardly as it extends towards the rod with the segment 42 being inclined downwardly as it extends away from the rod 7. The movement of the segments 40 and 42 can be coordinated to take place as the end of the instrument moves back over the shaft towards the segment 34. Alternatively the segments 40 and 42 may be fixed together to form an angled  
35 suit such that they can not move relative to each other. The segments 40 and 42 may be urged against the long segment 32 and the short segments 3 adjacent to the rod 7 as the segments 40 and 42 are being moved into place such that relative flexure of those parts occurs. When the joint between the segments 40 and 42 pass the segments 3 adjacent to the rod they spring back to allow the segment 42 to pass beneath the segment 34 and to maintain

the shape shown under flexure with those parts crossing the rod being urged against the rod. Furthermore, that binding force may also cause the segment 36 to be biased. The biasing forces may be assisted by the angled slope of the segment 42 sliding along the segment 34 and pushing further against the segment 34 as the segment 42 slides further beneath the  
5 segment 34.

The configuration of Figure 7 affords stability and strength in either direction. Furthermore trauma is reduced because of the considerable cross sectional area provided by the retractor or both sides of the shaft 7.  
10

Although not shown in the drawing of Figure 7, the end segment 42 may be connected to the shaft 7 by a control cable. The control cable may be tensioned to assist in the retractor leaving the straight configuration. As the wires tension the segments and as the retractor takes up the shape shown the cable may be tensioned or relaxed to assist in the shape being taken up.  
15

As the retractor crosses the rigid rod in Figures 5 and 7 (and as the retractor is fixed in Figure 6) when the rod is urged towards a liver with the cross parts being located between the rod and liver a rigid retractor is provided with a broad area of even force being applied.

20 Figures 8a - i are sequential views showing how the configuration of Figure 7 is formed when the wire 10 is pulled. The first part of the instrument that bends is the proximal part between the rod 7 and the long segment 32 that changes shape from Figures 8a to 8b to 8c. When the short segments 3 abut each other to prevent further rotation at that location the adjacent short segments then cause the shape to change from Figures 8c to 8d. It can be seen that further  
25 tightening causes turning of the instrument to progress towards the proximal end possibly with abutment of distally located segment prior to adjacent proximal segments commencing to turn or possibly with a partial turn of distal segments prior to adjacent proximal segments commencing to turn.

30 It can be seen though that there is no control over how and when each segment commences to turn. Further, there is a large sweep when moving from Figure 8a to 8i, for instance, which may not be acceptable when using the instrument as a surgical retractor.

Figures 9a to i start and finish with the same configuration as that of Figures 8a and 8i when  
35 the wire 10 is progressively tightened. However the turning sequence is controlled. When the instrument is in the position shown in Figure 9a, the force exerted on all segments urging them from the in line position may be equal.

The first turn occurs at the distal end with the short segments 3 between the long segments 40 and 38 moving from the configuration of Figure 9a to 9d. When those segments 3 but each other or before abutment occurs the segments 3 between the long segment 38 and the long segment 36 start to turn to change the configuration from that of Figure 9d to 9e. Again when those segments 3 may abut each other or before they abut each other the adjacent distal segments start to turn. Such progressive successive turning of adjacent distal segments continues until the configuration of Figure 9i is arrived at.

It can be seen that the change from Figures 9a to 9i involves only sweeping a very small area.

It will be appreciated that the individual control between adjacent segments that any sequence of progressive turning can be achieved.

Figures 10 to 12 show how the control is applied. Long segments 34, 36, 38 and 40 are shown as in Figure 7. However there may be a different number of short segments.

In Figures 10 and 11 the wire 10 that is pulled to turn the segments is not shown.

A control member 200 is connected to the end 40. The control member extends through the adjacent three segments 3 and has a free end 200A extending part of the way along segment 36. Further control members 202 extend from the long segment 36, through the segments 3, to the long segment 34. It will be appreciated that a control member may extend over the joint between two segments only or may extend across more than two segments. Furthermore, separate, spaced control members may be provided extending across the joints of different segments.

When the wire 10 is tightened to cause turning of the segments the control members 200 and 202 must also turn thus affording resistance to the turning (and also in due course assisting in the return of the segments to the configuration shown). The member 200 may be of the same material and/or may be of a slightly smaller diameter than each of the members 202. Accordingly the members 202 afford greater resistance to turning and the distal segments between the long segments 36 and 40 will start to turn first. Each control member may slide relation to part of the segments when these segments turn and may be stationary relative to one part of the segments. This is because the control members are one offset from the pivotal axis of the segments.

Either when all of the segments with the member 200 extending therethrough abut each other or shortly before that, the segments 3 with the members 202 extending through them will start to turn, overcoming the resistance afforded by the members 202.

Only one end of the members 202 is shown. They may be provided at each end with enlarged heads 204. This stops the members 202 from moving out of the segments that they control. It also allows for the members to be straight and curved without the heads abutting the segments to restrict turning as the distance between the heads at each end is greater than the distance that they occupy when the segments are at their limit of turning. Abutment of the segments may limit the extent of a turn. Alternatively or additionally abutment of the heads 204 at each end of one or both members 202 with segments at the end of a portion that is being controlled may limit the extent of a turn. As the member or members may be offset relative to the pivot axis of the segments, relative sliding between the member or members and the segments may occur.

The control members comprise spring steel or a memory metal such as NiTiNoL which may comprise Ni:Ti 50:50 Nickel Titanium alloy. Whilst the members 200 and 202 are shown as being of the same or similar diameter and material they may be of different material. Alternatively they may be of different cross sectional dimensions such as of different diameters. Alternatively the members 202 may be connected along their length.

Figures 12 and 13 show the location of the wire 10 and the control member 200.

Referring back now to Figures 9a to g, the resistance of the control member or members 200, 202, 204 and 206 progressively increases. However, if desired, the control members could be arranged in an order such that 200 affords the greatest resistance, then 204, then 202 and then 206 or, indeed, any sequence of turning may be effected by varying the location of the control members. In this manner the sequence of movement of any bendable member can be controlled.

Similarly in Figures 5 and 6 the control member 200 may afford less resistance than the control member 202

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

5

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

**CLAIMS:**

1. A surgical instrument comprising a retractor, the retractor including an elongate portion having a first part comprising adjacent pivotally connected segments pivotable from a first configuration to a second, different configuration and a second part comprising adjacent pivotally connected segments, at a different elongate extent along the elongate portion than the first part, pivotable from a first configuration to a second, different configuration in which, in the second configurations, the adjacent segments abut each other to inhibit further movement, at least one of the parts including a control whereby a force required to move the first part from the first configuration towards the second configuration is less than the force required to move the second part from the first configuration towards the second configuration and an actuator arranged to urge the first and second parts from the first to the second position at the same time.
2. An instrument as claimed in Claim 1 in which at least one control includes a flexible member arranged to exert a bias against movement of the part that includes that control from the first to the second position.
3. An instrument as claimed in claim 2 in which the flexible member extends across one part but not the other part or parts.
4. An instrument as claimed in claim 2 or 3 in which the flexible member is fixed to the elongate portion at one location only.
5. An instrument as claimed in any preceding claims in which at least two parts include a control.
6. An instrument as claimed in any preceding claim in which at least one control is an elongate member which has an elongate extent in the same general extent as the elongate portion.
7. An instrument as claimed in any preceding claim in which at least one control is located within the periphery of the elongate portion.
8. An instrument as claimed in Claim 7 in which at least one control is located in a central region of the elastic portion.
9. An instrument as claimed in any preceding claim in which at least one control is made of metal.

10. An instrument as claimed in any preceding Claim in which at least one end of at least one control is arranged to slide in the longitudinal direction relative to a portion of the elongate member which is coaxial to that end when the part that includes that control is moved from the  
5 first configuration towards the second configuration.

11. An instrument as claimed in Claim 10 in which both ends of the control are arranged to slide in the longitudinal direction relative to the portions of the elongate member which are coaxial with each end when the part that includes that control moves from the first  
10 configuration towards the second configuration.

12. An instrument as claimed in Claim 10 in which at least one end of at least one control is prevented from sliding in the longitudinal direction relative to a portion of the elongate member which is coaxial with that end when the part that includes that control is moved from the first  
15 configuration towards the second configuration.

13. An instrument as claimed in Claim 12 in which the end that is prevented from sliding is connected to the elongate portion at the location of the elongate portion that is coaxial with that end.  
20

14. An instrument as claimed in any preceding claim in which at least one control is capable of moving in the longitudinal direction of the elongate portion relative to the elongate portion when the part associated with that control is in the first configuration.

25 15. An instrument as claimed in Claim 14 in which at least one end region of the control cooperates with the elongate portion to restrict movement of the control in the at least one direction of the elongate extent.

30 16. An instrument as claimed in Claim 15 in which both end regions of the control cooperate with the elongate portion to restrict movement of the control in both elongate directions.

17. An instrument as claimed in Claim 16 in which the distance between the end regions of the control that restrict sliding movement of the control is arranged such that they do not simultaneously cooperate with the elongate portion when the part that includes that control is  
35 moved from the first towards the second configuration.

18. An instrument as claimed in claim 16 in which the distance between the end regions of the control co-operate with the elongate portion when the part that includes that control moves

to the second configuration whereby the distance between the end regions defines the limit of movement from the first configuration to the second configuration.

19. An instrument as claimed in any preceding claim in which the or each control is  
5 arranged to assist in returning the first and second parts from the second configuration towards the first configuration.

20. An instrument as claimed in claim 19 in which the second part is arranged to start to  
10 move from the second configuration towards the first configuration at a greater force than the force required to allow the first part to start to move from the second configuration towards the first configuration.

21. An instrument as claimed in any preceding claim in which the elongate portion includes  
15 at least three parts at different elongate extents along the elongate portion each movable from a first to a second, different configuration each having a control in which a force required to move the parts from the first towards the second configuration is different in the at least three parts.

22. An actuator as claimed in any preceding Claim in which the actuator is arranged, when  
20 the first and second parts are in the first configuration, to exert an equal bias on the parts to urge them away from the first configuration.

23. An instrument as claimed in any preceding claim in which the actuator comprises at  
25 least one wire extending along the elongate portion which wire is arranged to be tightened to effect movement from the first to the second configuration.

24. An instrument as claimed in any preceding claim in which at least the first part includes  
30 at least a gap along a side of the elongate portion which gap, in use, is arranged to be at least partially closed when the first part is moved from the first towards the second configuration.

25. An instrument as claimed in Claim in which the or each gap of that part is arranged to be  
at least partially closed before the second part starts to move from the first towards the second configuration.

35 26. An instrument as claimed in Claim 25 in which the or each gap of the first part is arranged to be completely closed before the second part starts to move from the first towards the second configuration.

27. An instrument as claimed in any of Claims 24 to 26 in which the or each gap is defined between two, separate segments.
28. A method of using a surgical instrument comprising causing axially spaced first and second parts of an elongate portion each comprising adjacent segments pivotally connected together to pivot from a first configuration to a second, different configuration and causing the first part to pivot from the first configuration towards the second configuration and then the second part to start to move from the first configuration towards the second configuration by the first part being less resistant to a force causing movement from the first configuration to the second configuration than a force causing the second part to move from the first configuration towards the second configuration the pivotal movement being effected by an actuator urging the first and second parts from the first to the second position at the same time and in which, when the parts are in the second portion the adjacent segments abut each other to inhibit further movement..
29. A method claimed in claim 28 comprising, when the first and second parts are in the second configuration, reducing the force simultaneously on each part holding them in that configuration and causing the control in at least one part to cause the second part to start to move from the second configuration towards the first configuration before the first part starts to move from the second configuration towards the first configuration.
30. A method as claimed in Claim 28 or 29 when using an instrument as claimed in any of Claims 1 to 27.

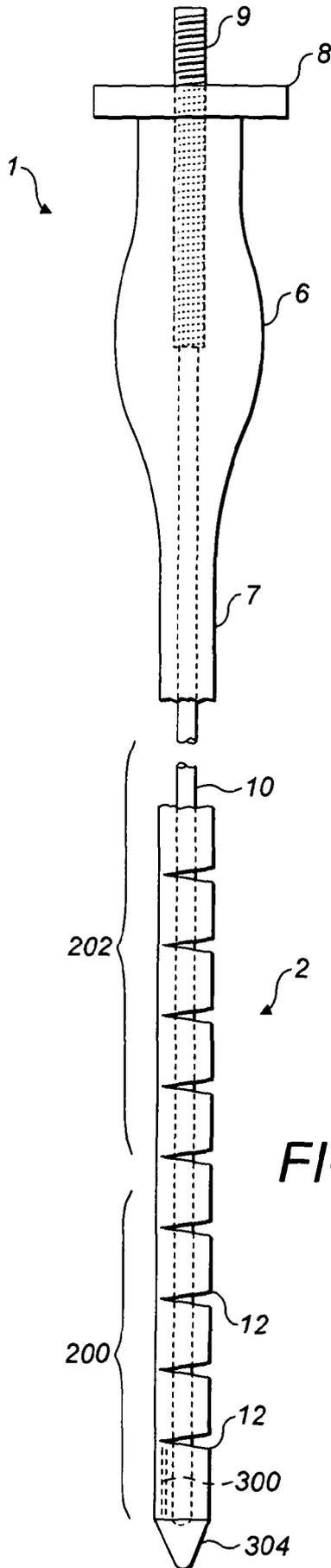


FIG. 1

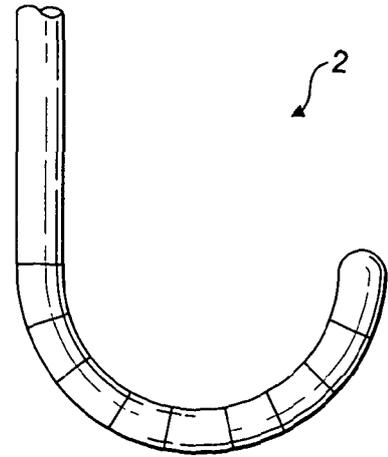


FIG. 2

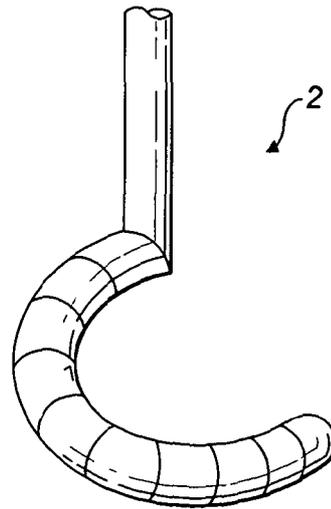


FIG. 3

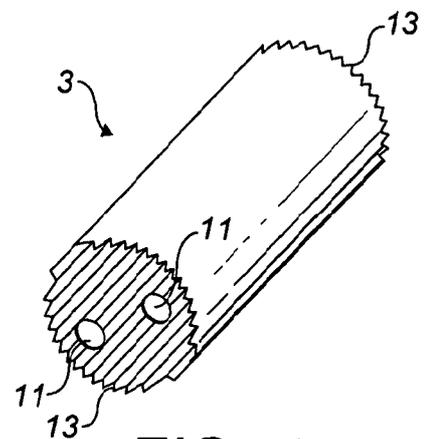


FIG. 4

2 / 9

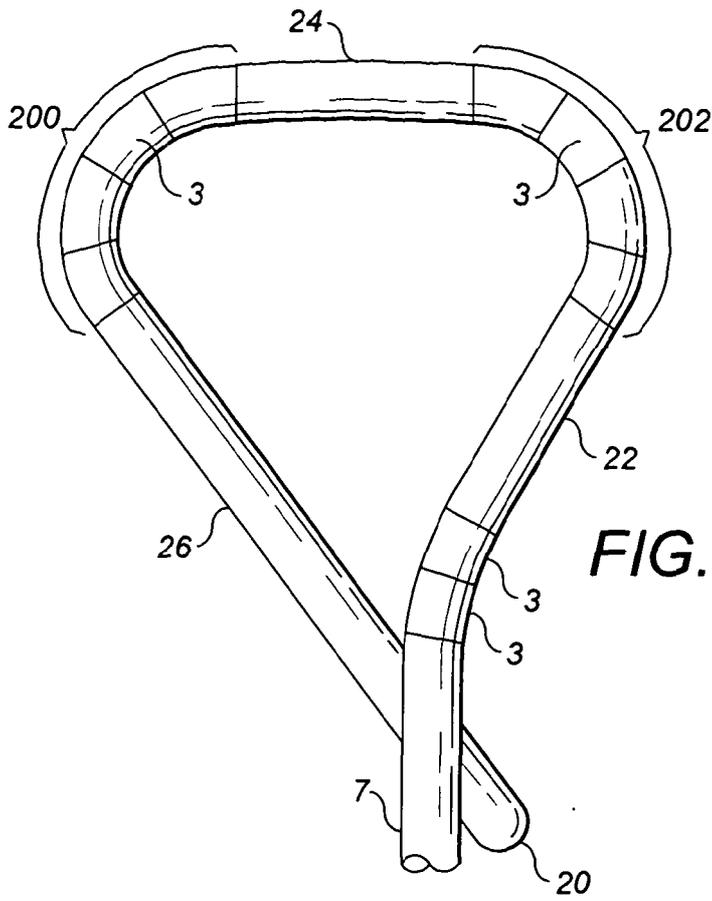


FIG. 5

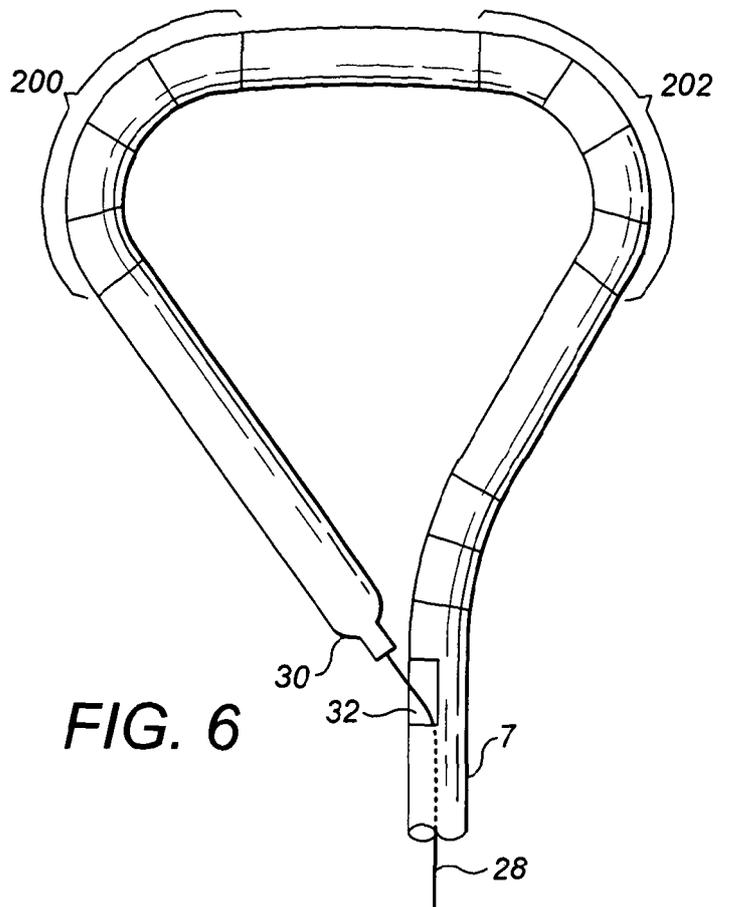


FIG. 6

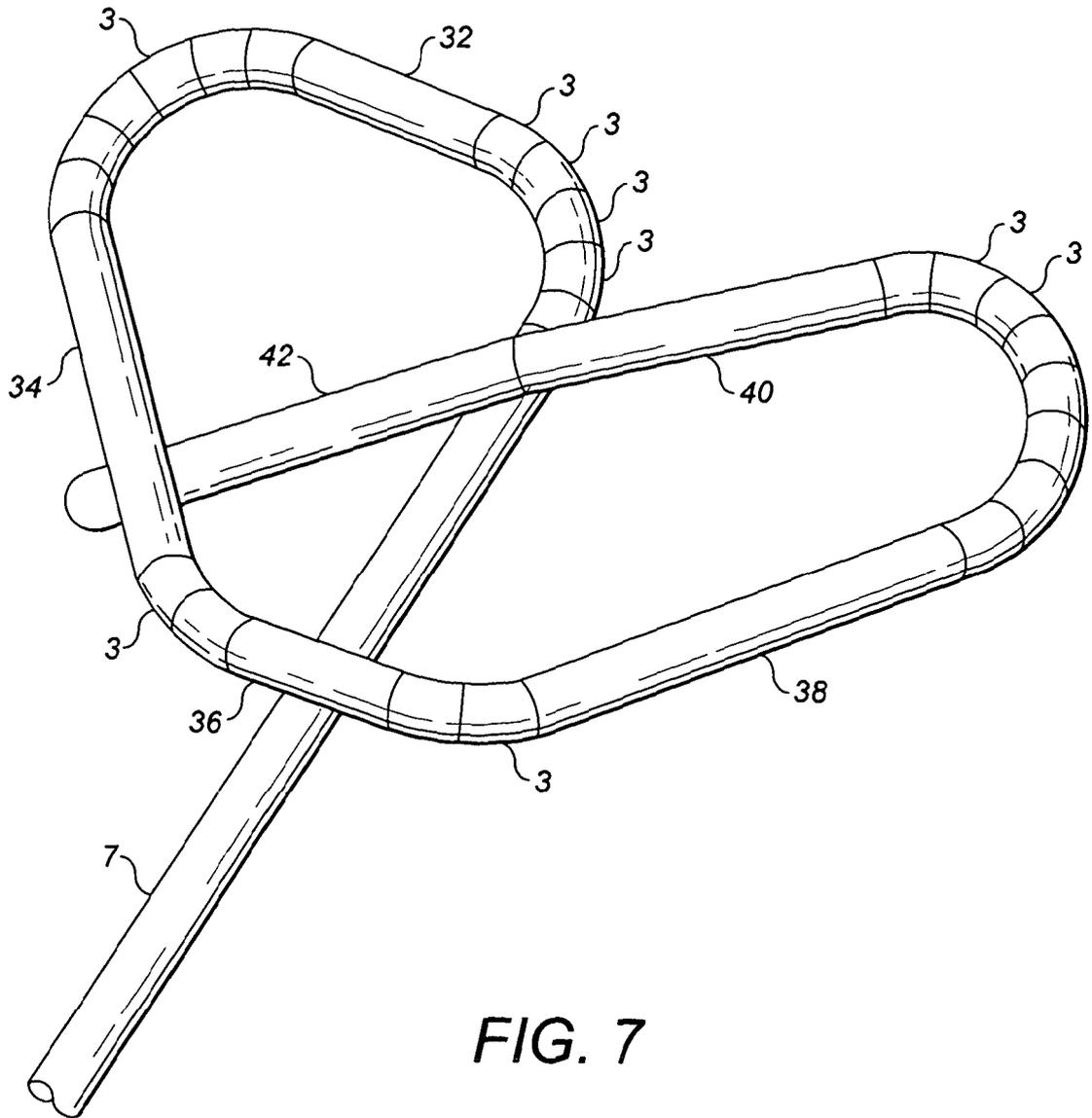


FIG. 7



FIG. 8a

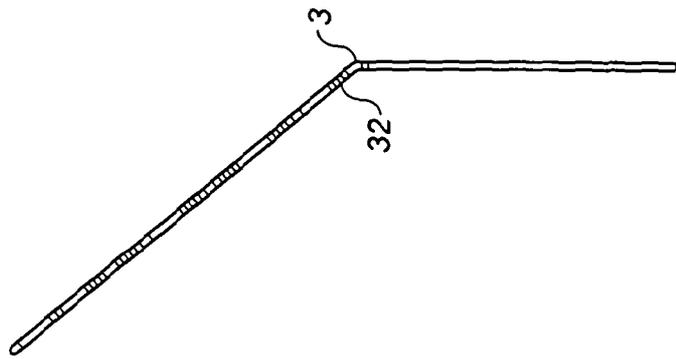


FIG. 8b

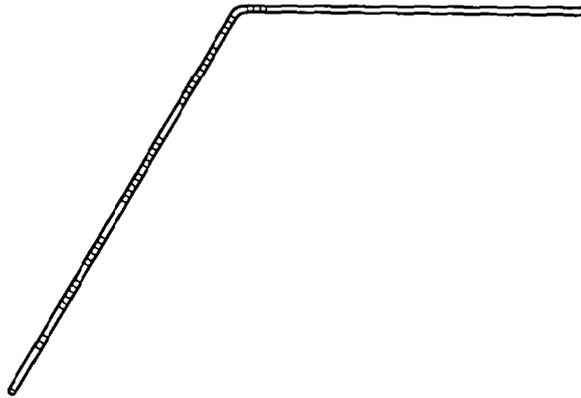


FIG. 8c

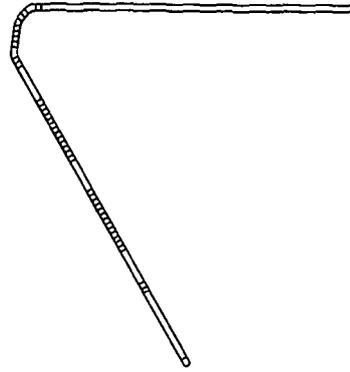


FIG. 8d

5 / 9

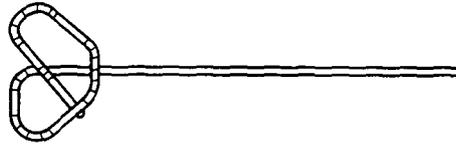


FIG. 8i

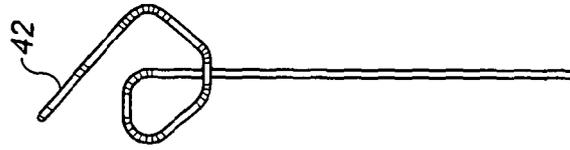


FIG. 8h

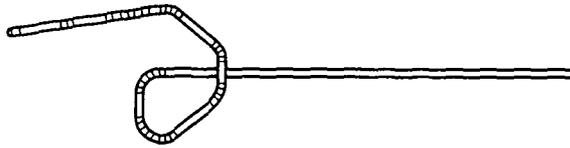


FIG. 8g

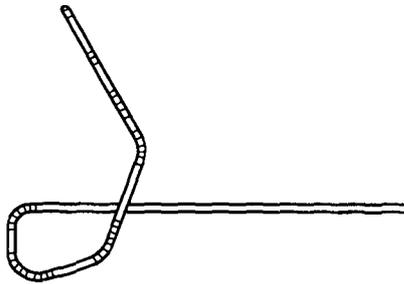


FIG. 8f

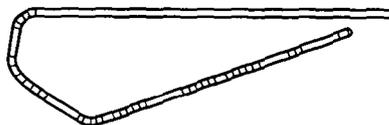


FIG. 8e

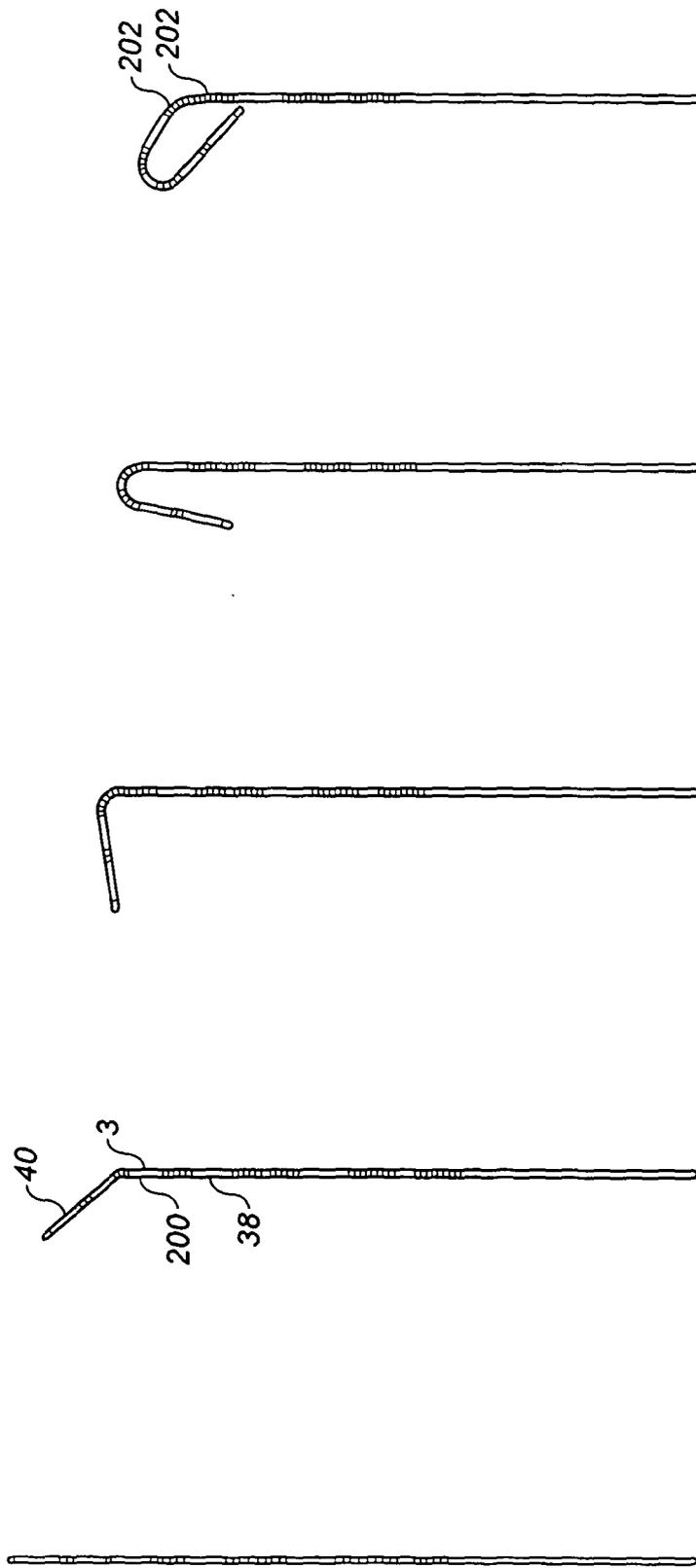


FIG. 9a      FIG. 9b      FIG. 9c      FIG. 9d      FIG. 9e

7 / 9

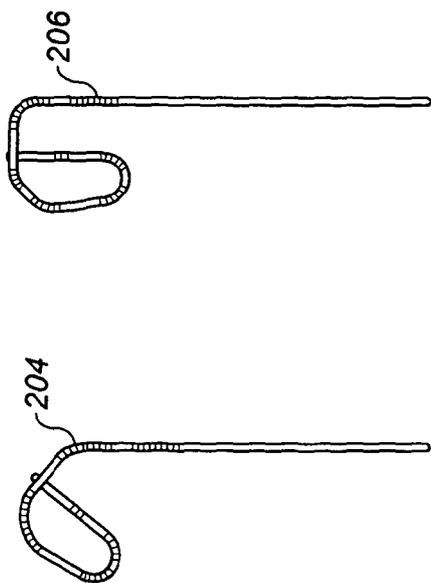


FIG. 9f

FIG. 9g

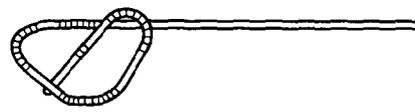


FIG. 9h

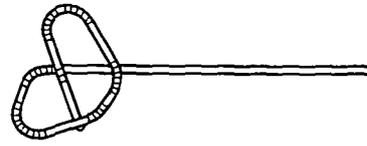


FIG. 9i

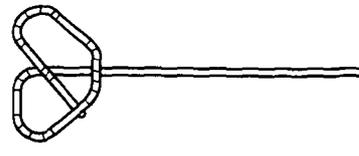


FIG. 9j

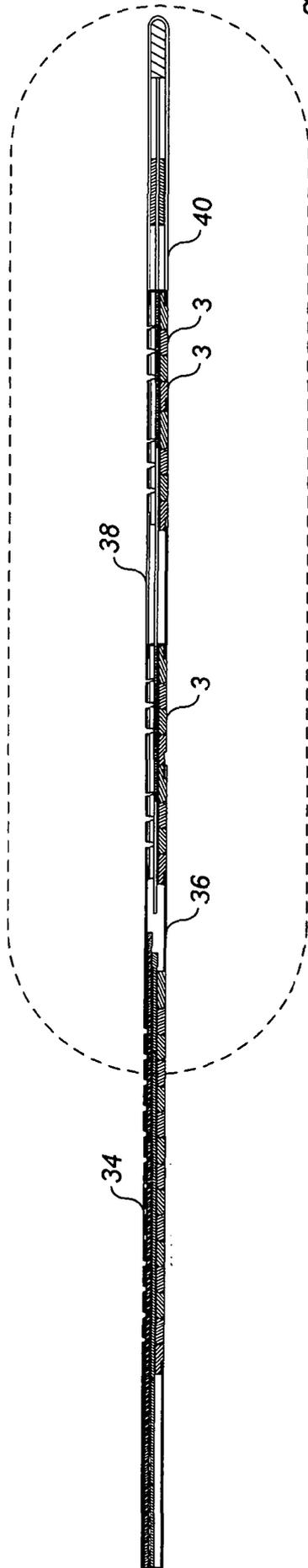


FIG. 10

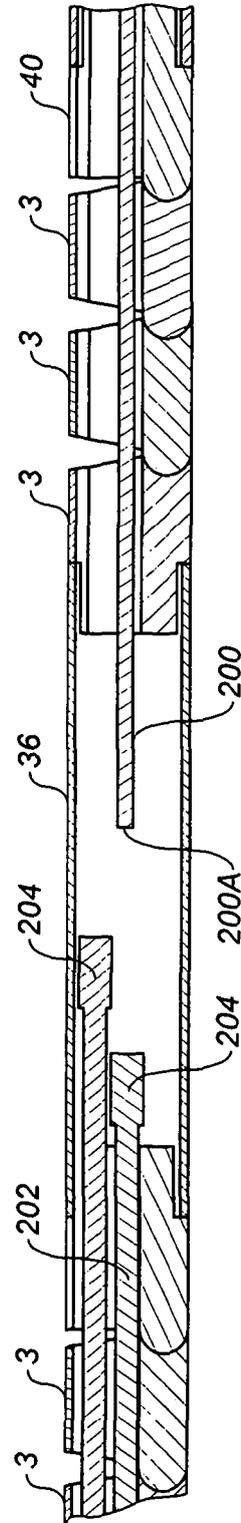
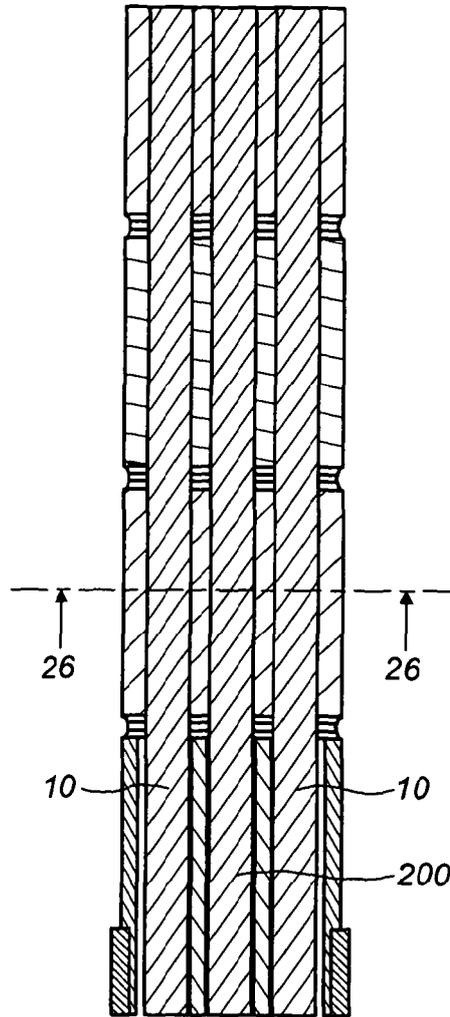
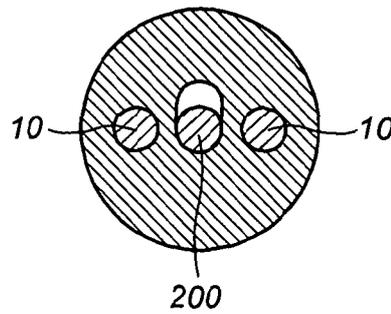


FIG. 11



**FIG. 12**



**FIG. 13**

# INTERNATIONAL SEARCH REPORT

International application No PCT/GB2011/05Q416
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. A61B17/02 ADD. A61B17/00                      A61B17/32                      A61B17/29		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) A61B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	wo 93/13713 AI (MCMAHON MICHAEL JOHN [GB] ; MORAN PETER [GB] ) 22 July 1993 (1993-07-22) page 25, line 9 - page 28, line 3; figures 23A-33 -----	1-27
A	wo 2007/089676 AI (MEDTRONIC INC [US] ; THOMPSON MARK [US] ; DICKERSON DARRIN [US] ; BOWMAN) 9 August 2007 (2007-08-09) page 14, line 4 - page 23, line 23; figures 1-12 -----	1-27
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 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. "&" document member of the same patent family
Date of the actual completion of the international search	Date of mailing of the international search report	
12 May 2011	20/05/2011	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Compos , Fabi en	

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2011/05Q416

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: 28-30  
because they relate to subject matter not required to be searched by this Authority, namely:  
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery.
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos. :
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2011/05Q416

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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wo 2007089676 AI	09-08-2007	AU 2007210011 AI	09-08-2007
		CA 2637550 AI	09-08-2007
		EP 1983904 AI	29-10-2008
		US 2007244473 AI	18-10-2007
		US 2007219550 AI	20-09-2007
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