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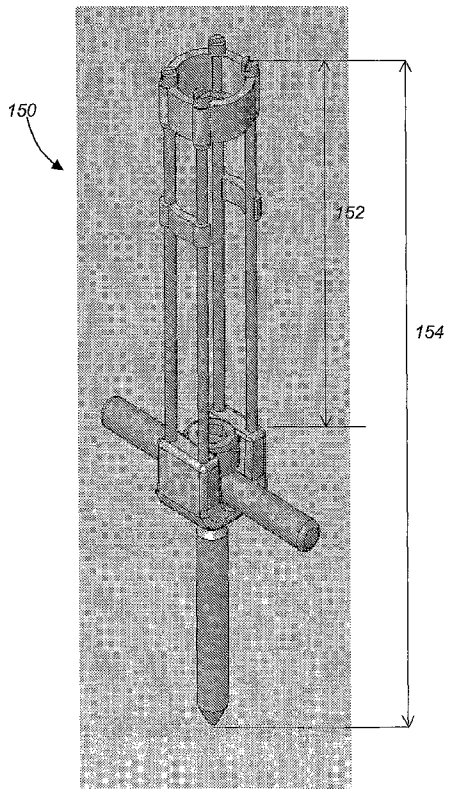
(54) **Title:** SYSTEM AND METHOD FOR IMPLANTING SPINAL STABILIZATION DEVICES



(57) **Abstract:** A system and a method for providing minimally invasive access to the spine of a patient and implanting spinal stabilization devices. The system utilizes one or more post-type access devices. The post-type access device includes a cage with an aperture and two or more posts extending from the cage and being removably attached to the cage. The posts are supported at the top of the access device by a support ring structure. A pedicle screw is inserted into the access device and through the cage aperture and the screw-access device assembly is inserted into an opening of the patient's body. The base aperture is dimensioned to securely support the head of the screw. Side openings between the posts allow the insertion and placement of stabilization devices, such as rods, wires, or plates from almost any direction.

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SYSTEM AND METHOD FOR IMPLANTING SPINAL STABILIZATION DEVICES

Cross Reference to related Co-Pending Applications

This application is a continuation in part of U.S. application Serial No. 10/669,927 filed on September 24th, 2003 and entitled APPARATUS AND METHOD FOR CONNECTING SPINAL VERTEBRAE the contents of which are expressly incorporated herein by reference. This application also claims the benefit of U.S. provisional application Serial No. 60/737,666 filed on November 17th, 2005 and entitled "SYSTEM AND METHOD FOR IMPLANTING SPINAL STABILIZATION DEVICES", the contents of which are expressly incorporated herein by reference.

Field of the Invention

The present invention relates to a system and a method for implanting spinal stabilization devices, and more particularly to a system and a method that allow the percutaneous transfer of connecting devices and instruments within one access channel or between two or more adjacent access channels placed deep in two or more locations of the patient's body, respectively.

Background of the Invention

It is well known that traditional surgical procedures in locations deep within a patient's body require a long incision, extensive muscle stripping, prolonged retraction of muscles for visualization, and denervation and devascularization of the adjacent tissue. These procedures result in extensive tissue traumatization and consequently in prolonged recovery time, risk of infections, high hospitalization costs, pain that can be more severe than the pain due to the initial ailment, and in some cases permanent scarring. The current state of the art for minimally invasive surgical procedures utilizes cylindrical tubes, cannulas, or blades to access locations deep in the patient's body. The use of these access devices rather than a long incision causes fewer traumas to the adjacent tissue, reduces the recovery time and pain and may be performed in some cases under only local anesthesia. The potential for the avoidance

of general anesthesia reduces post-operative recovery time and the risk of complications.

Minimally invasive surgical procedures are especially desirable for spine surgeries because spine pathologies are located deep within the body without clear muscle planes and there is danger of damaging the adjacent neural and vascular tissues. In treating the majority of spinal pathologies, the spinal muscles are stripped from the bony elements of the spine followed by laminectomy or discectomy to expose the dura, the nerve roots, and the discs. The incision has to be wide enough and the tissues have to be retracted to maintain a channel from the skin to the floor of the spinal canal that will allow direct visualization. Laminectomy or discectomy is usually followed by spine stabilization or fusion. Spine stabilization involves implantation of pedicle screws in the pedicles and securing of rods or plates to the pedicles screws, as described in US Patent 6,626,909, the contents of which are incorporated herein by reference. The destruction to the spinal structures is even more extensive during the spine stabilization procedures, which require more lateral tissue dissection and exposure to access the transverse processes and pedicles for placement of pedicle screws, rod constructs for stability, and bone graft under direct vision.

Furthermore, in spine stabilization procedures, connecting elements, such as rods, plates or wires are placed and fixed between two or more locations of the spine. Placement of these connecting elements requires open surgery, which is currently one of the major limitations of other percutaneous access methodologies. Accordingly there is a need for inserting and placing these connecting elements between two or more separate spinal locations without performing open surgery. The emerging percutaneous access systems that address some of the limitations of open surgeries are limited to cylindrical tubes, cannulas, or blades. One of the shared limitations of these systems is that they all have solid walls which in our experience tend to reduce visualization of the deep structures and require specific alignment of a predefined access slot. Accordingly, there is a need for a percutaneous access system that allows visualization of the deep structures and does not require specific alignment.

Summary of the Invention

In general, in one aspect, the invention features a system for providing access to a spine of a patient. The system comprises a post-type access device insertable into a first location of the patient's spine. The post-type access device includes a cage, at least two elongated posts and a support element. The cage includes a bottom portion configured to receive a bone fixation element and prevent the bone fixation element from passing entirely therethrough and two side portions extending from the bottom portion parallel to each other and forming a channel configured to receive a spine stabilization element and a locking element. Receipt of the locking element by the side portions causes locking of the relative positions of the bone fixation element and the stabilization element. The elongated posts extend from the side portions and are arranged to permit passage of the stabilization element along a direction transverse to a central axis of the access device. The support element is configured to be attached to proximal ends of the elongated post.

Implementations of this aspect of the invention may include one or more of the following features. The system may further include one or more additional post-type access devices insertable into the patient's spine in locations adjacent to the first location. The bone fixation element may be a polyaxial screw. The spine stabilization element may be rods, plates, wires, vertebral disc replacements, nuclear replacements, facet arthroplasty devices, dynamic stabilization devices, interbody fusion devices, or articulating versions thereof. The bone fixation elements may be screws, hooks, loops, pins, nuts, washers, wires, sutures, and staples. The support element may be a support ring or a support semi-ring. The elongated posts are arranged to permit passage of objects along the transverse direction or the central axis. The objects may be carrier devices, surgical instruments, medical devices, fixation devices, vertebral disc replacement devices, facet arthroplasty devices, vertebral element replacement devices, interbody devices, fixation tools, connecting devices, connecting tools, tissue, grafting material, or illumination devices. The system may further include a semi-ring configured to be attached to and connect the elongated posts along a direction transverse to the central axis.

In general, in another aspect, the invention features a method for performing percutaneous minimally invasive spinal surgery on a patient by inserting a first post-

type access device into a first location of the patient's spine and then inserting a second post-type access device into a second location of the patient's spine. Each of the post–type access device includes a cage, at least two elongated posts and a support element. The cage includes a bottom portion configured to receive a bone fixation element and prevent the bone fixation element from passing entirely therethrough and two side portions extending from the bottom portion parallel to each other and forming a channel configured to receive a spine stabilization element and a locking element. Receipt of the locking element by the side portions causes locking of the relative positions of the bone fixation element and the stabilization element. The elongated posts extend from the side portions and are arranged to permit passage of the stabilization element along a direction transverse to a central axis of the access device. The support element is configured to be attached to proximal ends of the elongated post.

Implementations of this aspect of the invention may include one or more of the following features. The method may further include attaching the cages of the first and second post-type access devices to first and second bone locations of the patient's spine via the bone fixation elements, respectively. Next, dissecting and cutting the fascia between the posts of the first and second post-type access devices. Next, inserting the stabilization element into the channels of the first and second post-type access devices, the stabilization element extending from the first to the second post type access device in a direction transverse to their central axes, and then locking the position of the stabilization element relative to the bone fixation elements via the locking elements. The method may also include removing the support rings and the posts from the first and second post-type access devices. The step of inserting may include making a first incision on a first location of the patient's skin, and then advancing a first guide wire through the first incision, through tissue underlying the first skin location and into the first underlying spine location. Next, forming a first body cavity around the first guide wire via a solid dilator, the cavity extending from the first skin location to the first underlying spine location and then sliding a hollow dilator over the solid dilator and then removing the solid dilator. The step of attaching includes tapping the first underlying spine location with a screw tap and then removing the screw tap, then inserting the bone fixation element into the cage and then inserting the cage with the bone fixation element through the hollow dilator

and attaching the bone fixation element and cage to the first underlying spine location. Next, inserting at least two elongated posts through the hollow dilator wherein the post comprise proximal ends and distal ends and extend from the first underlying spine location to the first skin location, then attaching the distal ends of the posts to the side portions and then attaching a support ring to the proximal ends of the elongated posts. Finally, removing the hollow dilators and the first guide wire. The method may further include inserting a second stabilization element into channels of a third and fourth post-type access devices, wherein the third and fourth access devices are inserted in third and fourth locations of the patient's spine adjacent to the first and second locations and wherein the second stabilization rod is arranged parallel to the first stabilization rod. The method may also include inserting a third stabilization rod wherein the third stabilization rod cross-links the first and second stabilization rods and is arranged transverse to the first and second stabilization rods. The cage may further include a second channel arranged perpendicular to the first channel and is configured to receive the third stabilization element. The access devices may be preassembled prior to inserting them into locations of the patient's spine or may be assembled after inserting them into locations of the patient's spine.

Among the advantages of this invention may be one or more of the following. The invention provides novel devices and methods for improving percutaneous surgeries for all applications and approaches in the body that previously required open surgery. These improvements will be beneficial to both patients and surgeons in that this invention will reduce the technical difficulty of these operations, improve visualization, decrease risks of iatrogenic injuries to vital structures, decrease length of hospitalization and associated costs, decrease operative time, decrease recovery time, and decrease postoperative pain.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and description below. Other features, objects and advantages of the invention will be apparent from the following description of the preferred embodiments, the drawings and from the claims

Brief Description of the Drawings

Referring to the figures, wherein like numerals represent like parts throughout the several views:

FIG. 1 is a top view of the back of a patient positioned prone on the operating table in preparation for spinal surgery;

FIG. 2 is a layered top view of the patient's back with incisions made on the skin extending through the lumbodorsal fascia to the deep tissues;

FIG. 3 is a layered top view of the patient's back with incisions on the skin and guide K-wires placed percutaneously through the skin and into the underlying vertebrae;

FIG. 4 is a top view of the patient's back with access devices placed in the openings formed from the skin surface and extending deep into the pathology areas;

FIG. 5 is a perspective view of an access device according to one embodiment of this invention;

FIG. 6 is a perspective view of an access device assembly including the access device of FIG. 5, a pedicle screw and a portion of a connecting rod;

FIG. 7 is an exploded perspective view of the access device assembly of FIG. 6;

FIG. 8 is a perspective view of two access device assemblies of FIG. 6 connected via a connecting rod;

FIG. 9 is a block diagram of the spinal surgical procedure according to one embodiment of this invention;

FIG. 10 is a schematic diagram of step 304 of the procedure of FIG. 9 depicting a perspective view of three guide K-wires in isolation, as positioned in the pedicles of three adjacent vertebras;

FIG. 11 is a schematic diagram of step 306 of the procedure of FIG. 9 depicting a perspective view of the three guide K-wires with solid dilators advanced along the guide wires for dilating the surrounding soft tissue;

FIG. 12 is a schematic diagram of step 308 of the procedure of FIG. 9 depicting a perspective view of the three guide K-wires with hollow dilators placed around the solid dilators;

FIG. 13 is a schematic diagram of step 310 of the procedure of FIG. 9 depicting a perspective view of the three guide K-wires with the solid dilators removed;

FIG. 14 is a schematic diagram of step 312 of the procedure of FIG. 9 depicting a perspective view of the three guide K-wires with a tapping tool placed over one of the guide wires for tapping the underlying pedicle;

FIG. 15 is a schematic diagram of step 314 of the procedure of FIG. 9 depicting attaching a pedicle screw and a cage to the pedicle;

FIG. 16 is a schematic diagram of step 316 of the procedure of FIG. 9 depicting inserting of post wires into the cage bores;

FIG. 17 is a schematic diagram of step 317 of the procedure of FIG. 9 depicting inserting posts along the post wires;

FIG. 18 is a schematic diagram of step 318 of the procedure of FIG. 9 depicting placing of a support ring over the posts;

FIG. 19 is a schematic diagram of step 319 of the procedure of FIG. 9 with the hollow dilators removed;

FIG. 20 is a schematic diagram of step 320 of the procedure of FIG. 9 with the guide wires removed;

FIG. 21 is a schematic diagram of step 321 of the procedure of FIG. 9 with the post wires removed;

FIG. 22 is a schematic diagram of step 322 of the procedure of FIG. 9 depicting a perspective view of the three access devices and fascia clipping tool inserted into one of the access devices ;

FIG. 23 is a schematic diagram of step 323 of the procedure of FIG. 9 depicting the insertion of a connecting rod through a channel formed by the posts of the access devices;

FIG. 24 is a schematic diagram of step 324 of the procedure of FIG. 9 depicting the pushing of the rod into the cage;

FIG. 25 is a schematic diagram of step 325 of the procedure of FIG. 9 depicting the tightening of the set screws;

FIG. 26 is a schematic diagram of step 326 of the procedure of FIG. 9 with the support rings and snap-rings removed;

FIG. 27 is a schematic diagram of step 327 of the procedure of FIG. 9 depicting the removal of the posts;

FIG. 28 is a perspective view of the final state of the installed rod and three pedicle screws assembly;

FIG. 29 is a perspective view of three adjacent vertebrae stabilized with connecting rods and pedicle screws according to the procedure of FIG. 9;

FIG. 30 is a detailed perspective view of the assembling procedure for the access device;

FIG. 31 is a perspective view of two installed stabilization rods in the X-direction and placement of a transverse stabilization rod in the Y-direction with the MIS access device of this invention; and

FIG. 32 is a perspective view of two installed stabilization rods in the X-direction and a transverse stabilization rod in the Y-direction.

Detailed Description of the Invention

The present invention relates to a system and a method for placing spinal stabilization devices into a patient's back via minimally invasive surgery (MIS).

Referring to FIG. 1, a patient 90 is positioned prone, lying flat on an operating table 91 in preparation for a minimally invasive surgery. Locations 92a-92f are marked on the patient's lower back corresponding to underlying pedicle locations of adjacent vertebrae 82a, 82b, 82c, respectively, and incisions are made on the marked areas, as shown in FIG. 2. The incisions extend through the lumbodorsal fascia to the deep tissues. Next, guide K-wires 96a-96f are inserted through the openings formed by the incisions and are placed in contact with the underlying pedicles, as shown in FIG. 3. For MIS procedures the tissue around the K-wires is dilated and access devices are inserted around the locations of the K-wires leading to the underlying pedicles, shown in FIG. 4. For spinal stabilization procedures, pedicle screws are inserted through the access devices and are attached to the underlying pedicles. Stabilizing connecting rods or plates are placed between the adjacent vertebrae and are attached to the pedicles via the pedicle screws.

According to one embodiment of this invention a post-type access device assembly allows the insertion and attachment of pedicle screws to the underlying pedicles and the insertion of connecting rods or plates from and into almost any direction. Referring to FIG. 5, FIG. 6 and FIG. 7 a post-type access device 100 includes a cage 102, four posts 104a, 104b, 104c and 104d, a support ring 108 and two snap semi-rings 106a, 106b. The four posts 104a-104d are threaded into four threaded bores 116a-116d of the cage 102, respectively. The support ring 108 attaches to the top of the four posts 104a-104d and helps to hold the four posts together. The two snap semi-rings 106a, 106b attach to two adjacent posts and provide additional support for the post-type access device. The top end of each post has a recess 144 for receiving a screwdriver. Each post also has a stop ring 146 for preventing the support ring 108 from sliding downwards. The support ring 108 may have a circular or rectangular cross section. The two semi-rings 106a, 106b may be semi-circular or straight. The cage 102 has a base 112 in which an aperture 114 is formed. The aperture is dimensioned so that a threaded portion 122 of the pedicle screw 120 may be inserted through the aperture 114, while a head 124 of the pedicle screw 120 rests on a

concave semispherical surface of the base 112. The head 124 may be polyaxially rotatable within the base 112. The cage 102 also has a pair of arms 118a, 118b, extending from the base 112, generally parallel to each other. Each of the arms 118a and 118b has two of the threaded bores 116a, 116d and 116b, 116c, respectively. The inside surfaces 119a, 119b, of the arms 118a, 118b, respectively, are threaded for receiving a set screw 140. After attaching the pedicle screw 120 to the underlying pedicle, a rod 130 is inserted and placed between the arms 118a, 118b. The set screw 140 is then threaded on top of the rod and into the threaded inner surfaces of the arms 118a, 118b of the cage 102, thereby pressing and securing the rod to the cage and the pedicle screw 120. The set screw 140 has a hexagonal recess for receiving a screwdriver. The outside surface of the set screw has threads that are dimensioned to engage with the threads of the inside surfaces of the arms 118a, 118b of the cage 102. The height 152 of the access device is in the range of 5cm to 20 cm. The posts 104a-104d may have a length in the range of 5cm- 15 cm. The height of the entire access device assembly may in the range of 5 cm to 25 cm.

For inserting the pedicle screw 120 into the pedicle, first the screw 120 is inserted through the base aperture 114 of the cage 102 and then the access device-pedicle screw assembly is inserted into the pedicle area and the screw is attached to the pedicle with a screwdriver. Next, the rod 130 is inserted through the channels formed between the posts 104a-104d of adjacent access devices 100a, 100b and is placed in between the arms of each cage 102a, 102b, respectively, shown in FIG. 8. Next the set screws 140a, 140b, are attached to the cages 102a, 102b, respectively, thereby securing the rod in the x-direction. In other embodiments, a second rod may be inserted through the channel formed in the y-direction and then secured between the arms of cage 102b and a third cage placed adjacent to cage 102b in the y-direction (not shown).

Referring to FIG. 9, and FIG. 10-30, the process of implanting a stabilization device between two adjacent vertebrae includes the following steps. First the surgeon performs small skin incisions on the patient's body, as shown in FIG. 2, and forms skin openings (302). Next, the surgeon inserts guide K-wires through the skin openings into the underlying tissue and bones and anchors them in the pathology areas (304), as shown in FIG. 3 and FIG. 10. In one example, the pathology areas are

the pedicles of the adjacent vertebrae. Next, the surgeon uses solid tissue dilators over the guide wires to open deep channels from the skin openings to the pathology areas (306), shown in FIG. 11. Next, he slides hollow dilators over the solid dilators (308), shown in FIG. 12, and then removes the solid dilators (310) (FIG. 13). Next, he taps the pedicles with the pedicle screw tap (312) (FIG. 14). Next, he removes the pedicle screw tap, inserts the cages with the protruding pedicle screws and drives the pedicle screws into the pedicles with a screw driver (314) (FIG. 15). Then, he inserts post wires into the hollow dilators and into the cage bores (316) (FIG.16). Next, he inserts posts along the post wires and screws them into the cage bores (317) (FIG. 17). Next, he places a support ring on top of the four posts and two snap-rings between two adjacent posts in each hollow dilator (318) (FIG. 18). Then, he removes the hollow dilators (319) (FIG. 19), the guide wires (320) (FIG. 20), and the post wires (321) (FIG. 21). Next, he dissects and cuts the fascia between the access devices (322) (FIG. 22). Next he inserts a rod into the channel formed by the posts of the access devices (323) and places the rod within the cages of the access devices (FIG. 23). Next, he pushes the rod with a pusher tool down into the cage base (324) (FIG. 24), and then inserts and tightens the set screws onto the cage thereby securing the rod to the cage (325) (FIG. 25). Once the rod is secured, the surgeon removes the support ring and the snap rings from the access device posts (326) (FIG. 26). Finally, he unscrews the access device posts from the cage, removes them from the patient's body (FIG.27) and closes the incisions (327). The advantage of the post-type access device is that it allows insertion and placement of the stabilizing rod from any direction between the four posts without having to rotate, remove and reinsert the access device during the operation. The screw can also be placed while rotating with the access device or separately from the access device. The lack of any solid sides also allows improved visualization of the tissues and the screws and rod. There is also the option to assemble the access device outside of the patient's body and then place the screw with the access device inside the patient's body. This is the first system that allows placement of wires inside the cage of a pedicle screw. This is also the first system that places cannulated posts inside the cage of a pedicle screw. The snap-on connectors are also unique features that provide stability to the posts for taller constructs above 5 cm. Stabilizing rods 170a, 170b may be placed between adjacent vertebrae 82a, 82b, 82c either in linear configuration (shown in FIG. 29), H-shape or X-shape configurations. Stabilizing rods may also be placed laterally 171, i.e.,

extending from pedicle screw 140c to 140f of FIG. 29 or extending from rod 170a to rod 170b, as shown in FIG. 31 and 32. This is the first system that allows placing crosslink rods 171 transverse to the longitudinal rods 170a, 170b, via an MIS procedure. Cage 174 of the MIS access device includes channels 175 and 176, oriented perpendicular to each other and dimensioned to accommodate the longitudinal rod 170a in the X-direction and the transverse rod 171 in the Y-direction, respectively.

Referring to FIG. 30, in another embodiment, four post wires 180a-180d, are inserted in the four bores 116a-116d of the cage 102. Next, the surgeon inserts the pedicle screw 124 into the aperture 114 of the cage base 112 and inserts the cage/ four post wires/ screw assembly into the patient. Next, the surgeon slides hollow posts 104a-104d over the post wires 180a-180d down into the bores and screws the hollow posts to the cage 102. Then he removes the post wires 180a-180d, leaving the hollow posts in place. This embodiment allows the pedicles screws to be placed and attached to the pedicles without the access device.

Other embodiments are within the scope of the following claims. For example, the cage and/or the support ring may have other cross-sections such as triangular, rectangular, square, oval or polygonal. The number of posts may be two, three, four or more than four. The stabilizing device may be a rod, wire or a plate. The stabilizing devices may be placed in x, y, or any other direction within the x-y plane or at an angle to x-y plane. The devices may be made of metal such as stainless steel, titanium, plastic, rubber, graphite, glass, expandable materials under body temperature, or other radiolucent materials. The access device may be preassembled outside of the patient's body and then inserted into the patient's spinal locations or it may be assembled inside the patient's body, as was described above.

Several embodiments of the present invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

CLAIMS

1. A system for providing access to a spine of a patient, the system comprising a post-type access device insertable into a first location of the patient's spine said access device comprising:

a cage comprising a bottom portion configured to receive a bone fixation element and prevent the bone fixation element from passing entirely therethrough and two side portions extending from said bottom portion parallel to each other and forming a channel configured to receive a spine stabilization element and a locking element, wherein receipt of the locking element by the side portions causes locking of the relative positions of the bone fixation element and the stabilization element;

at least two elongated posts extending from said side portions and arranged to permit passage of said stabilization element along a direction transverse to a central axis of the access device; and

a support element configured to be attached to proximal ends of said elongated post.

2. The system of claim 1 further comprising one or more additional post-type access devices insertable into the patient's spine in locations adjacent to said first location.

3. The system of claim 1 wherein said bone fixation element comprises a polyaxial screw.

4. The system of claim 1 wherein said spine stabilization element is selected from a group consisting of rods, plates, wires, vertebral disc replacements, nuclear replacements, facet arthroplasty devices, dynamic stabilization devices, interbody fusion devices, and articulating versions thereof.

5. The system of claim 1 wherein said bone fixation element is selected from a group consisting of screws, hooks, loops, pins, nuts, washers, wires, sutures, and staples.

6. The system of claim 1 wherein said support element comprises a support ring.

7. The system of claim 1 wherein said support element comprises a support semi-ring.

8. The system of claim 1 wherein said elongated posts are arranged to permit passage of objects along said transverse direction or said central axis, and wherein said objects are selected from a group consisting of carrier devices, surgical instruments, medical devices, fixation devices, vertebral disc replacement devices, facet arthroplasty devices, vertebral element replacement devices, interbody devices, fixation tools, connecting devices, connecting tools, tissue, grafting material, and illumination devices.

9. The system of claim 1 further comprising a semi-ring configured to be attached to and connect said elongated posts along a direction transverse to said central axis.

10. A method for performing percutaneous minimally invasive spinal surgery on a patient comprising:

inserting a first post-type access device into a first location of the patient's spine;

inserting a second post-type access device into a second location of the patient's spine; and

wherein said each of said post –type access device comprises

a cage comprising a bottom portion configured to receive a bone fixation element and prevent the bone fixation element from passing entirely therethrough and two side portions extending from said bottom portion parallel to each other and forming a channel configured to receive a spine stabilization element and a locking element, wherein receipt of the locking element by the side portions causes locking of the relative positions of the bone fixation element and the stabilization element;

at least two elongated posts extending from said side portions and arranged to permit passage of said stabilization element along a direction transverse to a central axis of the access device; and

a support element configured to be attached to proximal ends of said elongated post.

11. The method of claim 10 further comprising:

attaching said cages of said first and second post-type access devices to first and second bone locations of the patient's spine via said bone fixation elements, respectively;

dissecting and cutting the fascia between the posts of said first and second post-

type access devices;

inserting said stabilization element into the channels of the first and second post-type access devices, said stabilization element extending from said first to said second post type access device in a direction transverse to their central axes; and

locking the position of said stabilization element relative to said bone fixation elements via said locking elements.

12. The method of claim 11 further comprising removing said support rings and said posts from said first and second post-type access devices.

13. The method of claim 10 wherein said inserting comprises:

making a first incision on a first location of said patient's skin;

advancing a first guide wire through said first incision, through tissue underlying said first skin location and into said first underlying spine location;

forming a first body cavity around said first guide wire via a solid dilator, said cavity extending from said first skin location to said first underlying spine location; and

sliding a hollow dilator over said solid dilator and then removing said solid dilator.

14. The method of claim 13 wherein said attaching comprises:

tapping said first underlying spine location with a screw tap and then removing said screw tap;

inserting said bone fixation element into said a cage;

inserting said cage with said bone fixation element through said hollow dilator and attaching said bone fixation element and cage to said first underlying spine location;

inserting at least two elongated posts through said hollow dilator wherein said post comprise proximal ends and distal ends and extend from said first underlying spine location to said first skin location;

attaching said distal ends of said posts to said side portions;

attaching a support ring to the proximal ends of said elongated posts; and

removing said hollow dilators and said first guide wire.

15. The method of claim 11 further comprising inserting a second stabilization element into channels of a third and fourth post-type access devices, wherein said third and fourth access devices are inserted in third and fourth locations of the patient's spine adjacent to said first and second locations and wherein said second stabilization rod is arranged parallel to said first stabilization rod.

16. The method of claim 15 further comprising inserting a third stabilization rod wherein said third stabilization rod cross-links said first and second stabilization rods and is arranged transverse to said first and second stabilization rods.

17. The method of claim 16 wherein said cage further comprises a second channel arranged perpendicular to said first channel and is configured to receive said third stabilization element.

18. The method of claim 10 wherein said access devices are preassembled prior to inserting them into locations of the patient's spine.

19. The method of claim 10 wherein said access devices are assembled after inserting them into locations of the patient's spine.

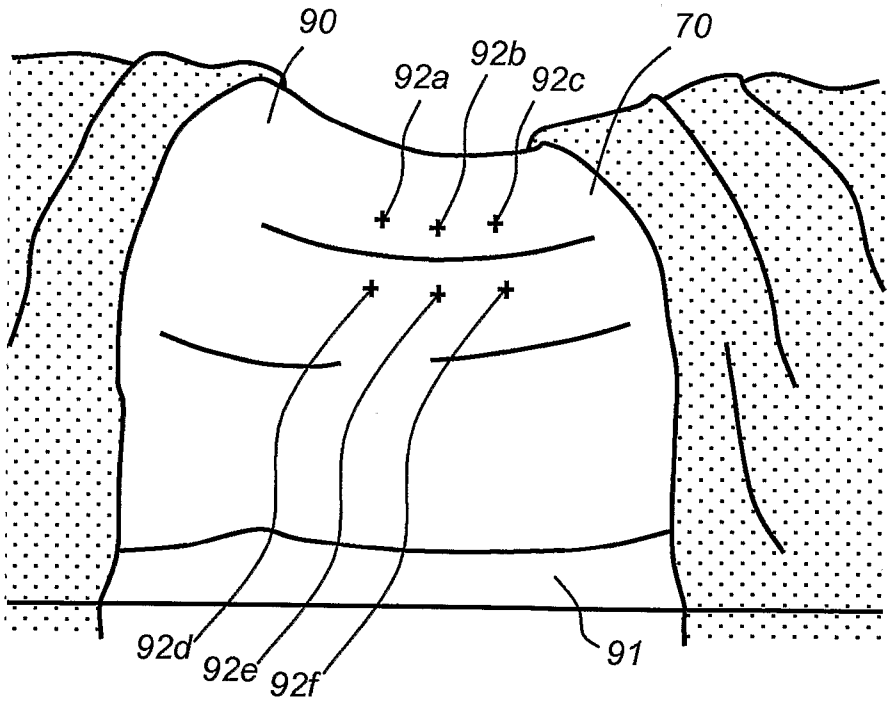


FIG. 1

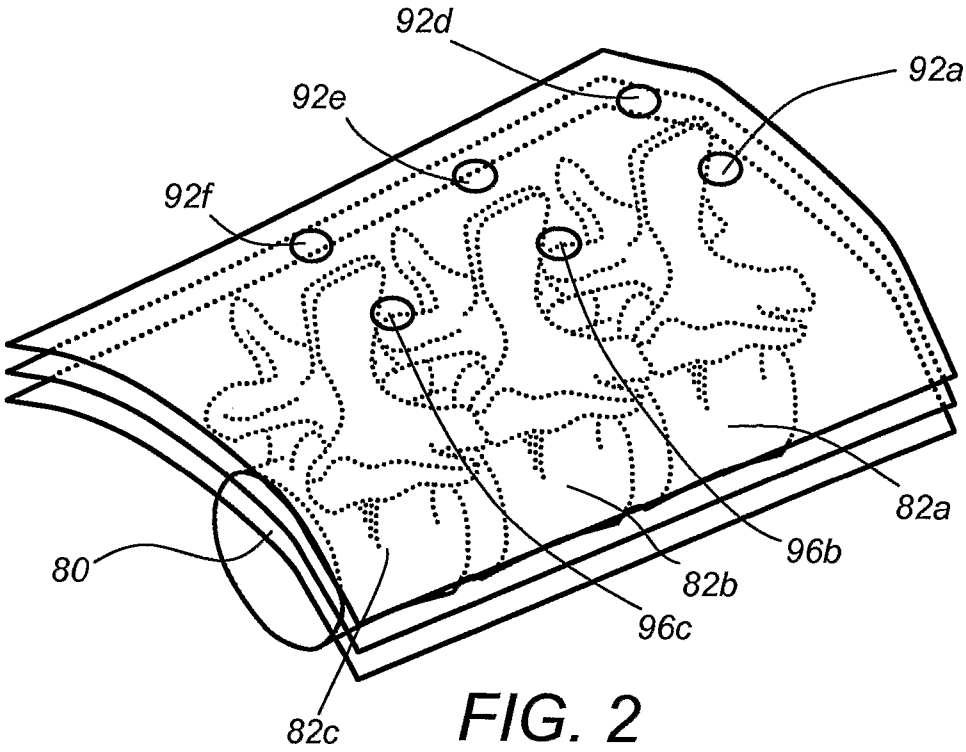


FIG. 2

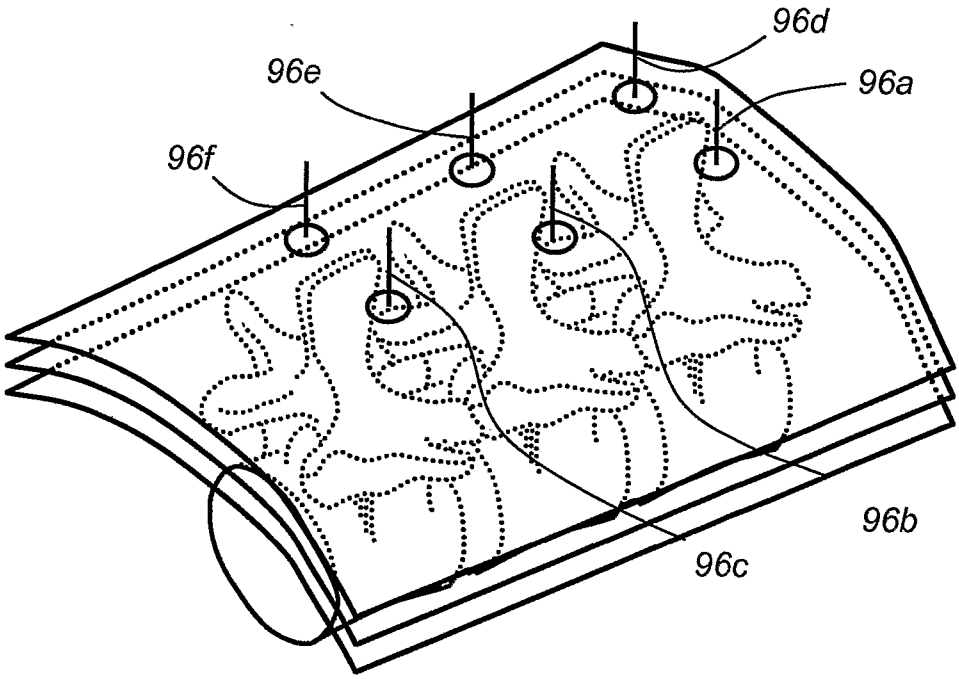


FIG. 3

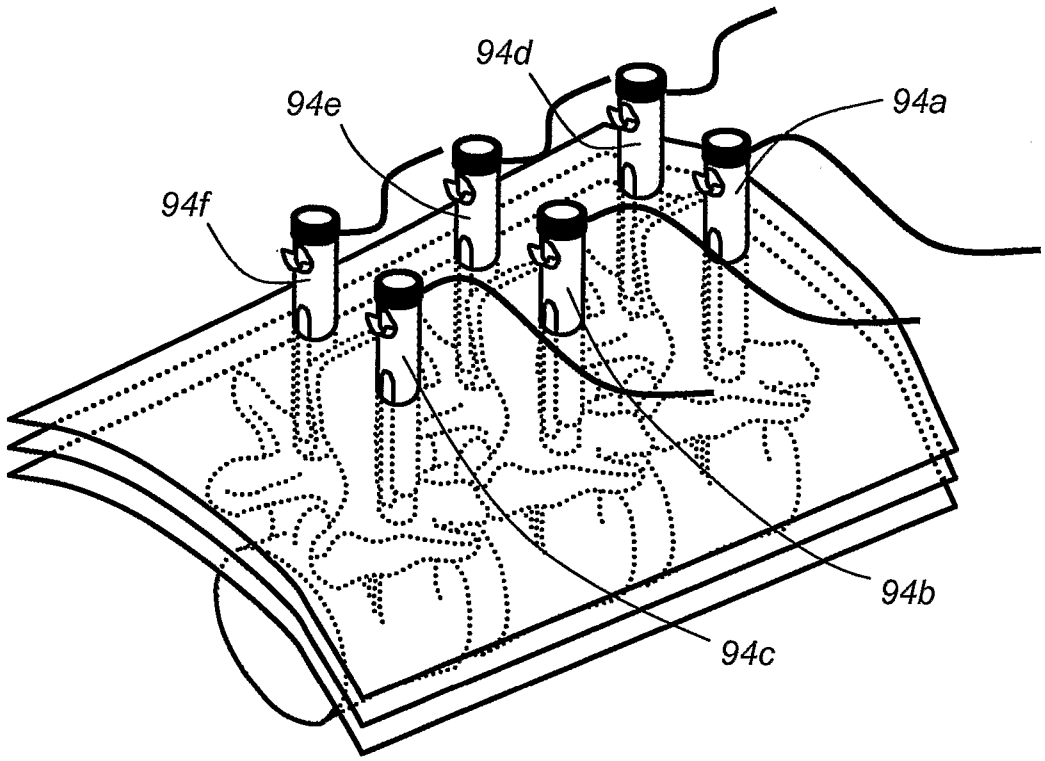


FIG. 4

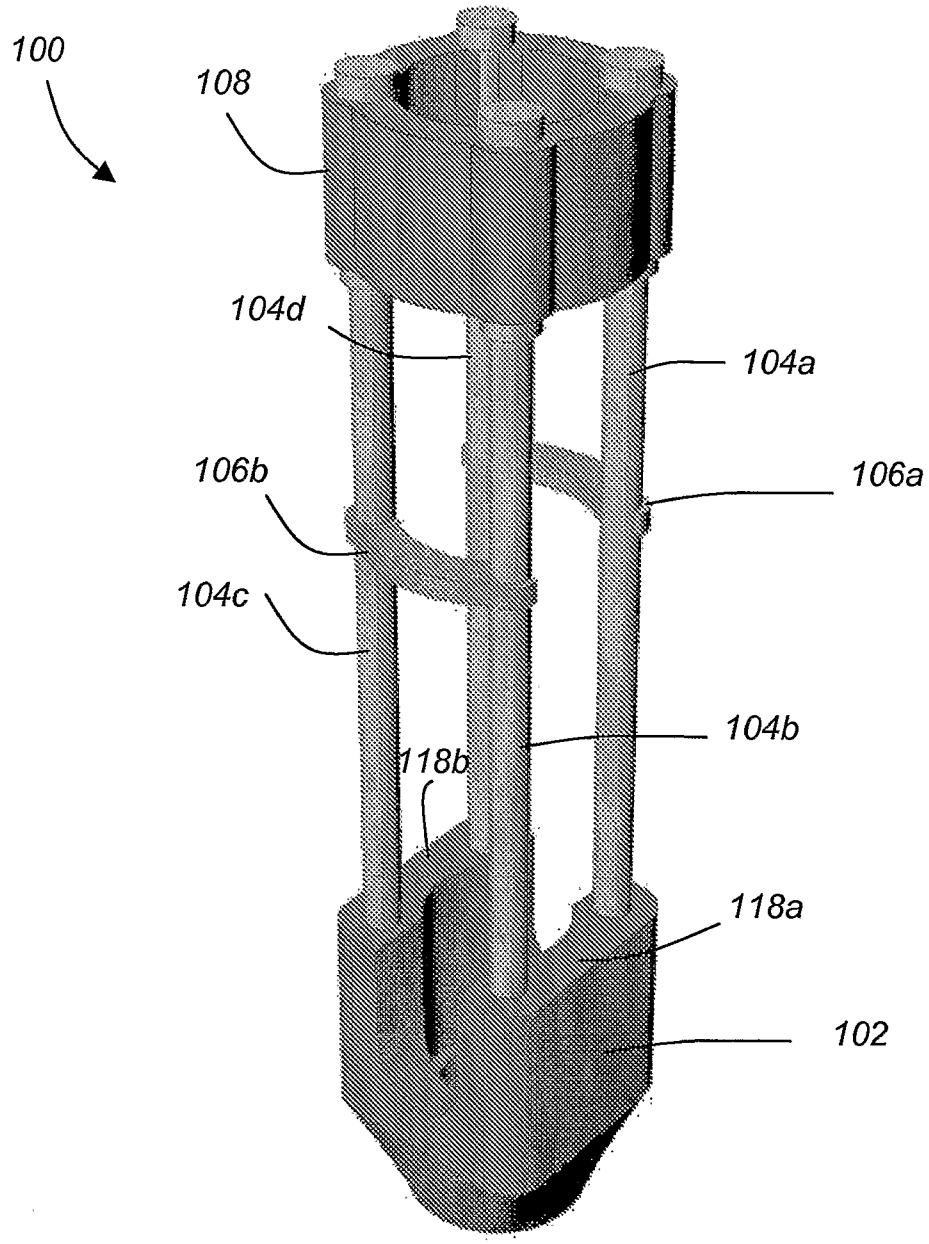


FIG. 5

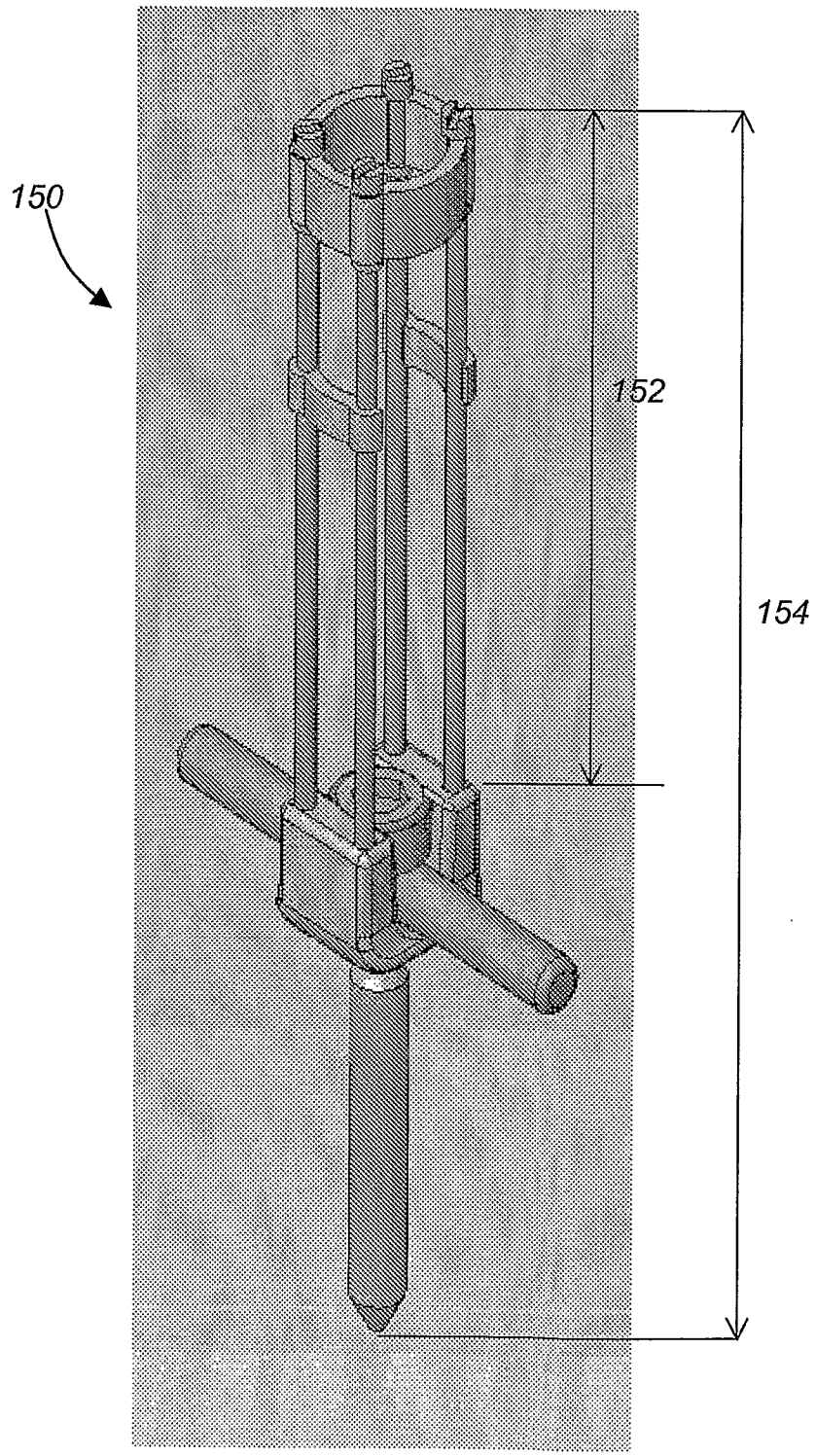
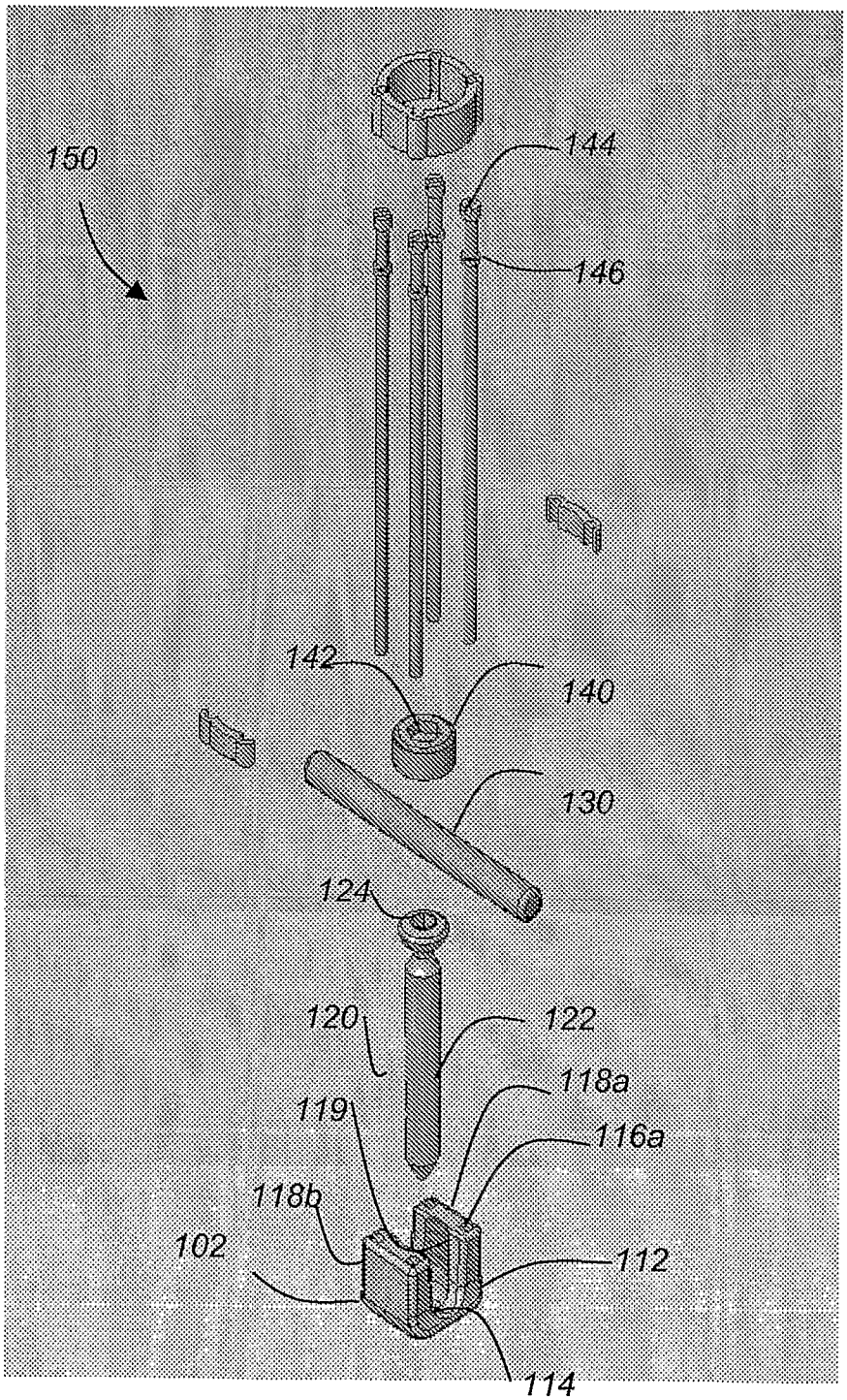


FIG. 6


150
144
146
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140
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124
120
122
118a
119
116a
118b
102
112
114

FIG. 7

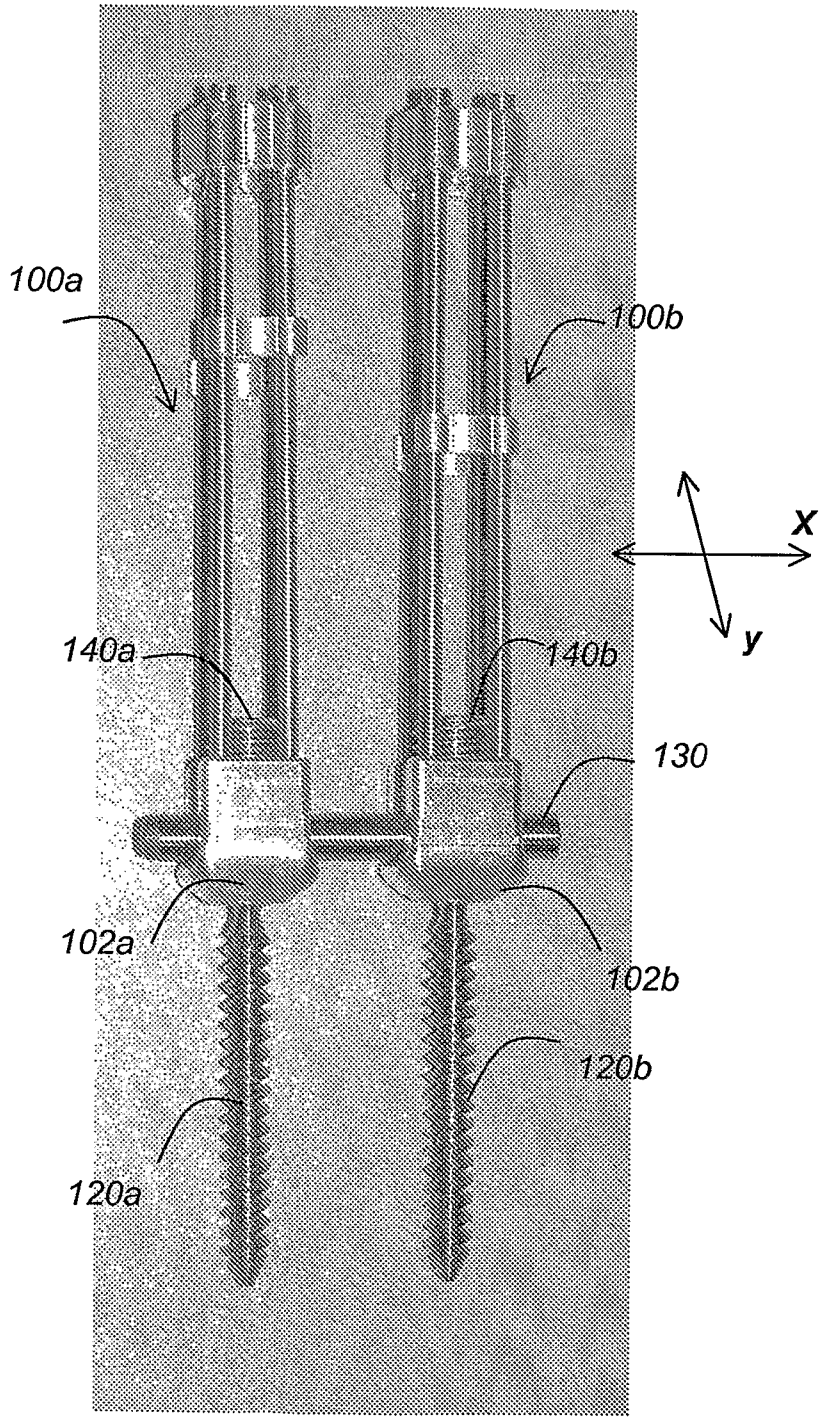

FIG. 8

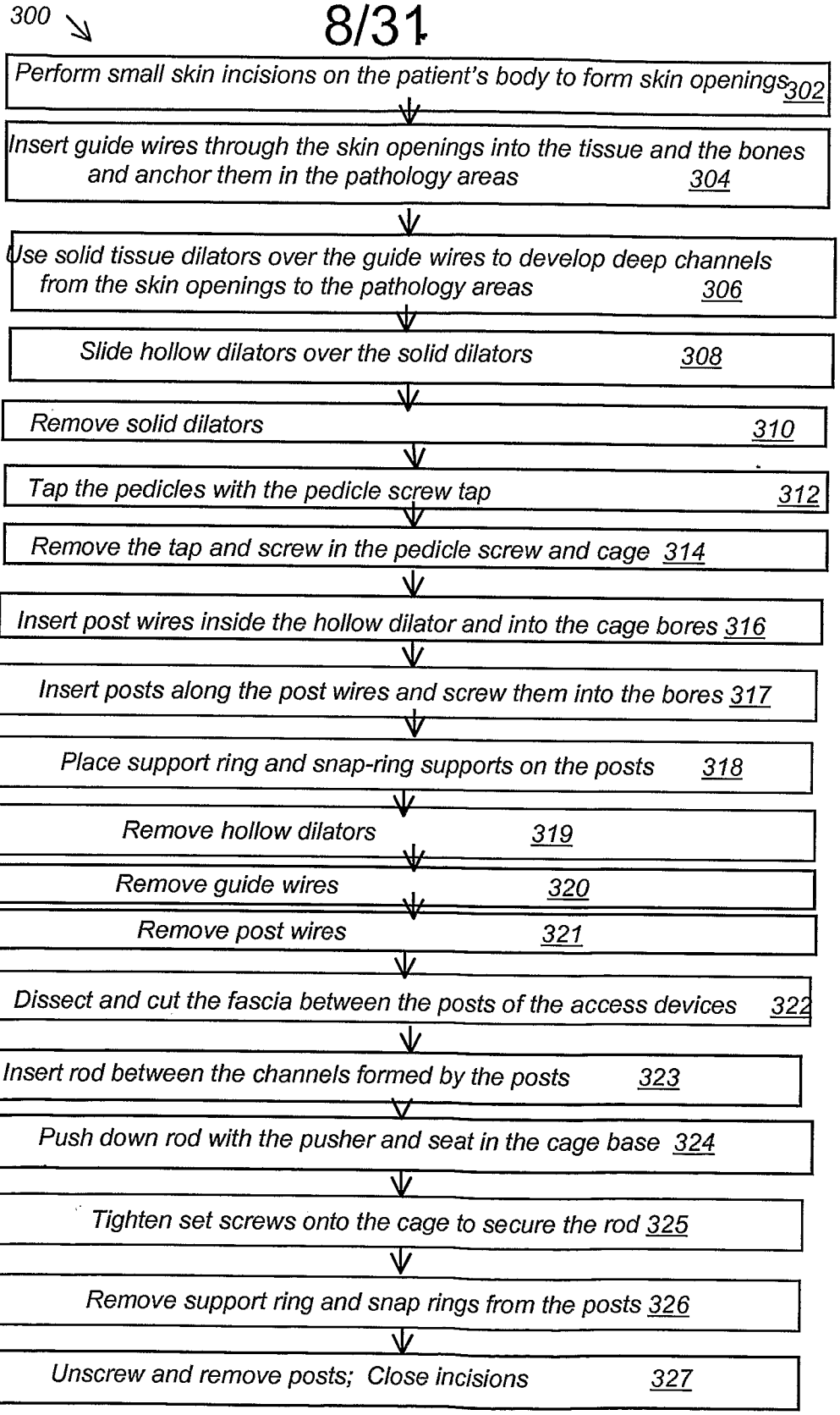
300
Perform small skin incisions on the patient's body to form skin openings 302
Insert guide wires through the skin openings into the tissue and the bones and anchor them in the pathology areas 304
Use solid tissue dilators over the guide wires to develop deep channels from the skin openings to the pathology areas 306
Slide hollow dilators over the solid dilators 308
Remove solid dilators 310
Tap the pedicles with the pedicle screw tap 312
Remove the tap and screw in the pedicle screw and cage 314
Insert post wires inside the hollow dilator and into the cage bores 316
Insert posts along the post wires and screw them into the bores 317
Place support ring and snap-ring supports on the posts 318
Remove hollow dilators 319
Remove guide wires 320
Remove post wires 321
Dissect and cut the fascia between the posts of the access devices 322
Insert rod between the channels formed by the posts 323
Push down rod with the pusher and seat in the cage base 324
Tighten set screws onto the cage to secure the rod 325
Remove support ring and snap rings from the posts 326
Unscrew and remove posts; Close incisions 327

FIG. 9

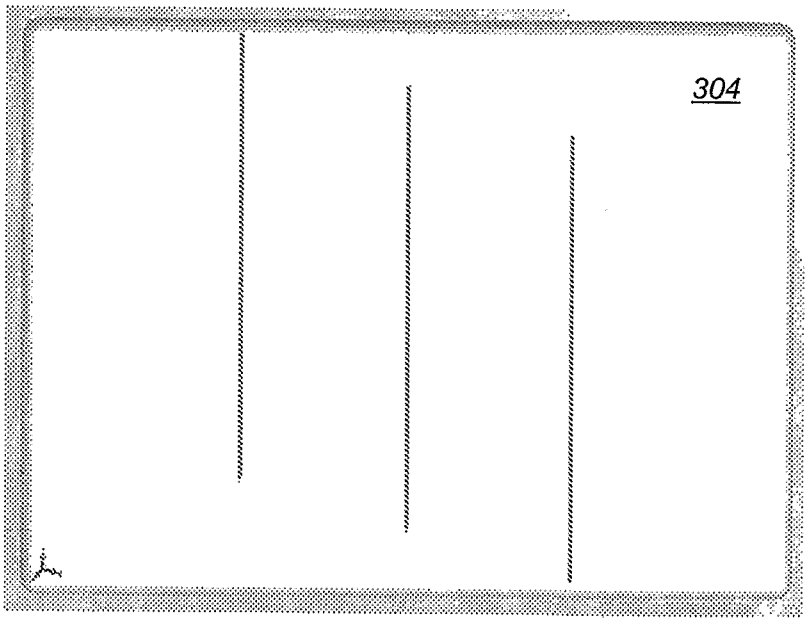

FIG. 10

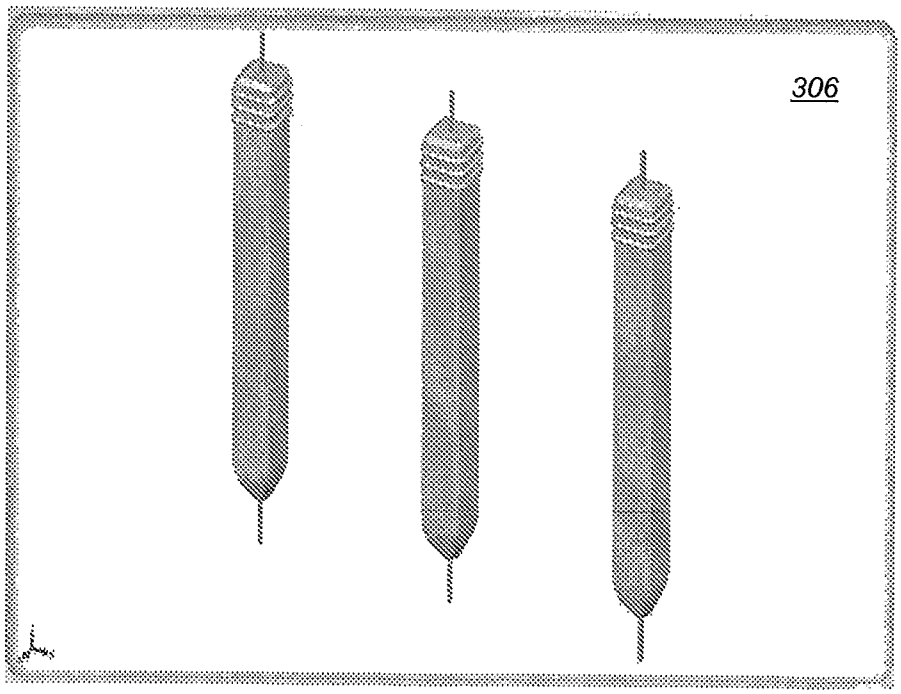

FIG. 11

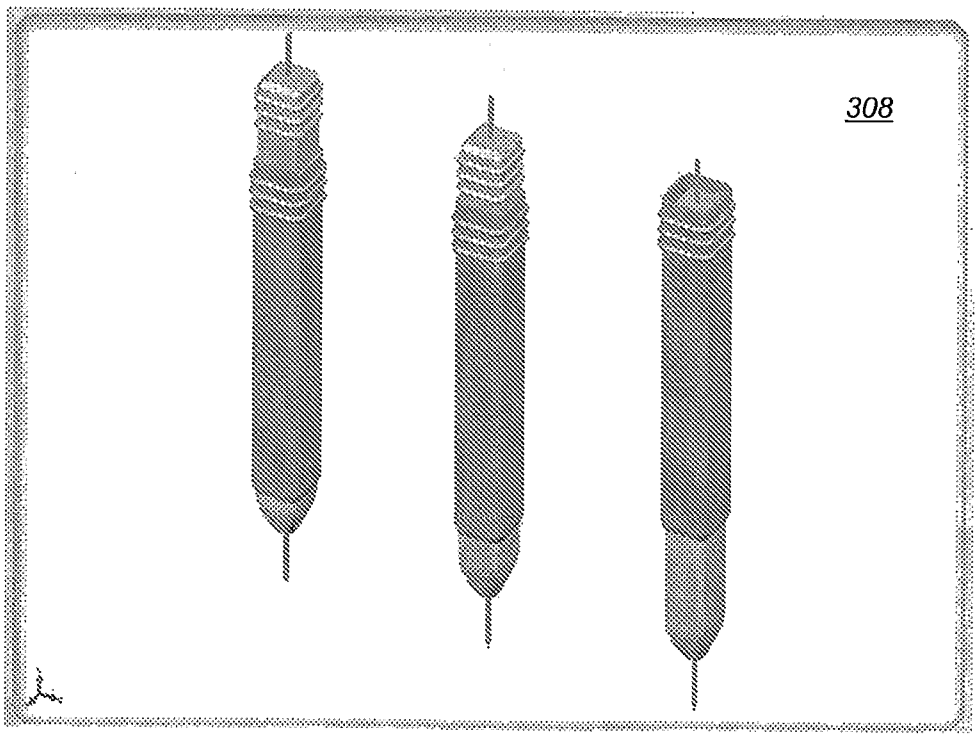

FIG. 12

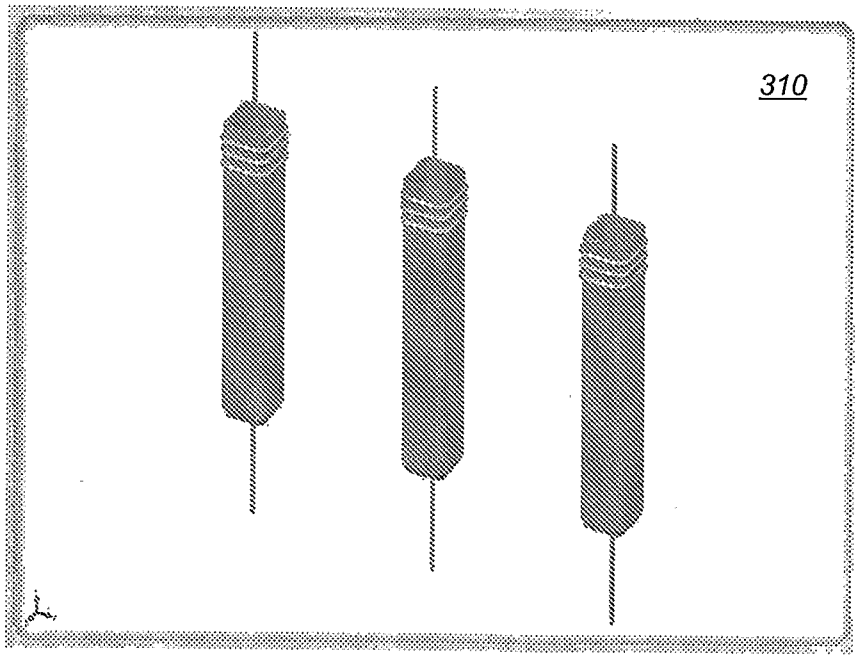

FIG. 13

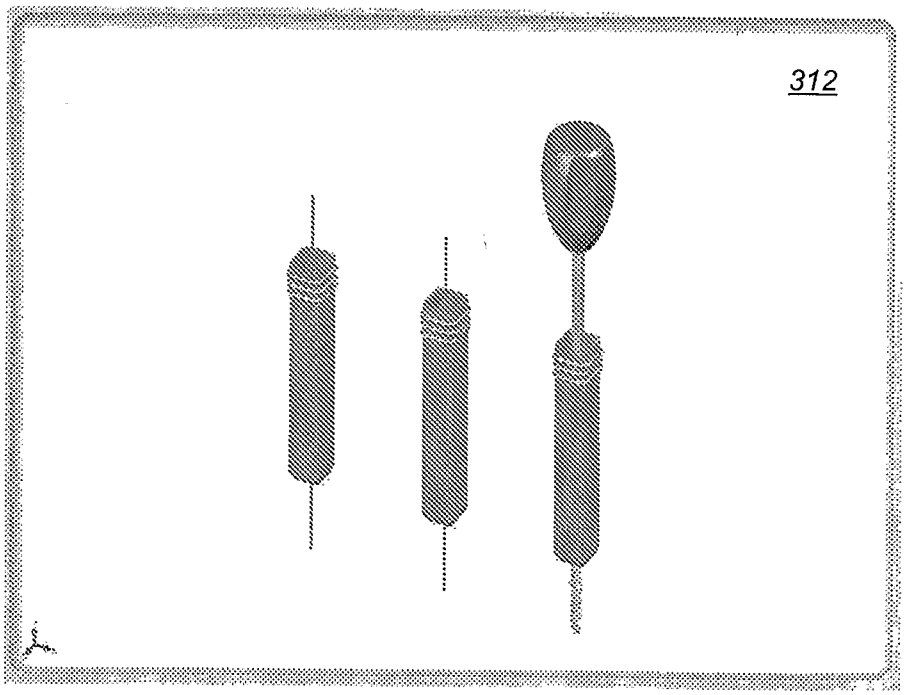

FIG. 14

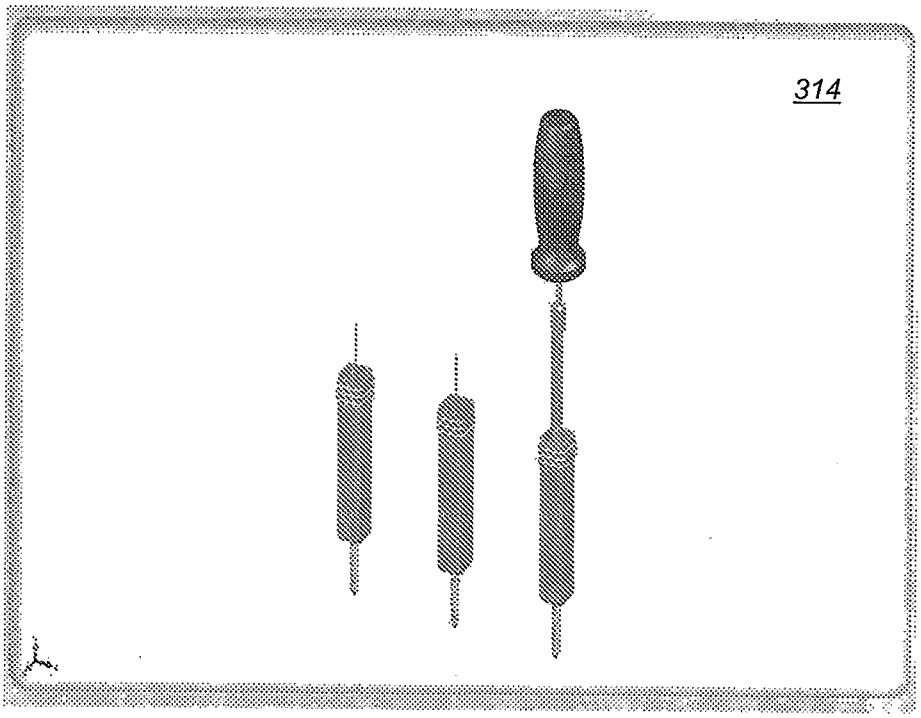

FIG. 15

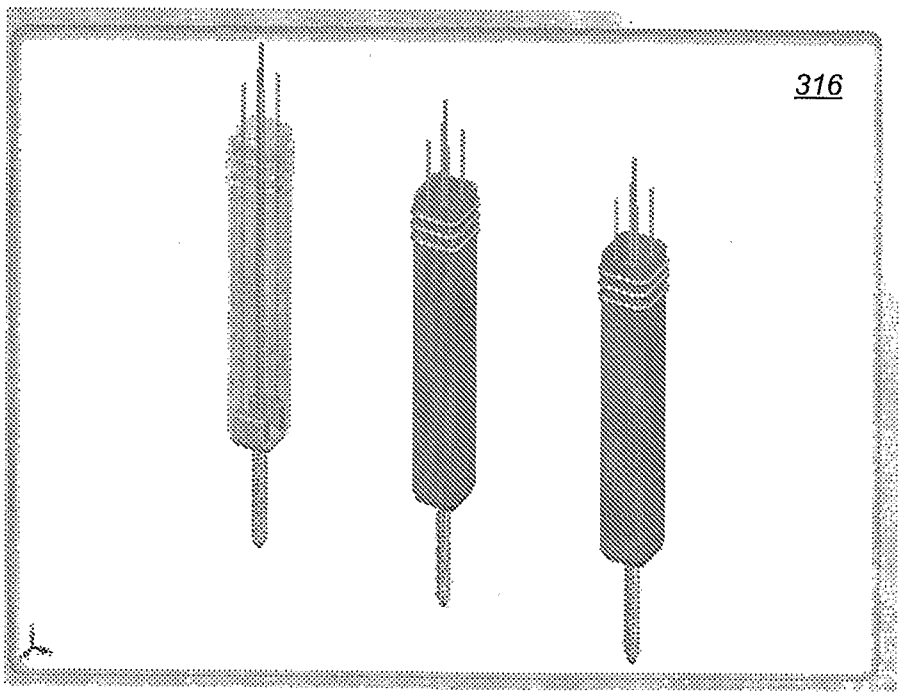

FIG. 16

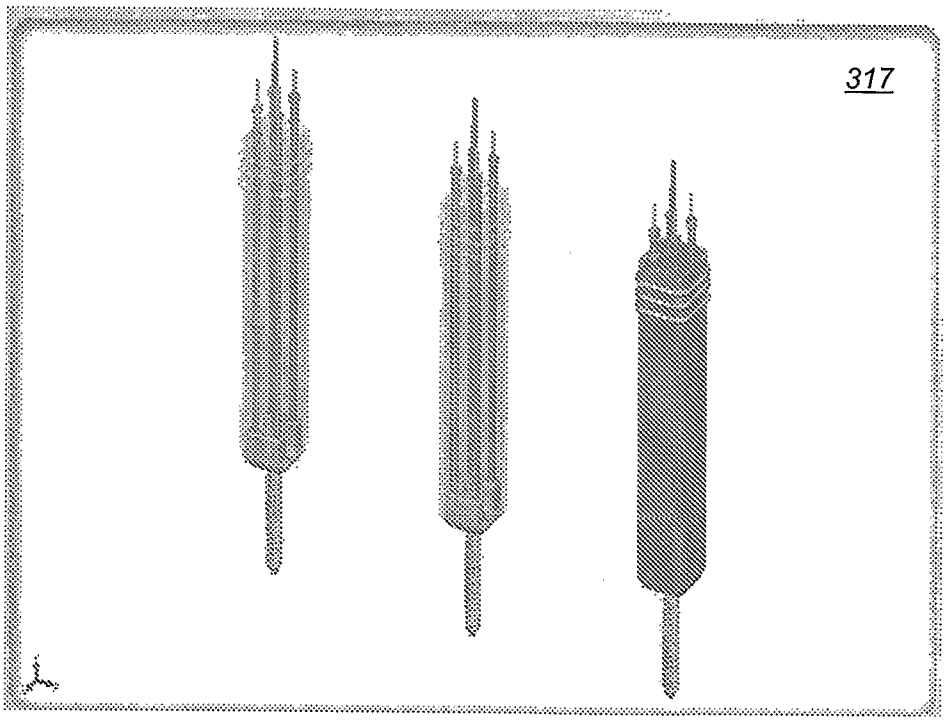

FIG. 17

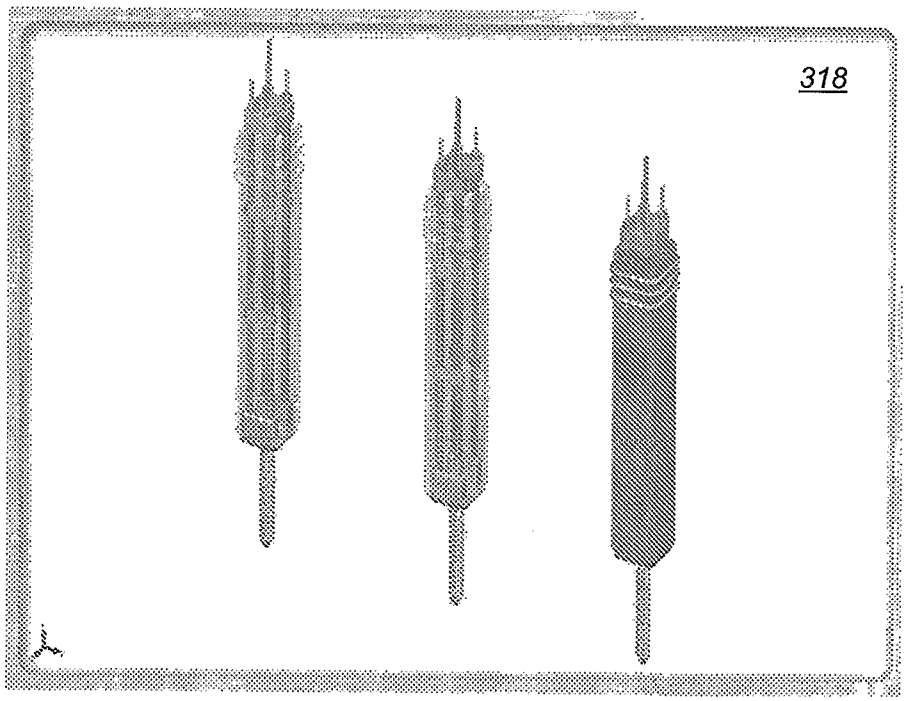

FIG. 18

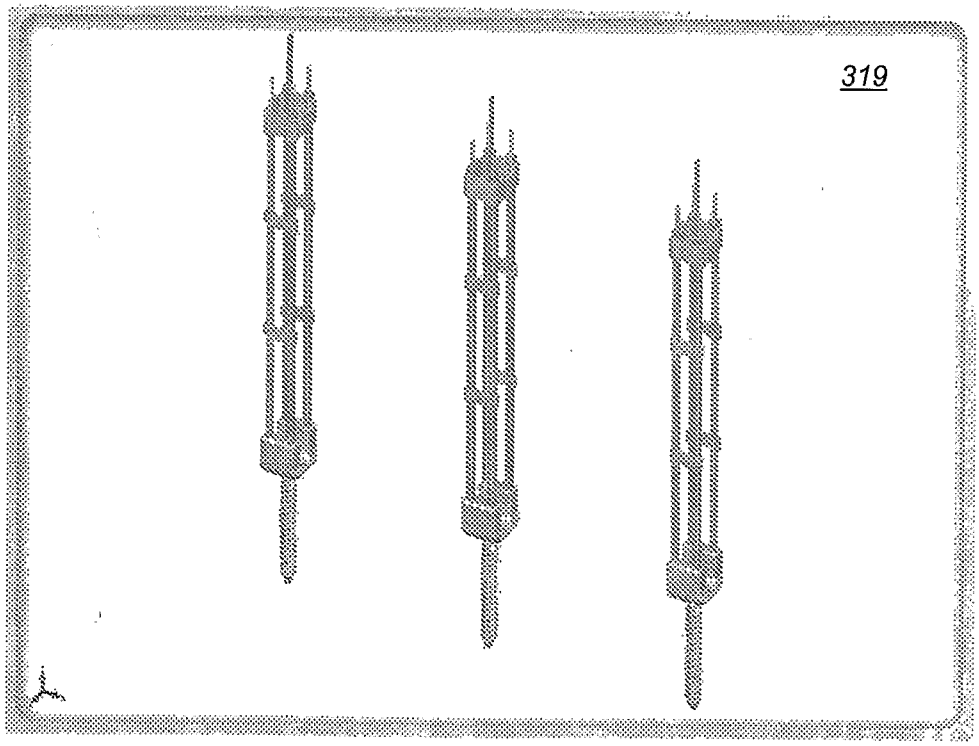

FIG. 19

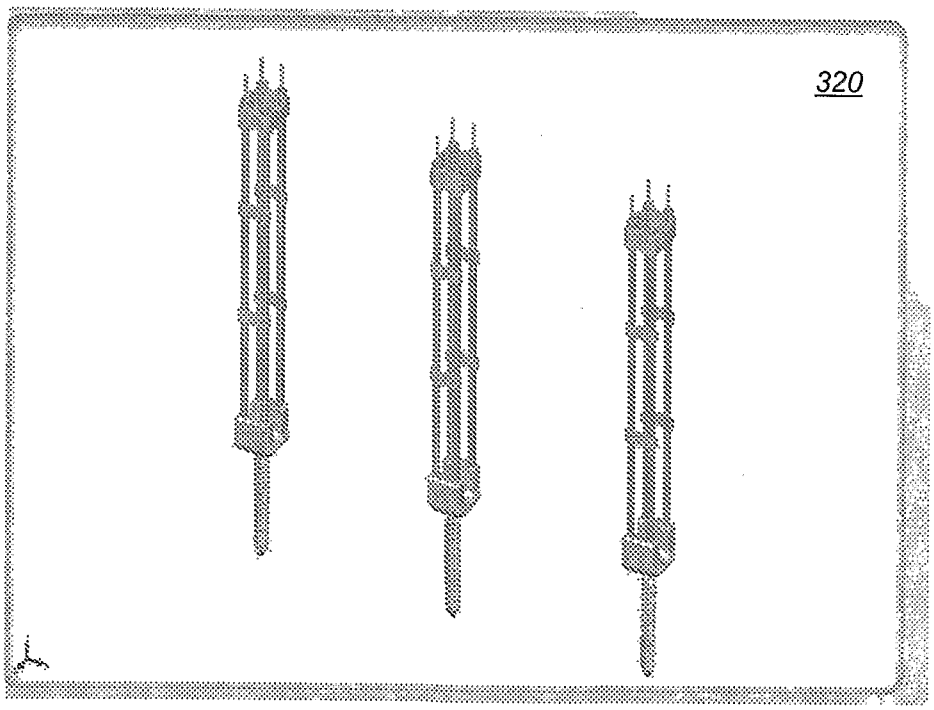

FIG. 20

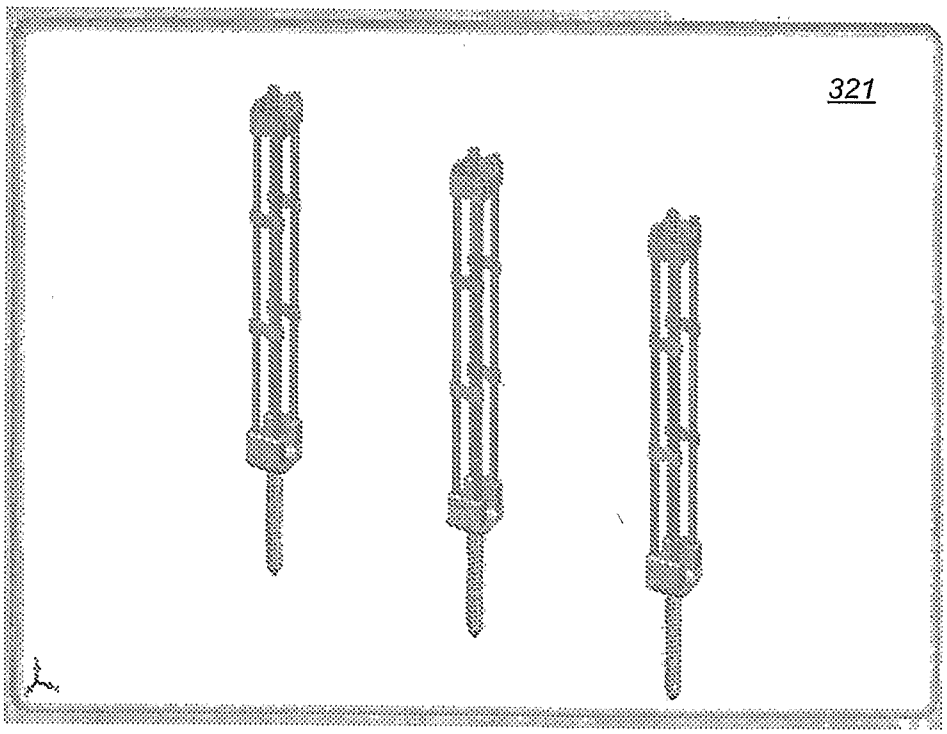

FIG. 21

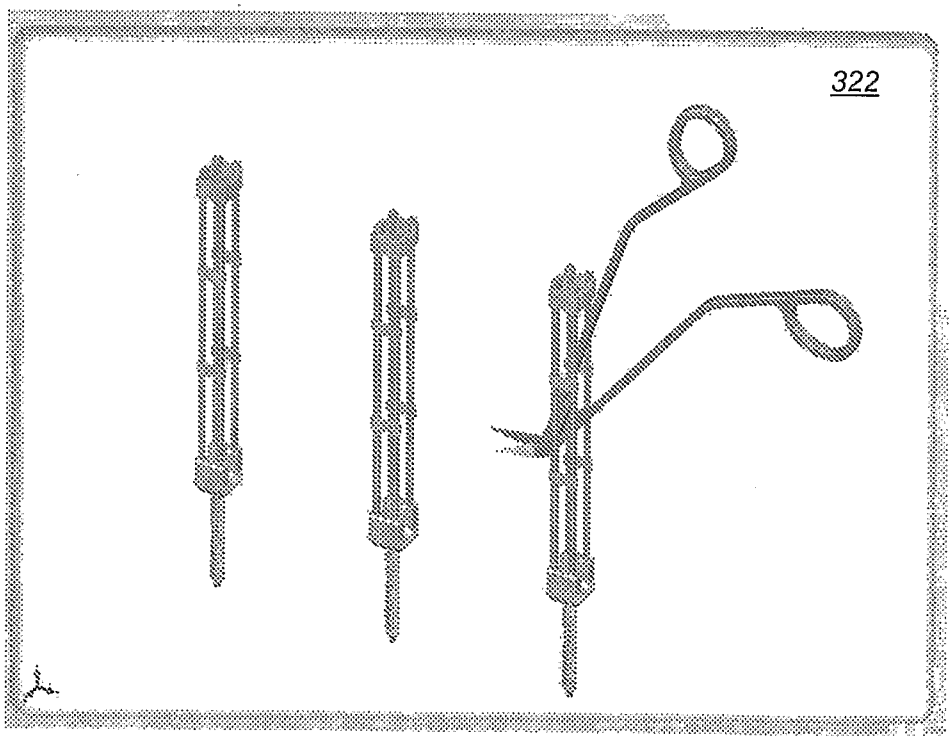

FIG. 22

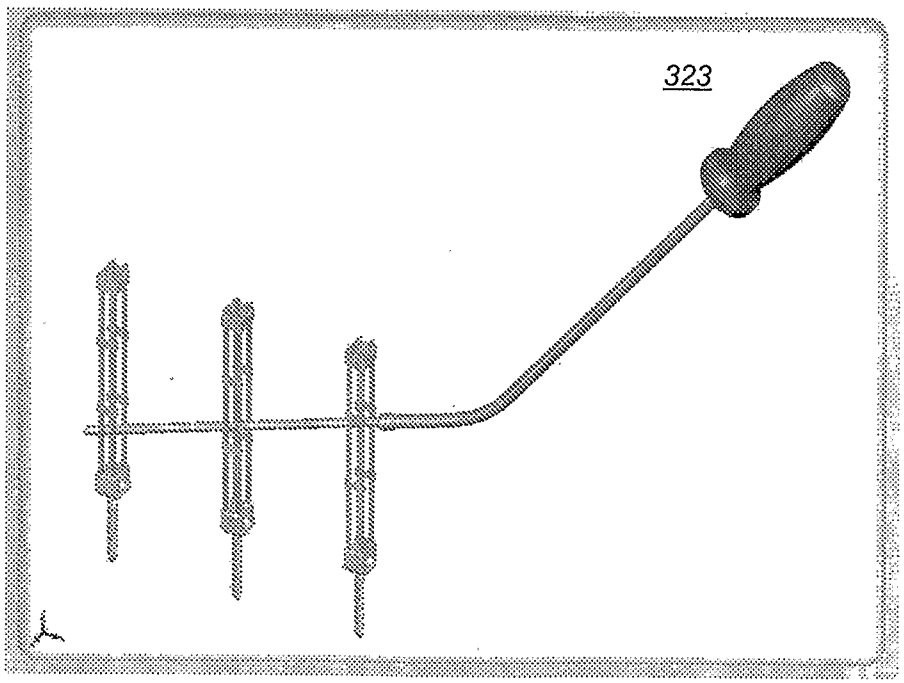

FIG. 23

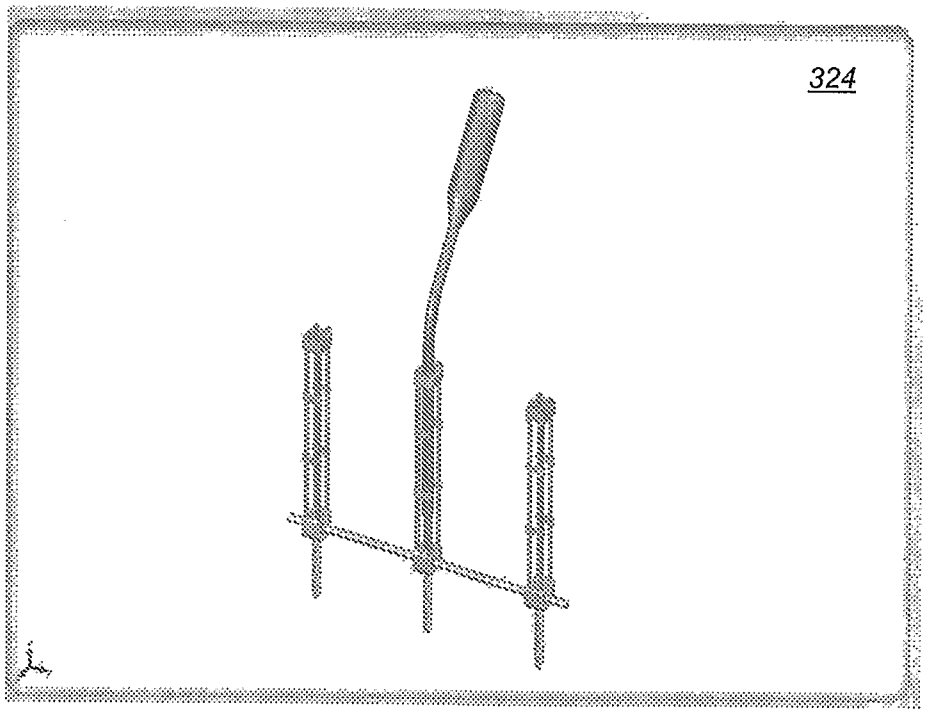

FIG. 24

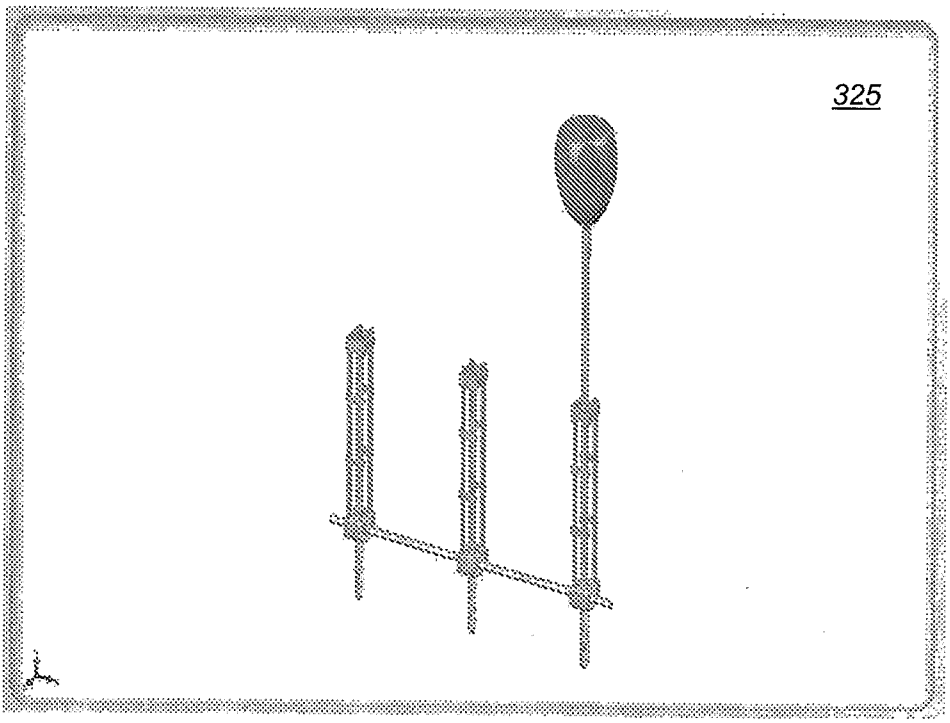

FIG. 25

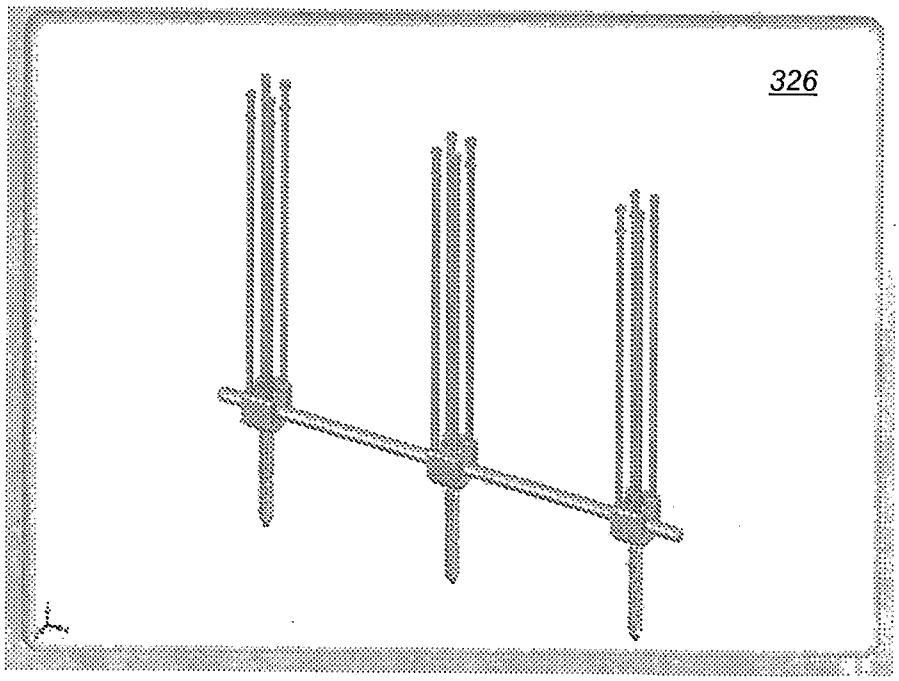

FIG. 26

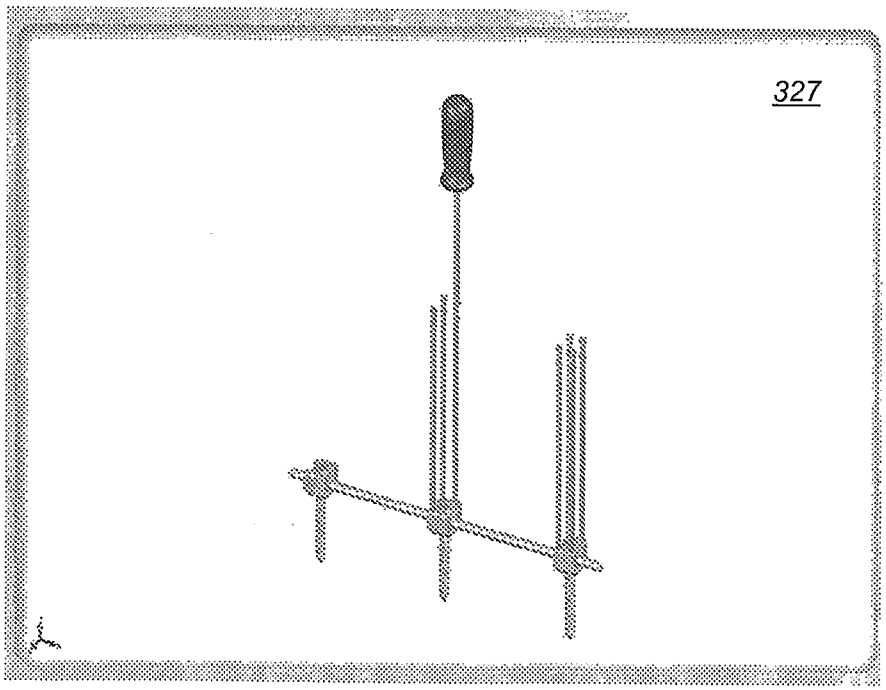

FIG. 27

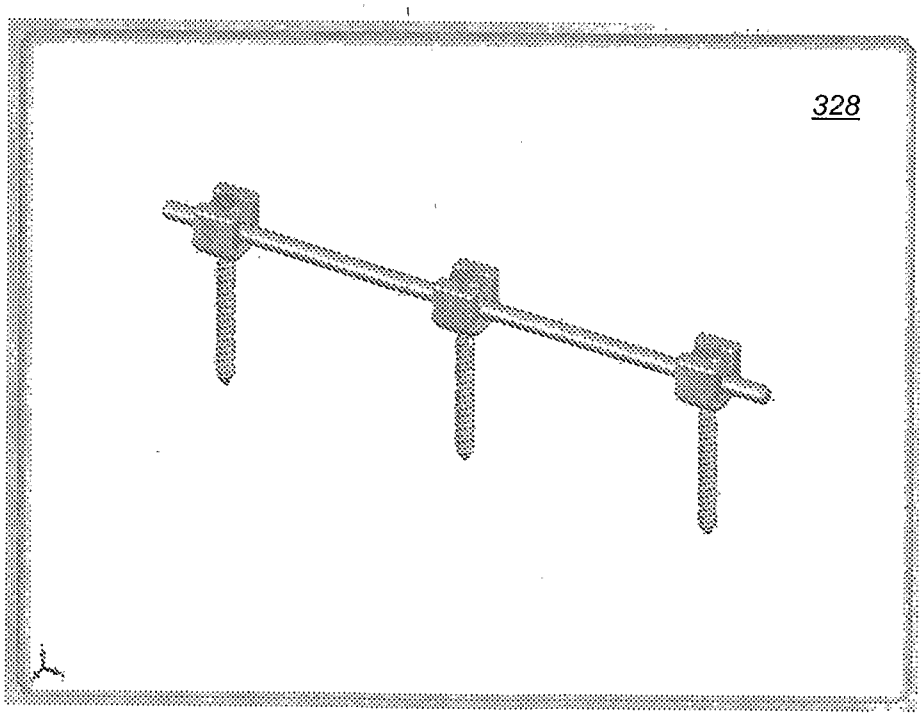

FIG. 28

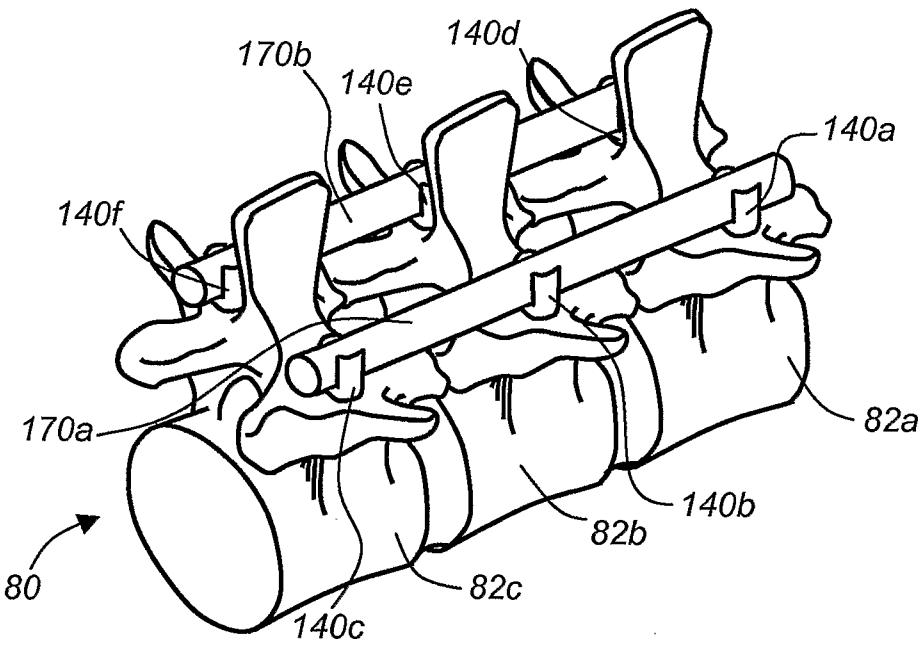

FIG. 29

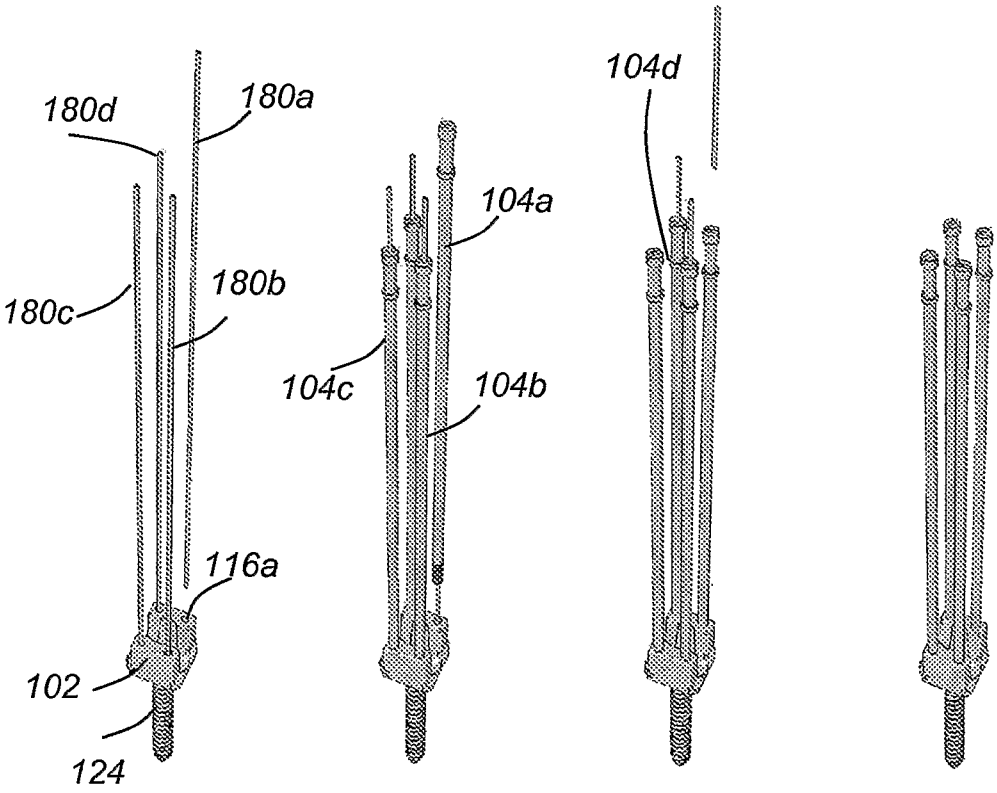

FIG. 30

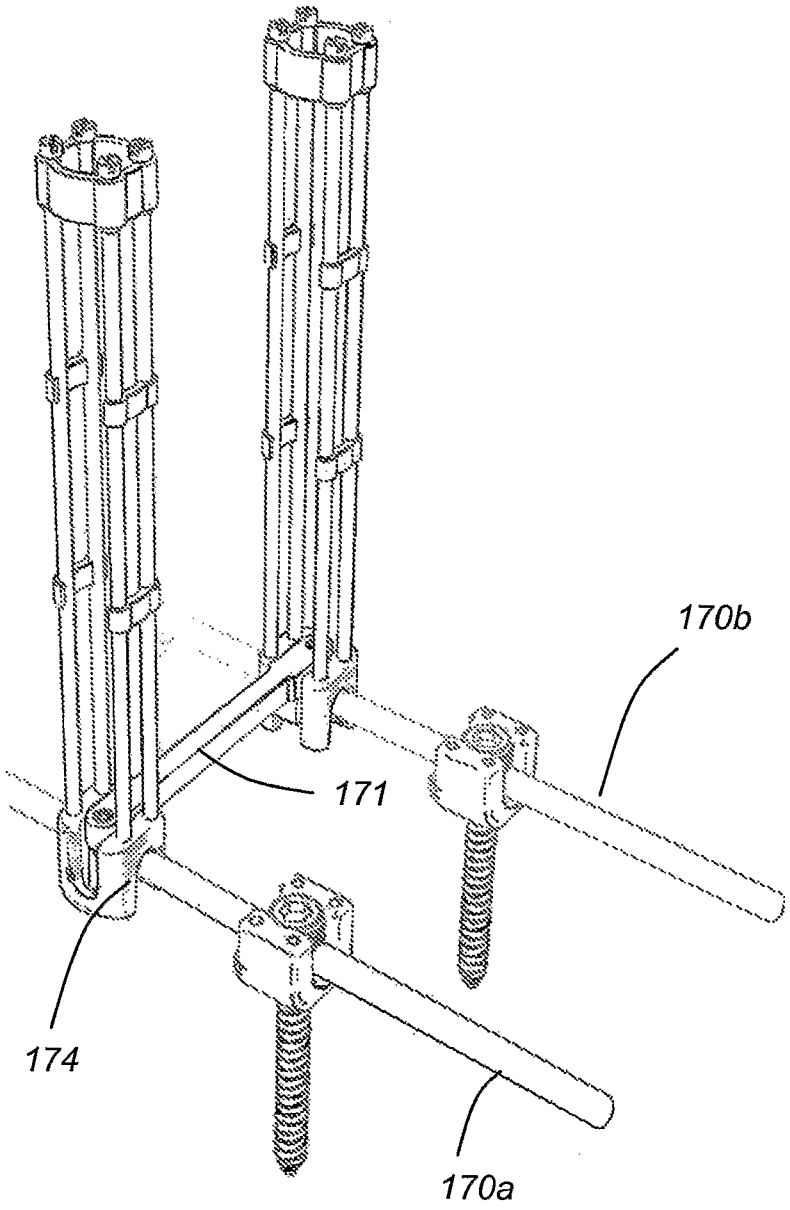

FIG. 31

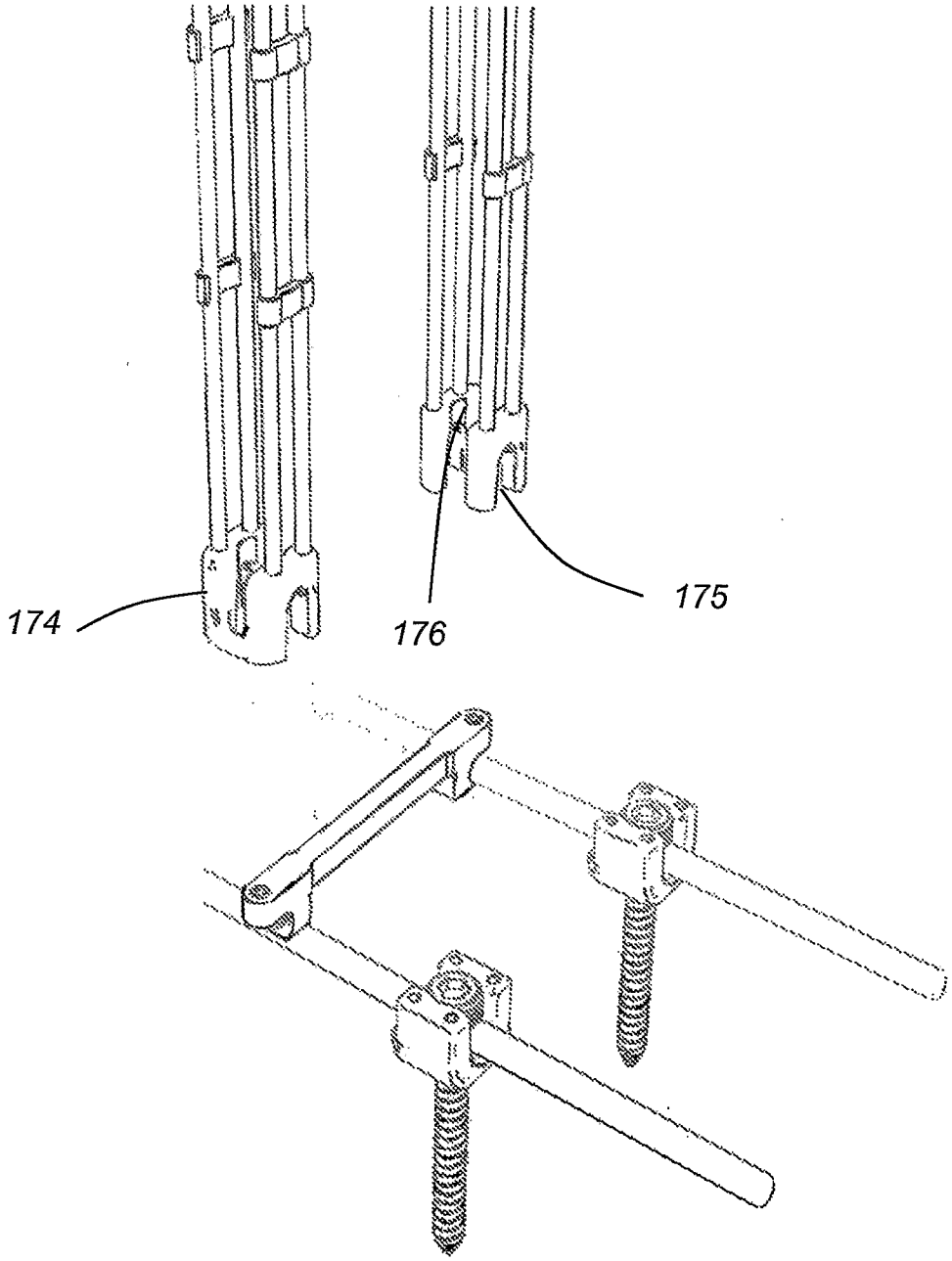

FIG. 32

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US06/60653

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 17/56 (2007.01)
USPC - 606/61
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(8) - A61B 17/56 (2007.01)
USPC - 623/17.11, 17.15, 17.16; 606/53-55, 60, 61, 90, 104

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)
USPTO EAST System (US, USPG-PUB, EPO, DERWENT), MicroPatent, IP.com, DialogPro

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/0065517 A1 (CHIN) 24 March 2005 (24.03.2005) entire document	1-12, 15, 18-19
– Y		16-17
Y	US 2005/0113927 A1 (MALEK) 26 May 2005 (26.05.2005) entire document	16
Y	US 2004/0193160 A1 (RICHELSOPH) 30 September 2004 (30.09.2004) entire document	17
A	US 2005/0159814 A1 (KARAHALIOS) 21 July 2005 (21.07.2005) entire document	1-19

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 July 2007	12 SEP 2007
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)