

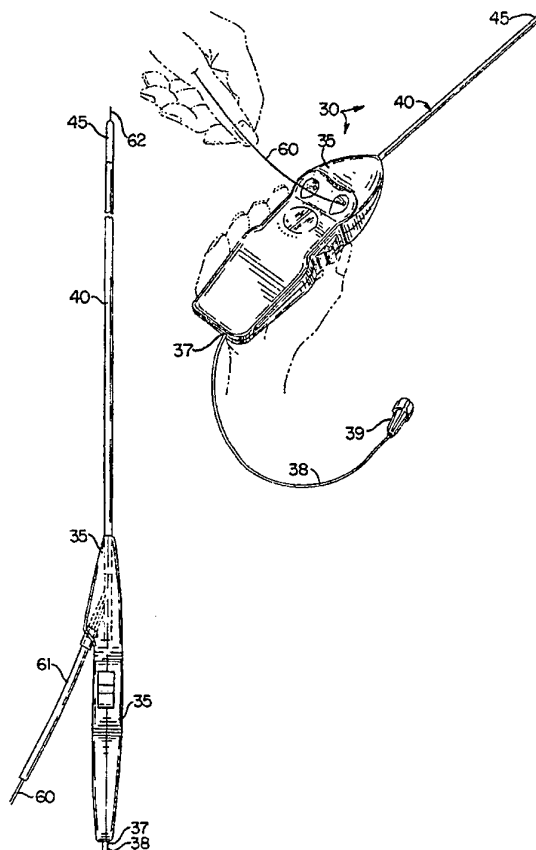


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(54) Title: APPARATUS FOR OBSERVING THE EPIDURAL REGION SUCH AS DURING EPIDURAL SURGERY**(57) Abstract**

An apparatus for observing the epidural region such as during epidural surgery is provided that improves visibility in the epidural space of a patient for more effectively conducting therapeutic surgery therein. The apparatus preferably includes a multi-lumen catheter characterized by being adapted for distending a portion of the epidural space of a patient and a fluid source connected to and in fluid communication with a first lumen of the catheter. The fluid source is adapted to be filled with a fluid to be supplied to the epidural space through the first lumen of the catheter. The apparatus also preferably includes an optical scope positioned within a second lumen of the catheter that supplies the distending fluid into the distended portion of the epidural space and an imaging source connected to the optical scope and adapted to provide a visual image of the epidural space.



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**APPARATUS FOR OBSERVING THE EPIDURAL
REGION SUCH AS DURING EPIDURAL SURGERY**

Field Of The Invention

This invention relates to an apparatus for epidural surgery in and around the epidural space.

Background Of The Invention

5 Back pain, and particularly lower back pain, is a major expense to society and is one of the most common disabling problems of those of working age. Injuries to the back vary from herniated disks of the spine to muscle strains and nerve damage. In the back, 10 posterior end, or epidural region of the human body, the epidural space is a potential space located in and extending the length of the spine. The epidural space is generally defined along one edge or side by the dura mater which surrounds the spinal cord. The epidural 15 space is further defined along a second edge or side by the periosteum of the bony vertebrae or by the ligamentum-flavum at the vertebral interspaces. Along the interior surface of the ligamentum-flavum lies the venus plexus, a complex configuration of veins. The 20 epidural space contains fat, connective tissue, blood vessels, lymphatic vessels, nerve fibers, and other structures. Various lesions, cystical masses, and nerve damage can occur in and around the epidural space which causes various back problems for the human body.

25 Although applying anesthesia to the epidural space has been known for procedures such as child birth or the like, the anatomy of the epidural space and

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related structures has not been fully investigated. Conventionally, the insertion of a catheter, fluid introducer, or the like for inducing spinal anesthesia directly into the subarachnoid space of the spinal column, such as seen in U.S. Patent 5,232,442 by Johnson, et al. entitled "*Method And Apparatus For Inducing Anesthesia*," has been through fluoroscopic or radiographic observation. Fluoroscopic observation techniques have also been used to try to locate the various sources of problems associated with back pain such as seen in U.S. Patent 5,215,105 by Kizelshteyn, et al. entitled "*Method Of Treating Epidural Lesions*." The fluoroscopic techniques are helpful for general guidance of instruments or other devices, but fail to give the physician or other medical personnel a detailed picture of structures within vessels or cavities, such as the epidural space, and therefore are limited in identifying the source of back pain problems.

Also, endoscopes have been used whereby internal areas or organs within a body vessel or cavity may be observed by inserting an elongated insertable part of the endoscope through a tube or sleeve inserted into a body vessel or cavity, or directly into the body vessel or cavity itself, such as seen in U.S. Patent 5,195,541 by Obenchain entitled "*Method Of Performing Laparoscopic Lumbar Discectomy*." An endoscope, as used herein, is an instrument for examining the interior of a bodily canal or hollow organ. A catheter, on the other hand, is a tube inserted into a bodily channel, such as a vein, to maintain an opening to a body vessel or cavity. These endoscopes, however, are relatively large with respect to a catheter and, therefore, do not cooperate with a catheter for performing delicate surgery such as the type surrounding the back or spinal column.

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Further, fiber optic scopes or fiberscopes have been used for various types of surgery such as surrounding the heart. These fiberscopes often are inserted into a vein or an artery for viewing blockage or the like within the vein or artery. The epidural space, however, has not fully been explored using visual techniques because the epidural space, as described above, does not take the form of a vein or artery. Because the epidural space collapses around an instrument or device inserted therein such as a catheter, an endoscope, a fiberscope, or a cutting tool, the space has not been considered for optical scope viewing or for performing many types of epidural surgical procedures.

Therefore, there is still a need for an apparatus for observing the epidural region such as during epidural surgery that allows a physician to effectively enter the epidural space of a patient, visually observe and document a problem area which could be the source of back pain in the patient, and therapeutically treat the problem area in or around the epidural space in a minimal amount of time and with minimal amount of cutting and other potential damage to the patient during surgery.

Summary Of The Invention

The present invention provides an apparatus for observing the epidural region such as during epidural surgery that improves visibility in the epidural space of a patient for more effectively conducting therapeutic surgery therein. The apparatus for observing the epidural region such as during epidural surgery involves the use of a catheter to distend a portion of the epidural space by filling the portion of the epidural space with a fluid supplied from a fluid source through the catheter positioned in the epidural space, the use of a portion of an optical

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scope positioned in the distended portion of the epidural space by inserting the optical scope through the catheter, and an imaging source connected to the optical scope to thereby provide a visual image of the epidural space. The apparatus for epidural surgery also allows a physician, or other medical personnel, to control and manipulate the catheter and an imaging source while simultaneously using surgical tools, such as fiberoptic scopes or the like, and fluids needed for medical operations to thereby allow the physician to positionally locate, isolate, and view problem areas within the epidural space. Because the apparatus for epidural surgery according to the present invention minimizes cutting and other potential damage to the patient during surgery, the invention provides an apparatus for epidural surgery that often can be used during an outpatient surgical procedure.

Brief Description Of The Drawings

Some of the objects and advantages of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a fragmentary skeletal view of a human body illustrating spinal column regions thereof;

FIG. 2 is a fragmentary view of a spinal column illustrating the position of the epidural space therein;

FIG. 3 is an elevational plan view of a surgical operation on a patient having a catheter positioned through an opening in the sacrum region and into the epidural space by a physician for therapeutic treatment of a problem area according to a first embodiment of the apparatus of the present invention;

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FIG. 4 is perspective view of an apparatus for epidural surgery according to the present invention;

FIG. 5 is a side elevational view of a catheter having a fiberscope inserted therein of an apparatus according to the present invention;

FIG. 6 is a perspective view of a catheter having a fiberscope inserted therein for an apparatus according to the present invention;

FIG. 7 is fragmentary top elevational view of a catheter for an apparatus according to the present invention;

FIG. 8 is an enlarged cross-sectional view of a first embodiment of a catheter taken along line 8-8 of FIG. 7 for an apparatus according to the present invention;

FIG. 9 is an enlarged cross-sectional view of a second embodiment of a catheter taken along line 8-8 of FIG. 7 for an apparatus according to the present invention;

FIG. 10 is an enlarged distal end plan view of a catheter taken from a distal end thereof for an apparatus according to the present invention;

FIG. 11 is enlarged fragmentary top plan view of a distal end of a catheter and having phantom lines therein illustrating the positioning of the multiple lumens within the catheter for an apparatus according to the present invention;

FIG. 12 is enlarged fragmentary side plan view of a distal end of a catheter for an apparatus according to the present invention;

FIG. 13 is a block diagram of a method of using the apparatus for epidural surgery according to a first embodiment of the present invention; and

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FIG. 14 is a block diagram of a method of using the apparatus for epidural surgery according to a second embodiment of the present invention.

Description Of Illustrated Embodiments

5 The present invention now will be described more fully hereinafter with reference to the accompanying drawings in which a preferred embodiment of the invention is shown. Like numbers refer to like elements throughout.

10 In the back, epidural region, or posterior end of the human body, as best illustrated in Figures 1 and 2, the epidural space 20 is potential space located in and extending the length of the spine 18. As illustrated in the fragmentary view of a spinal region

15 18 in Figure 2, the epidural space 20 has a generally cylindrical or crescent type shape and is generally defined along one edge or side by the dura mater 22 which surrounds the spinal cord 19. The epidural space is further defined along a second edge or side by the

20 periosteum of the bony vertebrae 23 or by the ligamentum-flavum 24 at the vertebral interspaces 25. Along the interior surface of the ligamentum-flavum 24 lies the venus plexus 26, a complex configuration of veins. The epidural space 20 is a collapsible

25 potential space that contains fat, connective tissue, blood vessels, lymphatic vessels, nerve fibers, and other structures. Various lesions, cystical masses, and nerve damage can occur in and around the epidural space which causes various back problems for the human

30 body. For example, fibrosis ranging from soft to tougher scar tissue may form randomly or in layers and adhere to the dura mater 22 and the periosteum of the body vertebrae 20 or the ligamentum-flavum 24 which form lesions extending across the epidural space 20.

35 These lesions can be caused by post operative scarring of nerves such as from laminectomy procedures. A

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ruptured, leaking, or torn disk can also cause lesions which are often the source of back pain.

An apparatus 15 for observing the epidural region such as during epidural surgery according to the present invention improves visibility in the epidural space 20, of a patient for more effectively conducting therapeutic surgery in and around the epidural space 20 such as applying a steroid fluid, performing a discectomy, or disrupting a fibrotic lesion. The apparatus 15 for epidural surgery according to the present invention preferably involves the use of a catheter 30 to distend a portion of the epidural space 20 by filling the portion of the epidural space 20 with a fluid, preferably a liquid such as a normal saline solution, supplied from a fluid source 50 through the catheter 30 positioned in the epidural space 20. Pressure monitoring means 55 as illustrated may also be connected to the fluid source 50 for monitoring the fluid pressure supplied from the fluid source 50 to the epidural space. As best shown in Figures 3-6, a portion of an optical scope 60 is positioned in the distended portion of the epidural space 20 by inserting the optical scope 60 through the catheter 30, and viewing means such as an imaging apparatus 80 connected to the optical scope provides a visual image 100 of the epidural space 20.

According to first and second embodiments of the present invention, the catheter 30 may be one of the numerous types of catheters or endoscopes known to those skilled in the art, but preferably is a multi-lumen, steerable catheter 30 having a relatively small outside diameter, i.e., about 2.7 millimeters (mm) or less, as best illustrated with reference to Figures 5-12. The catheter 30 preferably has an outside diameter of about 2.4 mm for easy insertion into the sacrum region, i.e., less than about 2.8 mm. The multi-lumen,

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steerable catheter 30 preferably has a multiple durometer tube portion 40 extending outwardly from a handle portion 35 such as disclosed and described in copending U.S. Patent Applications Serial No.

5 07/908,403 filed on July 6, 1992 and Serial No. 07/970,490 filed on November 2, 1992 which are hereby incorporated herein by reference. The catheter 30 preferably has at least first 41, and second 42 lumens extending longitudinally from a handle 35 to a distal
10 tip 45 thereof. The first lumen 41 preferably has a larger inside diameter than the second lumen 42 as best illustrated in Figures 8-10.

The optical scope 60 is preferably an 0.88 millimeter (mm) fiberscope, known to those skilled in
15 the art, that may preferably be inserted through the second lumen 42 of the steerable catheter 30, and preferably through a fiberoptic sheath 6 as shown in Figure 5 and have a portion 62 thereof extend into the epidural space 20. The fiberscope 60 preferably
20 communicates with an imaging apparatus 80 such as disclosed and described in copending U.S. Patent Application Serial No. 07/963,431 filed on October 12, 1992 which is also hereby incorporated herein by reference. As such, further details of the steerable
25 catheter 30, the optical scope 60, and the imaging source 80 will not be discussed except in relation to the operation thereof for the method and apparatus of epidural surgery according to the present invention.

By providing the combination of the steerable
30 catheter 30, the fiberscope 60, the fluid source 50, and the imaging apparatus 80, as illustrated in the elevational plan view of Figure 3, a physician 17, or other medical personnel, can control and manipulate the catheter 30 and the imaging apparatus 80 while
35 simultaneously using surgical tools, such as cutting instruments or the like, and fluids needed for medical

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operations to thereby allow the physician to positionally locate, isolate, and view problem areas on a television monitor 84, i.e., cathode ray tube display device, within the epidural space 20. The imaging apparatus 80 enables the physician to not only observe the visual image 100 of the distended portion of the epidural space 20, but also provides a means for recording and documenting the problem area such as the video cassette recording 86 mounted below the television monitor 84 on the portable stand 88. Since the steerable catheter 30 is preferably quite flexible and maneuverable within the epidural space 20, as best shown in Figures 6 and 7, the apparatus 15 also provides less radical interspinal surgical operations because problem areas can more effectively be observed and accessed with the optical scope 60 and steerable catheter 30 combination. Because the imaging apparatus 80 is preferably mounted on a stand 88 having wheels 87, as best shown in Figures 5, the physician 17, and other medical personnel, can position the imaging apparatus 80 close to the operation site. The control panel 83 of the imaging apparatus 80 provides image 100 adjustments, focus, and magnification to assist in viewing the epidural space 20 and the problem area when the portion of the epidural space 20 is distended by the liquid. It will be understood that the distended portion of the epidural space 20 to be viewed is preferably an amount of the epidural space 20 less than the entire boundaries thereof, the boundaries or peripheries being previously defined and described with reference to Figure 3.

More particularly with reference to the block diagrams illustrated in Figures 13 and 14, and the elevational plan view of a surgical operation in Figure 3, in using the apparatus 15 of the present invention, such an epidural surgical method preferably includes

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inserting a needle through the skin of a patient 120, preferably through a sacrum region 125 (Figure 13) or a lumbar region 135 (Figure 14) of the patient 120, and into the epidural space 20 to thereby provide an opening from the skin into the epidural space 20 of the patient 120.

As illustrated in Figure 1, the sacrum region 125 is at a lower end of the spinal column 18 below L-5 and adjacent the pelvic region 28. The sacrum 125 is a triangular shape bone formed generally by five fused vertebrae, i.e., sacral vertebrae, that are wedged dorsally between the two hip bones of the pelvic region 28 in this region of the human anatomy. It will also be understood by those skilled in the art that the invention is also applicable to various animals for veterinarian epidural procedures. The lumbar region 135 extends from L-1 to L-5 between the sacrum region 125 at a lower end and the thorax region (T-1 to T-12) at an upper end. The thorax region (T-1 to T-12) from an upper part 150 (T-12) lumbar region 135 to neck.

As illustrated in Figure 13, according to a first embodiment of an apparatus 15 for epidural surgery 160 according to the present invention, the patient is scrubbed in the sacrum region 125, preferably in an area around the sacral canal and up to the level of T-8 (Figure 1) with wide prep iodine, as shown by block 161. The patient 120 is draped, the physician 17 is scrubbed, and dressed in a sterile gown (Figure 3). The entry site is prepared and a one percent (1%) Xylocaine or (1%) Lignocaine solution is injected to create a skin wheel for incision. The patient 120 is then sedated with Versed, i.e., through an intra-venous cannula passed into the patient's hand, which is individually titrated to the patient's needs. The patient is also monitored with pulse oximetry, EKG, and a blood pressure monitor 42.

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After the patient is scrubbed and prepared, a needle, preferably an 18-gauge Touhy needle, is used to access the sacral foramen, as shown by block 162. The ligamentum-flavum 24 (Figure 2) is pierced and the
5 needle tip is inserted in the sacral hiatus. Under fluoroscopic guidance, as shown by block 163, a guide wire, preferably a 0.035-inch straight tip floppy guide wire, is inserted and advanced through the needle and into the epidural space. The guide wire is preferably
10 radiopaque and formed of stainless steel with a Teflon coating. The physician 17 then preferably fluoroscopically observes the position of the guide wire in the epidural space 20 with a fluoroscopy monitor, as understood by those skilled in the art, and
15 advances the guide wire to a spinal level where a suspected problem area within the epidural space 20 may have originated. As shown by block 164, the needle is extracted from the epidural space 20 and preferably discarded.

20 The catheter 30 of the apparatus 15, and preferably a multi-lumen, steerable catheter, is then inserted over the guide wire and into the opening to the epidural space 20, as shown by block 165. The guide wire functions as a guidance device as the
25 catheter 30 is advanced into the sacral hiatus. Because the catheter 30 is preferably a steerable catheter, the handle 35 and flexible distal end 45 ease the advancement and positioning of the catheter 30 within and around the epidural space 20.

30 The apparatus also has a fluid source 50 for supplying fluid through the catheter 30 to the epidural space 20. Fluid is supplied, and preferably continuously supplied, from the fluid source 50 to the first lumen 42 of the steerable catheter 30 to thereby
35 distend a portion of the epidural space 20. The first

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lumen 42 may also provide a working channel for surgical instruments and the like.

The fluid is preferably a liquid such as a conventional saline solution. A conventional saline bag can be accessed with an I.V. set and coupled to a three-way stop-cock, or valve for fluid regulation as best illustrated in Figure 3. A 20 cubic centimeter (cc) syringe is then coupled to a second port of the three-way stop-cock. An access port to a lumen 42 of the catheter 30 is also preferably coupled to a third port of the stop-cock. The fluid may also enter through tube portion 38 at a proximal end 37 at the handle portion 35 of the catheter 30 (as best shown in Figure 6). The 20 cc syringe is used first to extract all the air bubbles from the I.V. set and then fill the I.V. set with a normal-saline, liquid solution for distention of the epidural space. Twenty cc's of saline can be infused into the epidural space 20, as shown by block 166.

The fluid source 50 is preferably a fluid bag such as used with an I.V. and would preferably have a fluid indicator such as a scale formed integrally therewith or adjacent thereto. The fluid indicator provides feedback to the physician on the amount of fluid used during the procedure. The fluid flow control means of the apparatus 15 preferably includes a valve such as the three-way stop cock, a fluid flow indicator, and a connector, such as the Luer lock 38 and proximal tube 38 as illustrated in Figure 6, for fluidly connecting the fluid source to the catheter 30. Other means for indicating and/or controlling fluid flow to and through the catheter 30 may also be used. Although other techniques for fluid flow may be used, the amount of fluid supplied to the epidural space 20 according to the apparatus 15 is preferably relatively small, i.e., 25-50 milliliters (ml), which the body can

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readily absorb. The fluid source 50 is preferably mounted at a predetermined height so that the fluid pressure through the catheter 30 and into the epidural space is primarily caused by gravitational forces or the like. Although this fluid pressurization technique is preferred, others known by those skilled in the art may be used as well.

The 20 cc's of fluid from the fluid source 50 positioned or mounted at a predetermined height are sufficient to increase the pressure in a portion of the epidural space 20 and create a cavity in which the nerve root or other structures can be observed. A pressure monitoring means such as the fluid pressure monitor 55 illustrated may monitor the pressure of fluid flowing through the catheter 30 and into the epidural space 20. The fluid pressure monitor 55 may include a pump or the like for pumping fluid through and monitoring an I.V. system.

The position of the steerable catheter 30 within the epidural space may also be fluoroscopically observed. The catheter 30, like the guide wire, is also preferably radiopaque. Under such circumstances, the physician can advance the steerable catheter 30 under the fluoroscopical observation to the suspected problem area.

As shown by block 167, the apparatus 15 also has an optical scope 60, preferably a fiber optic scope or fiberscope, is then inserted preferably within another lumen 41 of the multi-lumen, steerable catheter 30. The fiberscope 60 can enter an access port in the handle portion 35, as best shown in Figure 6, or enter at a proximal end 37 of the handle portion 35 as shown in Figure 3 or 4. It will also be understood that the fiberscope 60 can be inserted prior to the advancement of the catheter 30 in the epidural space 20. A portion of the optical scope 60 is advanced within the lumen 41

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of the steerable catheter 30 and into the distended portion of the epidural space 20. The optical scope 60 preferably is not radiopaque and preferably will not extend into the epidural space 20 more than about one
5 centimeter (cm).

With the fluid supplied from the fluid source 50 distending a portion of the epidural space 20, the optical scope 60 can also be positioned within the distal tip 45 of catheter 30 and still view the
10 distended portion of the epidural space 20. The optical scope 60 illuminates the distended portion of the epidural space 20 to thereby visualize and display the epidural space 20 and a problem area therein with the imaging source 80, as shown by block 168. The
15 catheter 30 can be manipulated to place the distal end 45 into an optimal position to avoid any adhesions or naturally occurring fat globules that could hinder the flow of drugs such as a steroid fluid or that could hinder positioning of instruments or devices used in
20 surgical procedures. As shown by block 169, the catheter 30 is manipulated until the problem area such as an inflammation is recognized by its redness, increased vascularity, or other systems. The problem area is then observed and documented. This
25 documentation preferably includes recording the visual image by the video cassette recorder 86, a compact disc recorder, or the like. As shown by block 171, a treatment is then performed to the problem area within the epidural space such as the applying of a steroid
30 fluid to a nerve area, disrupting a fibrotic lesion, performing a discectomy, or other types of procedures. The apparatus is preferably used for therapeutic treatments which preferably include positioning a distal end 45 of the steerable catheter 30 adjacent the
35 problem area within the epidural space 20 and treating

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the problem area within the epidural space 20 through a lumen 41 or 42 of the steerable catheter 30.

After performing the treatment, the catheter 30 is then slowly extracted and a dressing is placed at the site of entry, as shown by blocks 172, 173. The patient is observed, preferably for about two hours, then discharged, as shown by block 174. The patient's chart is completed and a one week follow-up appointment may be made.

As illustrated in Figure 14, according to a second embodiment 180 of an apparatus 15 for epidural surgery of the present invention, a lumbar region 135 of the patient 120 is scrubbed and prepped, preferably in and around the L3-L4 area (Figure 1), as shown by block 181. In this second embodiment, in contrast to the first embodiment as illustrated in Figure 2, the patient 120 is preferably in a sitting position to spread the L1-L5 vertebrae to make access easier. It will also be understood that other sites of entry along the spinal column 18, besides the sacrum or caudal region 125 and lumbar region 135 of the patient 120, may be performed according to the present invention.

As shown by block 182, an 18-gauge Touhy needle is inserted into the interspinal space, such as between L3 and L4, using the loss of resistance technique well known to those skilled in the art. The epidural space 20 is confirmed and a guide wire, preferably a 0.035-inch straight floppy top guide wire, is inserted and advanced through the needle to the spinal level where the suspected problem area may be located in and around the epidural space 20, as shown by blocks 185, 186. The needle is then extracted (block 185) and preferably discarded.

As shown by block 187, the catheter 30 is inserted and advanced over the guide wire to the suspected problem area. The epidural space 20 is then

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infused with a fluid, as previously described with reference to the first embodiment, and distended (block 187). A portion of the optical scope 60 is inserted and advanced through a lumen 41 of the catheter 30 and
5 into the distended portion of the epidural space 20, as shown by block 188. The problem area is observed and documented, and the catheter is manipulated and positioned adjacent the problem area for more effectively performing a therapeutic procedure, such as
10 previously described (blocks 189, 191). A therapeutic procedure is then performed, also as previously described, as shown by block 192. The catheter 30 is then slowly extracted, the entry site is dressed, and the patient is observed (blocks 193-195). A follow-up
15 visit is then scheduled and the patient discharged.

The apparatus 15 of the present invention thereby provides improved visualization of the epidural space and more effective treatment of problems areas therein. The apparatus allows the physician to
20 effectively observe and document the problem area and then determine the most effective treatment for the patient. Since the steerable catheter is preferably quite flexible and maneuverable within the epidural space, the apparatus also provides less radical
25 interspinal surgical operations because problem areas can more effectively be observed and accessed with the optical scope and steerable catheter combination.

In the drawings and specification, there have been disclosed typical preferred embodiments of the
30 invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purposes of limitation. The invention has been described in considerable detail with specific reference to various illustrated embodiments. It will
35 be apparent, however, that various modifications and changes can be made within the spirit and scope of the

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invention as described in the foregoing specification
and defined in the following appended claims.

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CLAIMS:

1. An apparatus for epidural surgery that improves visibility in the epidural space of a patient for more effectively conducting therapeutic surgery therein, the
5 apparatus comprising:

a multi-lumen catheter characterized by being of such a size as to be readily inserted into the epidural space, said catheter characterized by having an outside diameter of less than 2.8 millimeters;

10 a fluid source connected to and in fluid communication with a first lumen of said catheter, said fluid source being adapted to be filled with a fluid to be supplied to the epidural space through said first lumen of said catheter;

15 an optical scope positioned within a second lumen of said catheter and adapted for having a portion thereof extend into the distended portion of the epidural space; and

viewing means connected to said optical scope for
20 providing a visual image of the epidural space.

2. An apparatus as defined in Claim 1, further comprising pressure monitoring means connected to said fluid source for monitoring the fluid pressure supplied to the epidural space.

25 3. An apparatus as defined in Claim 1, further comprising means for fluoroscopically observing the positioning of a portion of the catheter within the epidural space and adjacent a suspected problem area.

4. An apparatus as defined in Claim 1, further
30 comprising fluid flow control means connected to said fluid source and said catheter for controlling the amount of fluid flow to and through said catheter.

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5. An apparatus as defined in Claim 1, wherein the fluid supplied from said fluid source through said catheter to distend the portion of the epidural space is a liquid.

5 6. An apparatus as defined in Claim 5, wherein the distended portion of the epidural space comprises an amount of the epidural space less than entire boundaries of the epidural space.

7. An apparatus as defined in Claim 1, further
10 comprising means for monitoring the fluid flow to said first lumen of said catheter.

8. An apparatus as defined in Claim 4, wherein said fluid flow control means includes a fluid connector fluidly connected to said fluid source and to
15 said first lumen of said catheter.

9. An apparatus for epidural surgery that improves visibility in the epidural space of a patient for more effectively conducting therapeutic surgery therein, the
20 apparatus comprising:

a multi-lumen catheter characterized by being of such a size as to be readily inserted into the epidural space;

a fluid source connected to and in fluid
25 communication with a first lumen of said catheter, said fluid source being adapted to be filled with a fluid to be supplied to the epidural space through said first lumen of said catheter;

a fluid connector fluidly connected to said fluid
30 source and to said first lumen of said catheter and adapted for supplying fluid from said fluid source to said first lumen of said catheter;

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an optical scope positioned within a second lumen of said catheter and adapted for having a portion thereof extend into the distended portion of the epidural space; and

- 5 viewing means connected to said optical scope for providing a visual image of the epidural space.

- 10 10. An apparatus as defined in Claim 9, further comprising pressure monitoring means connected to said fluid source for monitoring the fluid pressure supplied to the epidural space.

11. An apparatus as defined in Claim 10, further comprising means for fluoroscopically observing the positioning of a portion of the catheter within the epidural space and adjacent a suspected problem area.

- 15 12. An apparatus as defined in Claim 9, wherein the fluid supplied from said fluid source through said catheter to distend the portion of the epidural space is a liquid.

- 20 13. An apparatus as defined in Claim 12, wherein the distended portion of the epidural space comprises an amount of the epidural space less than entire boundaries of the epidural space.

- 25 14. An apparatus as defined in Claim 9, further comprising means for monitoring the fluid flow to said first lumen of said catheter.

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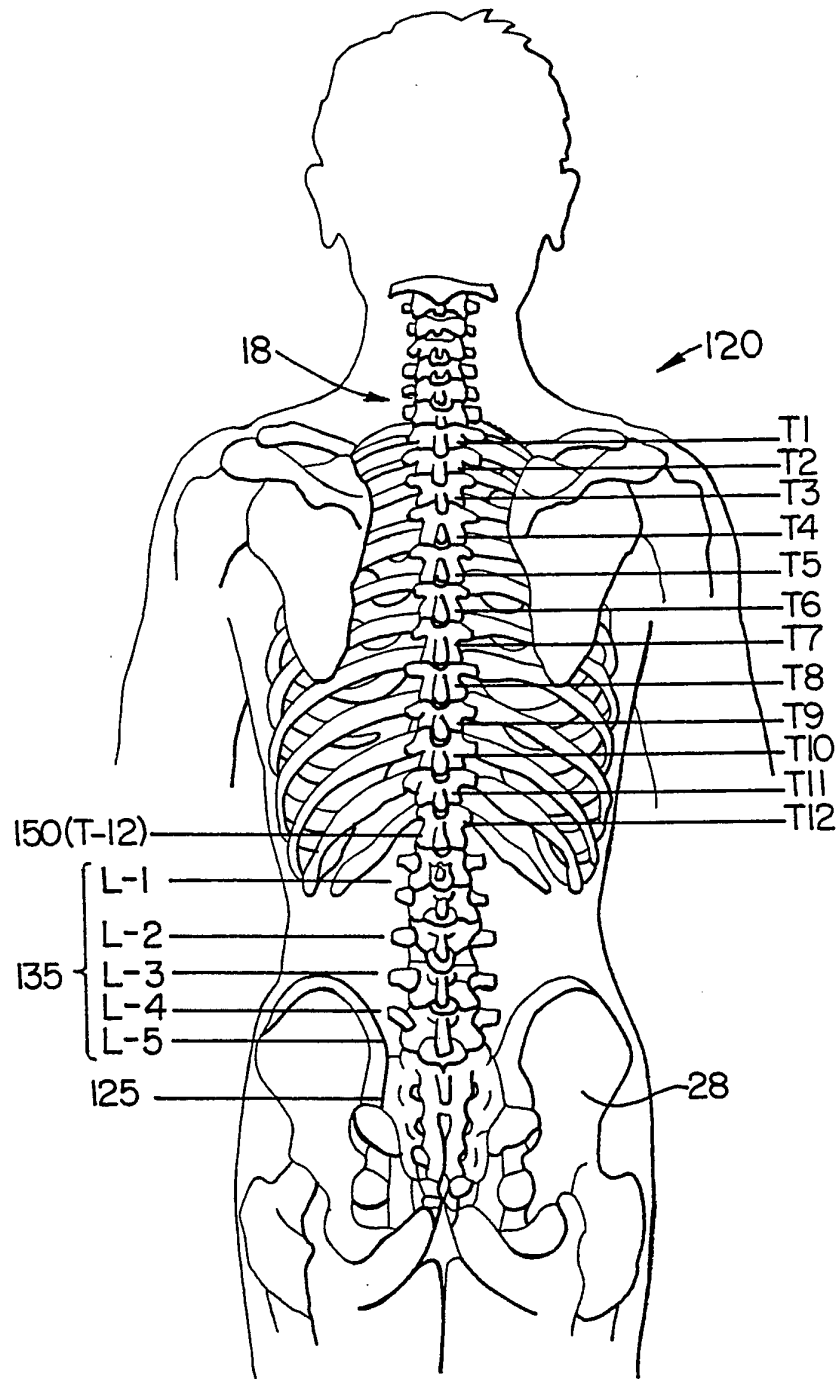
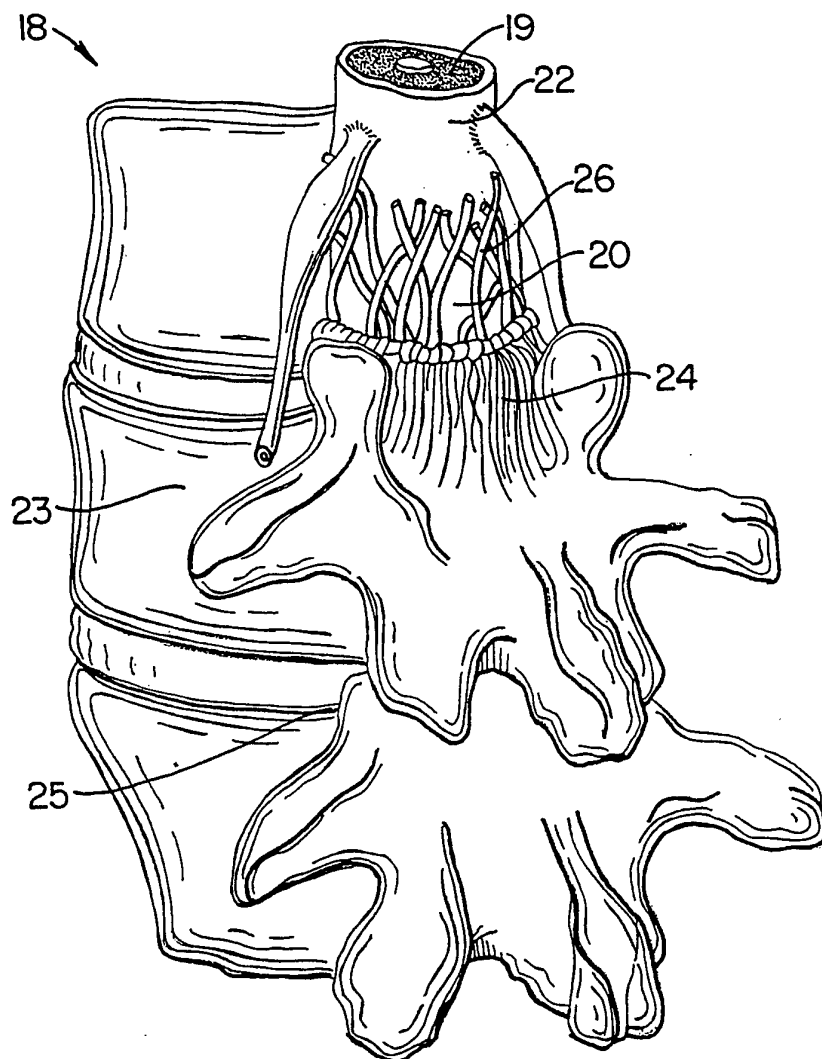
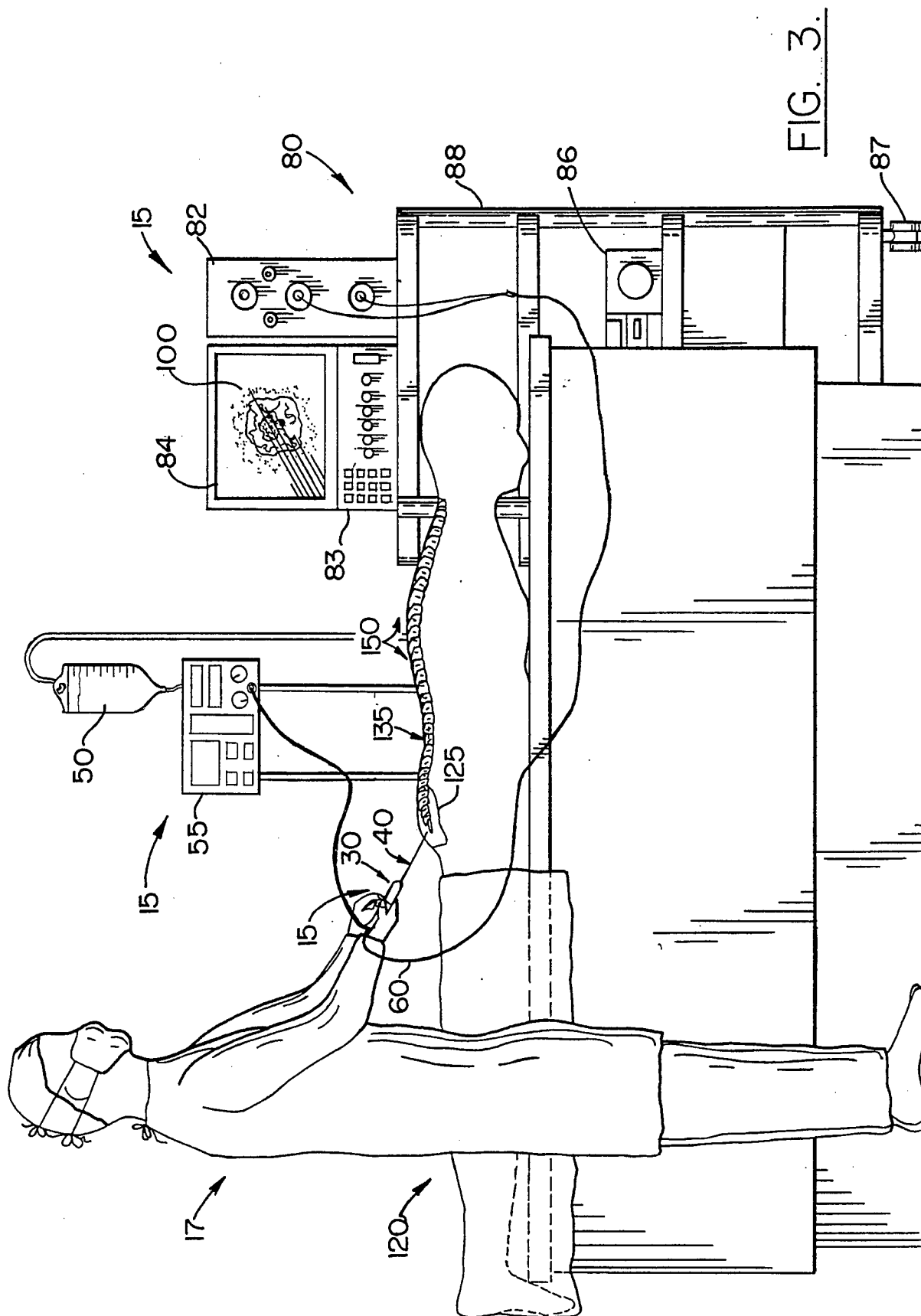


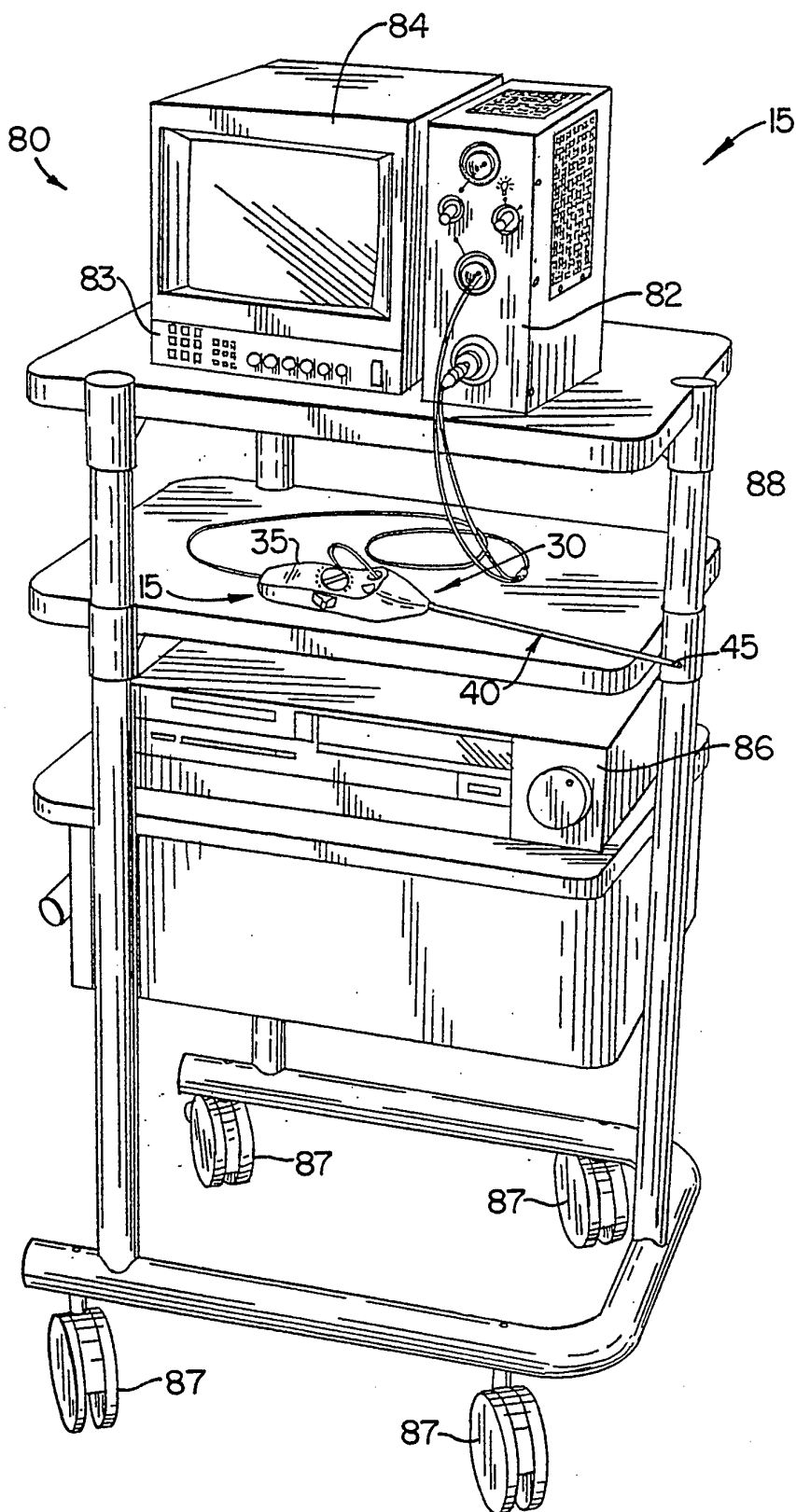
FIG. I.

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FIG. 2.



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FIG. 4.

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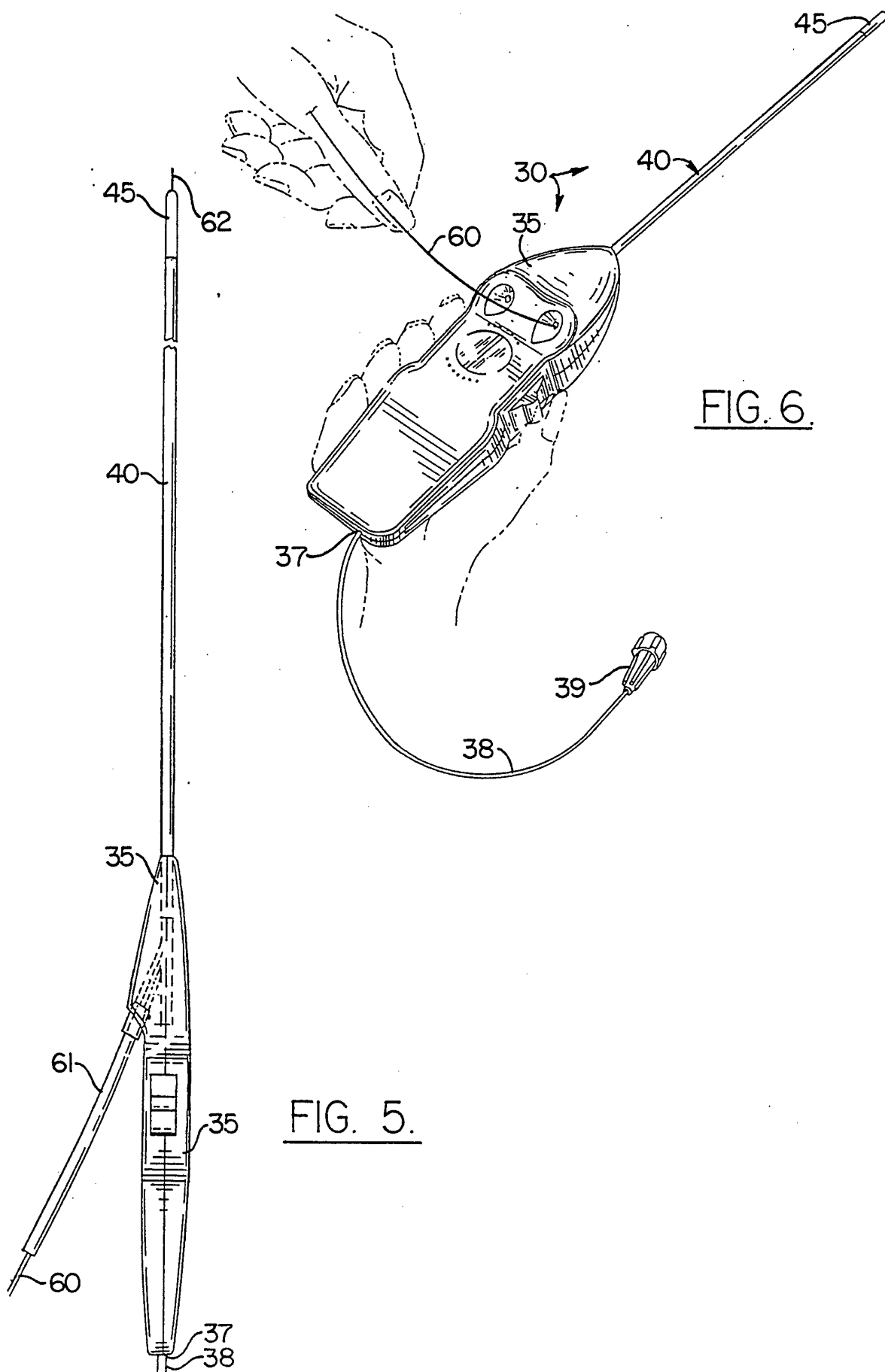
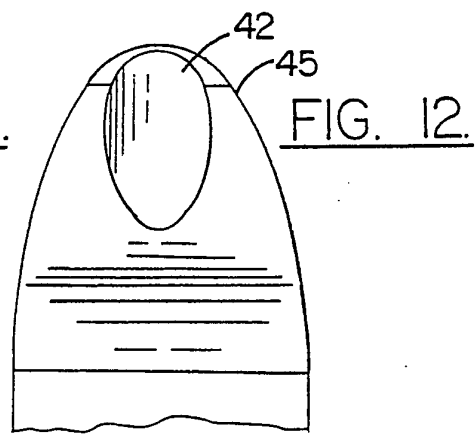
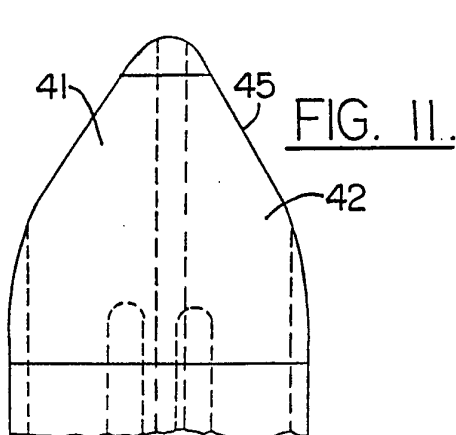
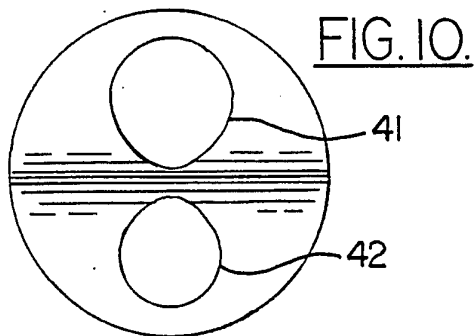
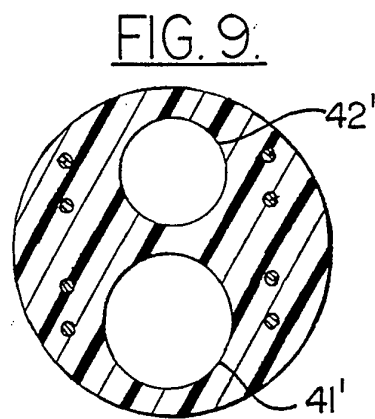
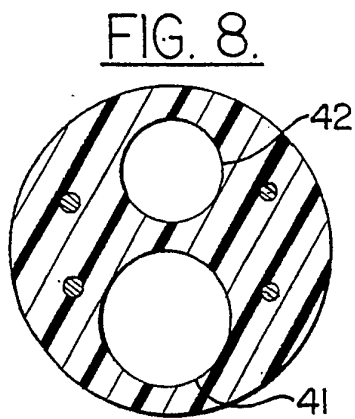
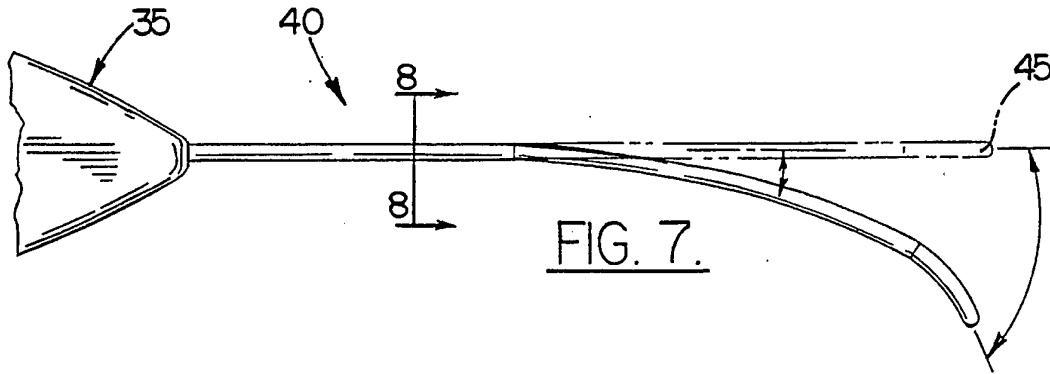


FIG. 6.

FIG. 5.



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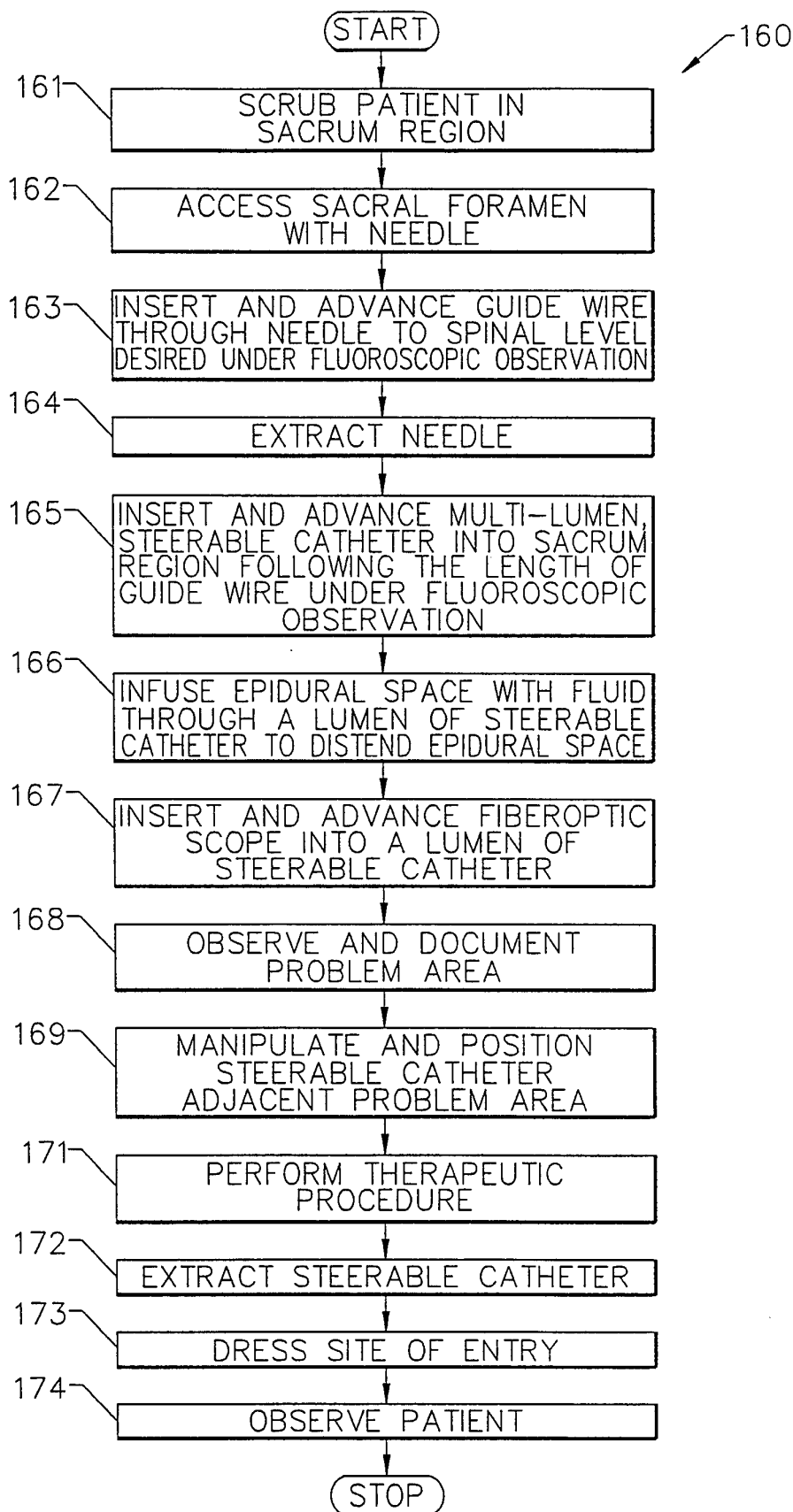


FIG. 13.

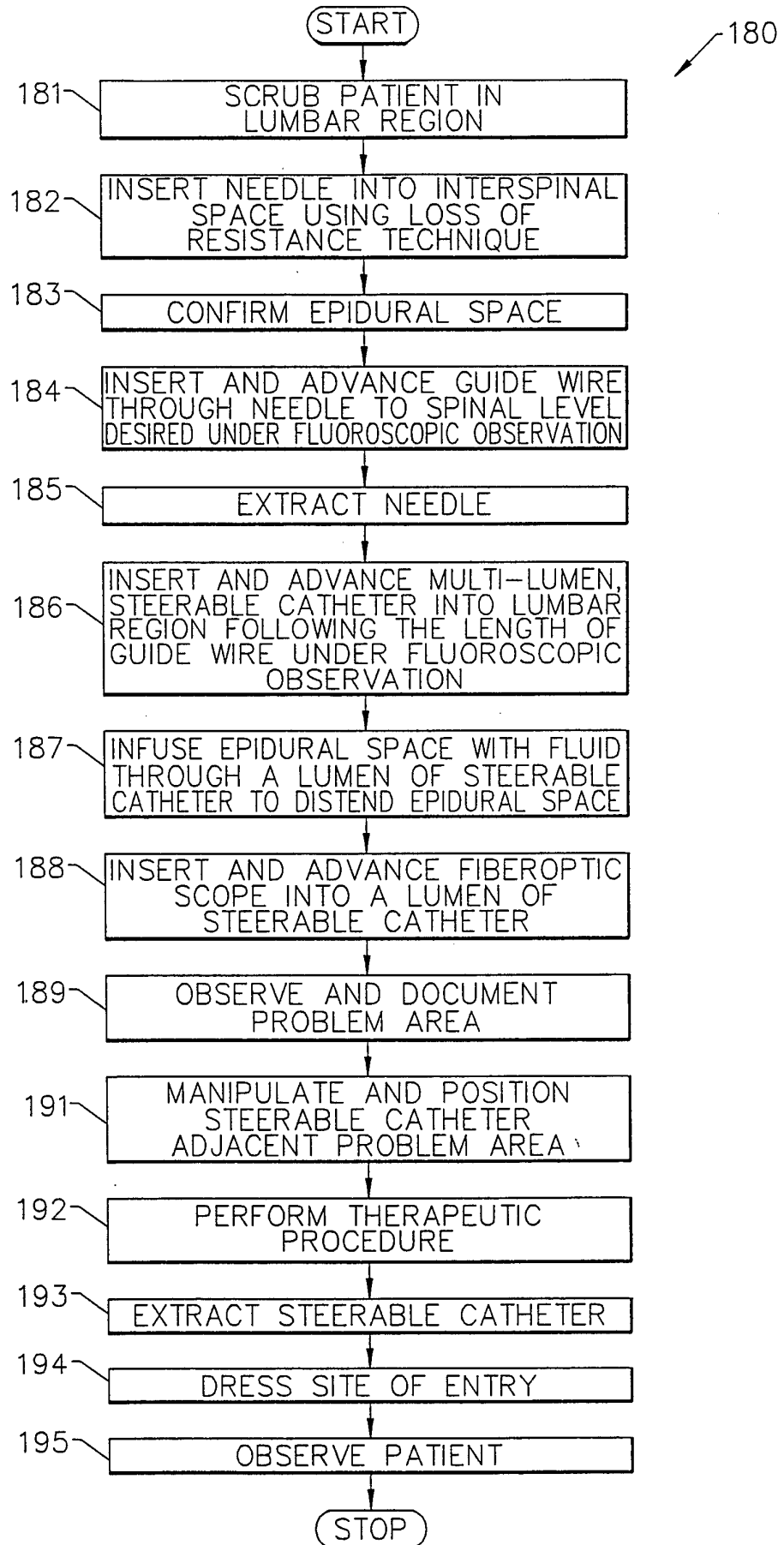


FIG. 14.

INTERNATIONAL SEARCH REPORT

Intern. al Application No

PCT/US 94/11006

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A61B17/34 A61B1/12 A61B1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 343 094 (FOGARTY) 23 November 1989 see column 4, line 56 - line 63; figures 9,11 ---	1-14
A	DE,A,39 16 288 (VILMAR) 30 November 1989 see abstract; figures 4,9 ---	1,9
A	US,A,5 215 105 (KIZELSHTEYN) 1 June 1993 cited in the application see claims 1,2,5,6,9,10 ---	3,11
A	US,A,5 024 655 (FREEMAN ET AL.) 18 June 1991 see abstract; figure 1 -----	1,9



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

25 January 1995

Date of mailing of the international search report

03.02.95

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern: al Application No

PCT/US 94/11006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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DE-A-3916288	30-11-89	NONE	
US-A-5215105	01-06-93	NONE	
US-A-5024655	18-06-91	US-A- 5084016	28-01-92