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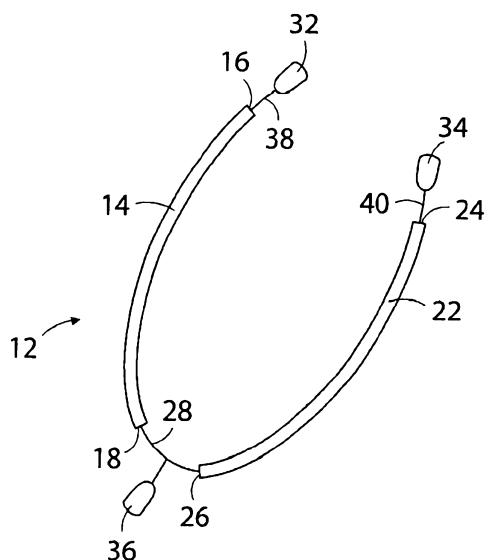


FIG. 1

(57) Abstract: An apparatus including a flexible length of cord and three tissue connectors positioned at the opposite ends of the cord and at an intermediate position of the cord is designed to be laparoscopically inserted through the abdominal wall and into the abdominal cavity, and used to move a first internal organ to a position away from a second internal organ where the apparatus holds the first internal organ in the position without further manual input, thereby providing surgical access to the second internal organ.

**APPARATUS AND METHOD FOR INTRA-ABDOMINALLY MOVING A FIRST
INTERNAL ORGAN TO A POSITION AWAY FROM A SECOND INTERNAL
ORGAN AND THEN HOLDING THE FIRST INTERNAL ORGAN IN THE POSITION
WITHOUT MANUAL INPUT**

BACKGROUND OF THE INVENTION

1. Field of the Invention

[001] The present invention is directed to an apparatus and its method of use in intra-abdominally moving a first internal organ to a position away from a second internal organ where the apparatus holds the first internal organ in the position without further manual input. More specifically, the present invention is directed to an apparatus that is inserted through the abdominal wall and into the abdominal cavity, and the method of using the apparatus in the abdominal cavity to move a human liver to a position away from a human stomach where the apparatus holds the liver in the position without further manual input, thereby providing surgical access to the stomach.

2. Description of the Related Art

[002] In laparoscopic surgical procedures, it is often necessary to make incisions through the abdominal wall for the sole purpose of providing access to the abdominal cavity for surgical graspers or other similar types of retracting instruments that are used to move one internal organ to a position away from a second internal organ to gain surgical access to the second internal organ. The incisions made for the surgical graspers or similar retracting instruments are in addition to the incisions

made in the abdominal wall for the surgical instruments used in performing the surgical procedure on the second organ.

[003] Furthermore, it is often necessary that an additional surgeon or surgical assistant be present solely for the purpose of manipulating the surgical graspers or other similar retracting instruments in moving the first internal organ to a position away from the second internal organ, and then manually holding the first internal organ in the position during the surgical procedure performed on the second internal organ.

[004] The need for the additional surgical personnel to manipulate and hold the surgical graspers or other similar retracting instruments during the surgical procedure increases the costs of surgery. In addition, the additional incisions in the abdominal wall required for the surgical graspers or other similar retracting instruments often results in additional discomfort to the patient following surgery and additional scarring.

[005] What is needed to overcome these disadvantages associated with the above-described type of laparoscopic surgical procedure is an apparatus that can be operated to intra-abdominally move a first internal organ to a position away from a second internal organ and then hold the first internal organ in the position without requiring additional manual input other than that provided by the surgeon and without requiring additional abdominal incisions other than those required for the surgery.

SUMMARY OF THE INVENTION

[006] The present invention overcomes the above-described shortcomings of laparoscopic surgical procedures by providing an apparatus that can be inserted into the abdominal cavity through the same incision to be used in a laparoscopic surgery procedure, and the method of using the apparatus to move or retract a first internal organ, for example the liver, away from a second internal organ, for example the stomach, and then hold the first internal organ in the retracted position providing surgical access to the second internal organ without requiring further manual input.

[007] The apparatus is constructed of component parts that are often used in laparoscopic as well as other types of surgical procedures. The component parts will be described herein using their common understood names and their functions, without going into details of the particular constructions of the component parts.

[008] The basic construction of the apparatus of the invention includes a length of cord. The cord could be comprised of a first cord segment having a flexible length with opposite first and second ends, and a second cord segment having a flexible length with opposite first and second ends. The cord segments could be provided by lengths of suture, lengths of tubing such as IV tubing, lengths of umbilical tape or elastic strips, or other equivalent cord constructions. The first and second cord segments could be separate cord segments that are attached together, or could be two cord segments of a single continuous length of cord.

[009] First, second, and third separate tissue connectors are attached to the first and second cord segments. The tissue connectors can be any type of known tissue connector that can be manually manipulated to connect to body tissue, and then

manually manipulated to be removed from the body tissue without leaving any significant damage to the body tissue. In addition, the tissue connectors can be biocompatible tissue connectors that are designed to be left in the abdominal cavity after the surgery. Some examples of such tissue connectors include suture needles, "T" bars, graspers, barbed needles, hooks, clasps, rivet assemblies, or any other equivalent type of connector. The first and third tissue connectors are attached to the opposite ends of the first cord segment and the second and third tissue connectors are attached to the opposite ends of the second cord segment. This positions the first and second tissue connectors at the opposite ends of the combined lengths of the first and second cord segments, and positions the third tissue connector at an intermediate position of the combined lengths of the first and second cord segments.

[010] In the use of the apparatus according to the method of the invention, the apparatus is first manually passed through the abdominal wall, for example through an incision or a cannula in the abdominal wall, and is positioned in the abdominal cavity in the area of the first and second internal organs. The third tissue connector is then manually connected to tissue adjacent the first internal organ. This positions the ends of the first and second cord segments connected to the third tissue connector between the first and second internal organs and on an opposite side of the first internal organ from the abdominal wall. The first tissue connector attached to the opposite end of the first cord segment from the third tissue connector is manually moved causing the length of the first cord segment to move and engage across the first internal organ and to move the first internal organ toward the position

away from the second internal organ. The first tissue connector is then manually connected to the abdominal wall.

[011] The second tissue connector attached to the opposite end of the second cord segment from the third tissue connector is then manually moved causing the second cord segment to move and engage across the first internal organ and move the first internal organ toward the position away from the second internal organ. The second tissue connector is then manually connected to the abdominal wall.

[012] In the above matter, the first and second cord segments engaging across the first internal organ hold the first internal organ at the position away from the second internal organ without further manual input. This provides surgical access to the second internal organ.

[013] In a further embodiment of the apparatus of the invention, the apparatus is comprised of a cord having a continuous flexible length with opposite first and second ends. A needle is attached to one end of the length of cord and a knot is formed in the opposite end of the length of cord.

[014] According to the method of use of this embodiment of the apparatus, the apparatus is first positioned inside the abdominal cavity in the same manner as the previously-described embodiment. The knotted end of the length of cord is then connected to tissue adjacent the first internal organ by first passing the needle through the tissue and then manually pulling the length of cord through the tissue. This attaches the knotted end of the cord to the tissue between the first and second internal organs.

[015] The needle is then passed through the inter-abdominal wall and manually moved back into the abdominal cavity, causing a first segment of the length of cord to engage across the first internal organ and move the first internal organ toward the position away from the second internal organ.

[016] The needle is then again inserted through the inter-abdominal wall at a location spaced from the first insertion of the needle through the inter-abdominal wall, and the needle and length of cord are pulled manually into the abdominal cavity.

[017] The needle and the end of the length of cord attached to the needle are then passed through the knot formed at the opposite end of the length of cord and pulled tight, causing a second segment of the length of cord to engage across and move the first internal organ toward the position away from a second internal organ. A knot is then tied between the opposite ends of the length of cord and the portion of the cord extending from the knot to the needle is cut and removed with the needle from the abdominal cavity. The length of cord left in the abdominal cavity forms a triangular loop with first and second cord segments that engage across and hold the first internal organ in the position away from the second internal organ without manual input. In this manner, surgical access is provided to the second internal organ without manual input.

[018] As described above, the apparatus of the invention and its method of use enable intra-abdominally moving a first internal organ to a position away from a second internal organ where the apparatus holds the first internal organ in the position without manual input.

DESCRIPTION OF THE DRAWING FIGURES

[019] Further features of the apparatus of the invention and its method of use are set forth in the following detailed description of the apparatus and method and are shown in the drawing figures.

[020] Figure 1 is a plan view of one embodiment of the apparatus of the invention.

[021] Figure 2 is a plan view of a further embodiment of the apparatus of the invention.

[022] Figure 3 is a plan view of a still further embodiment of the apparatus of the invention.

[023] Figure 4 is a representation of the apparatus of Figure 1 being inserted into the abdominal cavity.

[024] Figure 5 is a representation of the apparatus of Figure 1 being used according to the method of the invention.

[025] Figure 6 is a representation of the apparatus of Figure 2 in use according to the method of the invention.

[026] Figure 7 is a representation of the apparatus of Figure 3 in use according to the method of the invention.

[027] Figures 8A-8E represent the insertion of one embodiment of the apparatus into the abdominal cavity and one method of use of the apparatus.

[028] Figures 9A-9E represent the insertion of a further embodiment of the apparatus into the abdominal cavity and the method of using the apparatus.

[029] Figures 10A and 10B represent the insertion of a further embodiment of the apparatus into the abdominal cavity and the method of using the apparatus.

[030] Figures 11A and 11B represent a further embodiment of the apparatus and its method of use.

[031] Figures 12A and 12B represent a further embodiment of the apparatus and its method of use.

[032] Figures 13A and 13B represent a further embodiment of the apparatus and its method of use.

[033] Figures 14A-14C represent a further embodiment of the apparatus and its method of use.

[034] Figures 15A and 15B represent a further embodiment of the apparatus and its method of use.

[035] Figures 16A and 16B represent a further embodiment of the apparatus and its method of use.

[036] Figure 17 represents a further embodiment of the apparatus and its method of use.

[037] Figures 18A and 18B represent a further embodiment of the apparatus and its method of use.

[038] Figures 19A and 19B represent a further embodiment of the apparatus and its method of use.

[039] Figures 20A and 20B represent a further embodiment of the apparatus and its method of use.

[040] Figures 21A and 21B represent a further embodiment of the apparatus and its method of use.

[041] Figures 22A and 22B represent a further embodiment of the apparatus and its method of use.

[042] Figure 23 represents a further embodiment of the apparatus and its method of use.

[043] Figures 24A-24C represent component parts of a further embodiment of the apparatus.

[044] Figure 25 represents a component part of a further embodiment of the apparatus.

[045] Figure 26 represents a component part of a further embodiment of the apparatus.

[046] Figures 27A and 27B represent a further embodiment of the apparatus.

[047] Figures 28A and 28B represent a further embodiment of the apparatus.

[048] Figures 29A and 29B represent a further embodiment of the apparatus.

[049] Figures 30A and 30B represent a further embodiment of the apparatus.

[050] Figure 31 represents a further embodiment of the apparatus.

[051] Figure 32 represents a further embodiment of the apparatus.

[052] Figure 33 represents a component part of an embodiment of the apparatus.

[053] Figure 34 represents a component part of an embodiment of the apparatus.

[054] Figure 35 represents a component part of an embodiment of the apparatus.

[055] Figure 36 represents a component part of an embodiment of the apparatus.

[056] Figure 37 represents a component part of an embodiment of the apparatus.

[057] Figure 38 represents a component part of an embodiment of the apparatus.

[058] Figures 39A-39C represent component parts of an embodiment of the apparatus.

[059] Figures 40A and 40B represent component parts of an embodiment of the apparatus.

[060] Figure 41 represents a component part of an embodiment of the apparatus.

[061] Figure 42 represents a component part of an embodiment of the apparatus.

[062] Figure 43 represents a component part of an embodiment of the apparatus.

[063] Figures 44A and 44B represent component parts of an embodiment of the apparatus.

[064] Figures 45A-45E represent component parts of an embodiment of the apparatus.

[065] Figures 46A-46E represent component parts of an embodiment of the apparatus and its method of use.

[066] Figures 47A-47D represent component parts of an embodiment of the apparatus and its method of use.

[067] Figures 48A-48D represent component parts of an embodiment of the apparatus and its method of use.

[068] Figures 49A and 49B represent component parts of an embodiment of the apparatus and its method of use.

[069] Figures 50A and 50B represent component parts of an embodiment of the apparatus and its method of use.

[070] Figures 51A-51E represent a method of positioning an embodiment of the apparatus in an abdominal insertion device.

[071] Figures 52A and 52B represent embodiments of the apparatus and an insertion device and the method of mounting the apparatus on the insertion device.

[072] Figure 53 represents embodiments of the apparatus and an insertion device and a method of mounting the apparatus on the insertion device.

[073] Figure 54 represents embodiments of the apparatus and an insertion device and a method of mounting the apparatus in the insertion device.

[074] Figures 55A-55C represent an embodiment of the apparatus and a method of using the apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[075] Figure 1 shows one embodiment 12 of the apparatus for intra-abdominally moving a first internal organ to a position away from a second internal organ and then holding the first internal organ in the position without manual input. As stated earlier, the apparatus 12 is constructed of component parts that are often used in laparoscopic instruments and procedures as well as other types of surgical instruments and procedures. Because such component parts are known, the component parts that make up the apparatus 12 of the invention will be described herein using their common understood names and functions, without going into the details of the particular constructions of the component parts. As is conventional with laparoscopic apparatus, the component parts of the apparatus are dimensioned to be inserted through an incision in the abdominal wall or through a cannula

extending through the abdominal wall to position the apparatus in the abdominal cavity.

[076] The basic construction of the apparatus 12 of the invention includes a length of cord. In the example of Figure 1 the cord length is 10 inches, but the size of the apparatus 12 could change depending on the size of the patient in which the apparatus is used. In the embodiment shown in Figure 1, the cord is comprised of a first cord segment 14 having a flexible length with opposite first 16 and second 18 ends, and a second cord segment 22 having a flexible length with opposite first 24 and second 26 ends.

[077] The cord segments 14, 22 could be provided by lengths of suture, lengths of tubing such as IV tubing, lengths of umbilical tape or elastic strips, or other equivalent cord constructions. The tubing or tape configurations of the cord segments have the advantage of being less likely to dig into or cut into the first internal organ in use of the apparatus to be described. The first 14 and second 22 cord segments could be separate cord segments that are attached directly together, or separate cord segments that are attached by way of a further cord segment 28 or some other component part of the apparatus, or two cord segments of a single continuous length of cord such as the two cord segments 14a, 22a shown in Figure 2.

[078] First 32, second 34, and third 36 separate tissue connectors are attached to the first 14 and second 22 cord segments. The tissue connectors 32, 34, 36 can be any type of known tissue connector that can be manually manipulated to connect to body tissue, and then manually manipulated to be removed from the body tissue

without leaving any significant damage to the body tissue. In addition, the tissue connectors 32, 34, 36 could be biocompatible tissue connectors that are designed to be left in the abdominal cavity after the surgical procedure is completed. Some examples of tissue connectors include suture needles, "T" bars, surgical graspers, barbed needles, hooks, clasps, rivet assemblies, or any other equivalent type of connector. In the apparatus of the invention, it is not necessary that all three tissue connectors 32, 34, 36 be the same type of tissue connector. Because various different types of tissue connectors may be employed with the apparatus 12 of the invention, the three tissue connectors 32, 34, 36 of the apparatus 12 are represented schematically in the drawing figures. The first 32 and third 36 tissue connectors are attached to the opposite ends of the first cord segment 14. The third tissue connector 36 is also attached to one end of the second cord segment 22, with the second tissue connector 34 being connected to the opposite end of the second cord segment 22. This positions the first 32 and second 34 tissue connectors at the opposite ends of the combined lengths of the first 14 and second 22 cord segments, and positions the third tissue connector 36 at an intermediate position of the combined length of the first 14 and second 22 cord segments. In Figure 1, the first 32 and second 34 tissue connectors are shown connected to the respective first end 16 of the first cord segment 14 and the first end 24 of the second cord segment 22 through the intermediary of additional cord segments 38, 40. The third tissue connector 36 is shown connected to the second end 18 of the first cord segment 14 and the second end 26 of the second cord segment 22 through the intermediary of a further cord segment 28. Figure 2 shows the apparatus 12 with the first 32 and

second 34 tissue connectors connected directly to the respective first end 16 of the first cord segment 14 and the first end 24 of the second cord segment 22. Figure 2 also shows the third tissue connector 36 connected directly to the second ends 18, 26 of the first cord segment 14 and the second cord segment 22.

[079] Figures 4 and 5 illustrate an example of the use of the apparatus 12 of Figure 1 according to the method of the invention. In use, the apparatus 12 is first manually passed through the abdominal wall 42, for example through an incision or a cannula 44 in the abdominal wall 42, and is positioned in the abdominal cavity 46 in the area of the first 48 and second 50 internal organs. In Figure 4, the first internal organ 48 represented is the human liver, and the second internal organ 50 represented is the human stomach.

[080] The third tissue connector 36 of the apparatus is then manually connected to tissue 52 adjacent the first internal organ 48 and between the first 48 and second 50 internal organs. In the example shown in Figure 4, the tissue 52 is the crus of the diaphragm. Connection of the third tissue connector 36 to the tissue 52 positions the second ends 18, 26 of the first 14 and second 22 cord segments connected to the third tissue connector 32 between the first 48 and second 50 internal organs and on an opposite side of the first internal organ 48 from the abdominal wall 42.

[081] The first tissue connector 32 attached to the opposite end 16 of the first cord segment 14 from the third tissue connector 36 is then manually moved causing the length of the first cord segment 14 to move and engage across the first internal organ 48. Continued movement of the first tissue connector 32 causes the first cord segment 14 engaging across the first internal organ 48 to move the first internal

organ toward a position away from the second internal organ 50. The first tissue connector 32 is then manually connected to the inner abdominal wall 42.

[082] The second tissue connector 34 attached to the opposite end 24 of the second cord segment 22 from the third tissue connector 36 is then manually moved causing the second cord segment 22 to move and engage across the first internal organ 48. Continued movement of the second tissue connector 34 causes the second cord segment 22 engaging across the first internal organ 48 to move the first internal organ 48 toward the position away from the second internal organ 50. The second tissue connector 34 is then manually connected to the inner abdominal wall 42.

[083] With the apparatus 12 connected between the tissue 52 and the inner abdominal wall 42 in the manner discussed above, the first cord segment 14 and the second cord segment 22 engage across the first internal organ 48 and hold the first internal organ 48 at the position away from the second internal organ 50 without further manual input. This provides surgical access to the second internal organ 50. Without requiring manual holding or restraining of the first internal organ 48 in the position away from the second internal organ 50.

[084] Figure 6 is a representation of the apparatus of Figure 2 that has been connected between the tissue 52 and the inner abdominal wall 42 according to the same method as the apparatus of Figure 1 described above.

[085] In a further embodiment of the apparatus of the invention shown in Figure 3, the apparatus 54 is comprised of a single cord 56 having a continuous flexible length with opposite first 58 and second 60 ends. A tissue connector in the form of a

needle 62 is attached to the first end 58 of the length of cord 56. At the opposite second end 60 of the length of cord 56, the cord is formed in a knot 64.

[086] The method of using the embodiment of the apparatus 54 shown in Figure 3 is illustrated in Figure 7. The apparatus 54 is first positioned inside the abdominal cavity in the same manner as the previously described embodiments. The knotted end 64 of the length of cord is then connected to the tissue 52 adjacent the first internal organ 48 by first passing the needle 62 through the tissue 52 and then manually pulling the needle 62 and the attached length of cord 56 through the tissue 52. This attaches the knotted second end 64 of the length of cord 56 to the tissue 52 between the first 48 and second 50 internal organs.

[087] The needle 62 is then passed through the inter-abdominal wall 42 and the needle 62 and the attached length of cord 56 are pulled from the insertion site 72 back into the abdominal cavity 46. This causes a first segment 74 of the cord length 56 to move into engagement with and across the first internal organ 48. The engagement of the first cord segment 74 with the first internal organ 48 moves the first internal organ 48 toward the position away from the second internal organ 50.

[088] The needle 62 is then again inserted through the inter-abdominal wall 42 at a second insertion location 76 spaced from the first insertion location 72. The needle 62 and the attached length of cord 56 are pulled manually through the second insertion 76 into the abdominal cavity 46 until an intermediate section of cord 78 extends between the two insertion sites 72, 76.

[089] The needle 62 and the attached length of cord 56 are then passed through the knot 64 formed at the opposite end of the length of cord 56 and are pulled tight.

This causes a second cord segment 82 of the length of cord 56 to engage across and move the first internal organ 48 toward the position away from the second internal organ 50. The length of cord 56 is pulled tight and a knot is tied between the opposite ends of the cord at the knot 64 on the cord second end 60. The portion of the length of cord 54 extending from the knot 64 to the needle 62 is then cut and removed from the abdominal cavity. The length of cord 54 left in the abdominal cavity forms a triangular loop with the first 56 and second 82 cord segments extending across the first internal organ 48 and holding the first internal organ in the position away from the second internal organ 50 without manual input. In this manner, surgical access is provided to the second internal organ 50 without manually holding the first internal organ 48 in its retracted position.

[090] Figures 8A-8E represent one method of inserting the apparatus of the invention into the abdominal cavity and the method of using the apparatus. The embodiment of the apparatus 12 shown in these drawing figures has a pair of keith needles 80, 82 as the first and second tissue connectors, and a "T" bar 84 as the third tissue connector. The apparatus 12 is first positioned inside an insertion device 86 in the form of a hollow narrow tube. The insertion device 86 is then inserted through a trocar or cannula 44 that has been positioned in the abdominal wall 42 in a conventional manner. Once inside the abdominal cavity 46, the apparatus 12 is removed from the interior of the insertion device 86 and the insertion device is removed from the abdominal cavity through the cannula 44. The "T" bar 84 or the third tissue connector is then passed through the body tissue 52, i.e., the right diaphragm crus as described earlier. Once the "T" bar 84 is passed through the

tissue 52, it is rotated to its substantially 90 degree position relative to its pathway through the tissue 52 as shown in Figure 8C. The apparatus 12 is then pulled from the keith needles 80, 82. As represented in Figure 8D, the keith needles 80, 82 are then passed through the abdominal wall 42 and the apparatus is pulled tight against the first internal organ 48, i.e., the liver. The needles 80, 82 are then pulled at the exterior of the abdominal wall 42, causing the apparatus to move the first internal organ 48 away from the second internal organ, i.e., the stomach. A pair of tension clasps 88, 90 are attached to the respective first 14 and second 22 cord segments of the apparatus on the exterior of the abdominal wall 42 to hold the apparatus in its position across the first internal organ 48 in the abdominal cavity 46.

[091] Figures 9A-9E represent a method of using an embodiment of the apparatus 12 that is similar to that shown in Figures 8A-8E and described above. In this example, the apparatus 12 also employs the "T" bar 84 as its third tissue connector. However, there is no needle provided on the first cord segment 14 and there is no needle provided on the second cord segment 22. In this embodiment of the apparatus 12, the first cord segment 14 is a length of suture having a free end 92 opposite the "T" bar 84 and the second cord segment 22 is a length of suture also having a free end 94 opposite the "T" bar 84. The apparatus 12 is shown in Figure 9A as being positioned in the abdominal cavity 46 using the insertion device 86 in the same manner described earlier with reference to the method of Figures 8A-8E. The apparatus 12 of Figure 9A is also initially used according to the same method of Figures 8A-8E in that the "T" bar 84 is passed through the body tissue 52 and is positioned substantially 90 degrees relative to the pathway through the tissue. A pair

of GraNee needles 96, 98 are then passed through the abdominal wall 42. One of the GraNee needles 96 grabs the suture free end 92 of the first cord segment 14 and the other GraNee needle 98 grabs the suture free end 94 of the second cord segment 22. The GraNee needles 96, 98 are then withdrawn through the abdominal wall 42 pulling the suture free ends 92, 94 through the abdominal wall. The suture free ends 92, 94 are then secured to the abdominal wall using a pair of clamps 88, 90 as was done in the previously-described embodiment of Figures 8A-8E.

[092] Figures 10A and 10B are a representation of the method of the invention practiced using an ENDO STITCH® device marketed by United States Surgical Corporation. Figure 10A represents the distal end of the ENDO STITCH® 102 being inserted through the cannula 44 in the abdominal wall 42 to a position adjacent the diaphragm crus 52. As is conventional, the pair of jaws 104, 106 at the ENDO STITCH® distal end 102 hold a needle 108 and a length of suture 110. The ENDO STITCH® 102 is manually actuated to pass the needle 108 through the tissue 52 of the crus from one jaw 104 of the ENDO STITCH® to the opposite jaw 106 of the ENDO STITCH®. The length of suture 110 is then removed from the abdominal cavity 46 through the cannula 44 and is pulled tight, causing the length of suture 110 to move and hold the first internal organ away from the second internal organ in substantially the same manner as described earlier.

[093] Figures 11A and 11B represent a further embodiment of the apparatus 12 and its method of use. The embodiment of the apparatus 12 shown in Figures 11A and 11B and its method of use are substantially the same as that of earlier-described

embodiments, except that the "T" bar of the previously-described embodiments is replaced by a "J" hook locking clasp 112. Figure 11A shows the locking clasp 112 in its open position prior to the hook portion of the clasp being passed through the tissue 52 of the diaphragm crus. Figure 11B shows the locking clasp 112 after the hook of the clasp has been passed through the tissue 52 and the clasp has been locked. The method of further using the apparatus to move and hold an internal organ is substantially the same as that of earlier-described embodiments.

[094] Figures 12A and 12B show a further embodiment of the apparatus 12 and its method of use. The construction of the embodiment of the apparatus 12 shown in Figures 12A and 12B is substantially the same as earlier described embodiments, except that the "T" bar or locking clasp is replaced by a barbed needle 114. The method of using the embodiment of the apparatus shown in Figures 12A and 12B is substantially the same as that of earlier described embodiments, except that the barbed needle 114 is passed through the tissue 52 of the diaphragm crus until the barb of the needle emerges from the tissue as shown in Figure 12B. This secures the apparatus to the tissue 52. Further use of the apparatus to move and hold an internal organ is substantially the same as that of earlier-described embodiments.

[095] Figures 13A and 13B show a further embodiment of the apparatus 12 of the invention that is substantially the same as that as earlier-described embodiments except that the third tissue connector or "T" bar is replaced by a resilient biased clasp 116. In the method of using the apparatus of Figures 13A and 13B, the opposite arms 118, 120 of the clasp 116 are compressed to open the jaws 122, 124 of the clasp as shown in Figure 13A. The jaws 122, 124 are then positioned around

the tissue 52 of the diaphragm crus and are allowed to close, thereby securing the clasp 116 to the tissue 52. The subsequent method of using the apparatus shown in Figures 13A and 13B is substantially the same as that of previously-described embodiments of the apparatus.

[096] Figure 14A-14C show a further embodiment of the apparatus 12 that is substantially the same as that of previously-described embodiments except that the third tissue connector is a two-piece rivet assembly. The assembly is comprised of a pin 126 having an enlarged point 128 and a cap 130 having a circular center opening 132. In the method of using the apparatus of Figures 14A-C, the pin 126 is first inserted through the tissue 52 of the diaphragm crus until the point 128 projects from the opposite side of the tissue. The point 128 is then inserted through the center opening 132 of the cap 130, thereby securing the pin 126 and the cap 130 to the tissue 152. The subsequent steps of using the apparatus of Figures 14A-14C is substantially the same as that of earlier-described embodiments of the apparatus.

[097] Figures 15A and 15B show a further embodiment of the apparatus 12 that has substantially the same construction of earlier-described embodiments of the apparatus except for the first and second tissue connectors being a pair of "J" shaped hooks 134, 136. In the method of using the embodiment of the apparatus shown in Figures 15A and 15B, the first cord segment 14 and the second cord segment 22 are secured to the inner abdominal wall 42 by passing the hooks 134, 136 through the tissue of the inner abdominal wall. Apart from this, the method of using the apparatus shown in Figures 15A and 15B is substantially the same as that of earlier-described embodiments of the apparatus.

[098] Figures 16A and 16B represent a further embodiment of the apparatus and its method of use that are substantially the same as that of previously-described embodiments, except for the first and second tissue connectors being a pair of “J” hook locking clasps 138, 140. In the method of using the apparatus of Figures 16A and 16B, the hook portions of the locking clasps 138, 140 are passed through the tissue of the inner abdominal wall 42 and then are locked closed. This secures the first cord segment 14 and the second cord segment 22 to the inner abdominal wall. Apart from this, the method of using the apparatus of the invention shown in Figures 16A and 16B is substantially the same as that of earlier-described embodiments of the apparatus.

[099] Figures 17 shows a representation of an embodiment of the apparatus where the first and second tissue connectors are provided as a pair of resilient, biased clasps 142, 144 that have substantially the same construction of the earlier-described clasp 116. The clasps 142, 144 are secured to the inner abdominal wall 42 by first opening the clasps and positioning tissue of the inner abdominal wall between the open jaws of the clasps, and then allowing the jaws of the clasps to close over the tissue. This secures the first cord segment 14 and the second cord segment 22 to the inner abdominal wall. Apart from this, the method of using the apparatus represented in Figure 17 is substantially the same as that as earlier-described embodiments of the apparatus.

[0100] Figures 18A and 18B show an embodiment of the apparatus and its method of use that is substantially the same as that of Figure 7. The embodiment of Figures 18A and 18B differs from that of the Figure 7 embodiment in that the free ends 146,

148 of the length of suture 150 are tied in a knot completing the triangular loop configuration of the length of suture 150 at a location that is displaced from the portion of the suture 150 passed through the tissue 52 of the diaphragm crus. Apart from this, the method of using the apparatus of the invention shown in Figures 18A and 18B is substantially the same as that of the embodiment of the apparatus shown in Figure 7.

[0101] Figures 19A and 19B show a further embodiment of the apparatus and its method of use. The apparatus shown in these drawing figures is comprised of a length of cord 152 with a circular pledget 154 secured at one end of the cord and a needle, for example a keith needle 156, secured to the opposite end of the cord. The cord 152 could be a length of suture or other similar material. In the method of using the apparatus shown in Figures 19A and 19B, the needle 156 is first passed through the abdominal wall 42 and into the abdominal cavity 46. The needle 156 is then passed through the tissue 52 of the diaphragm crus. The needle 156 is then again passed through the abdominal wall 42 to the exterior of the abdomen and is pulled tight. This results in the length of cord 152 engaging against and moving the first internal organ away from the second internal organ in substantially the same manner as previously-described embodiments. The tight length of cord 152 is then secured in place by a clasp 158 attached to the length of cord 152 against the exterior of the abdominal wall 42.

[0102] Figures 20A and 20B show a representation of a further embodiment of the apparatus and its method of use. In Figure 20A, the apparatus is shown comprised of a length of cord 160 having a circular pledget 162 at one end and a needle, for

example a keith needle 164, at the opposite end. The apparatus also includes a second shorter length of cord 166 with a "T" bar 168 at one end and a loop 170 formed in the opposite end. In the embodiment, the cords 160, 166 may be suture or other similar materials. The method of using the apparatus is represented in Figure 20B. The "T" bar 168 is first secured to the tissue 52 of the diaphragm crus. The needle 164 is then passed through the tissue of the inner abdominal wall 42, through the loop 170 and then through the abdominal wall 42 to the exterior of the abdomen. Pulling the needle 164 on the exterior of the abdomen pulls the cord 160 tight across the internal organ to move and hold the internal organ in substantially the same manner as that of previously-described embodiments of the apparatus.

[0103] Figures 21A and 21B show a further embodiment of the apparatus that is substantially the same as that of the embodiment of Figures 20A and 20B, except that the needle 164 is removed from the end of the length of cord 160, leaving a free end 172 of the cord. The method of using this embodiment of the apparatus is substantially the same as that of the previously-described embodiment except for the step of passing the cord free end 172 through the abdominal wall 32. A GraNee needle (not shown) may be used to perform this step of the method.

[0104] Figures 22A and 22B show a further embodiment of the apparatus that is substantially the same as that of the previously-described embodiment, except that it is comprised of only the length of cord 160 having the circular pledget 162 at one end and a free end 172 of the cord at the opposite end. In the method of using this embodiment of the apparatus, the suture free end 172 is first passed through the inner abdominal wall 42, then through the tissue 52 of the diaphragm crus, and then

through and out of the abdominal wall 42. As in the previously-described embodiment, the suture free end 172 can be passed through the tissue of the abdominal wall 42 and the crus 52 using a GraNee needle or other similar instrument. The length of cord 160 is pulled tight to move and hold the first internal organ relative to the second internal organ in substantially the same manner as previously-described method embodiments of the apparatus.

[0105] Figure 23 shows a further embodiment of the apparatus that is substantially the same as that of earlier-described embodiments except for the first and second tissue connectors being "J" hook locking clasps 174, 176 that incorporate one-way clutch mechanisms. The ends of the cord segments 14, 22 can be pulled through the clutch mechanisms of the clasps 174, 176 in one direction, but are prevented by the clutch mechanisms from being pulled through the clasps 174, 176 in the opposite directions.

[0106] Figure 24A-24C show representations of a "J" hook locking clasp such as that shown in Figure 23, with a one-way clutch mechanism. The one-way clutch mechanism is comprised of a rotatable pulley 178 and a "V" shaped groove 180 positioned adjacent the pulley 178. An end portion of the cord 182 is threaded through the "V" shaped groove 180 and then around the pulley 178. When the end of the cord 182 extending from the pulley 178 is pulled tight, the relative positions of the pulley 178 and the groove 180 cause the portion of the cord 182 to wedge and become locked in the bottom of the groove 180.

[0107] Figure 25 shows a further representation of the embodiment of the apparatus employing a "J" hook locking clasp 184 with a one-way clutch mechanism.

The one-way clutch mechanism is comprised of a pair of pivoting cams 186, 188 having opposing ratchet tooth surfaces 190, 192. A portion of the apparatus cord 194 is threaded between the opposed tooth surfaces. The portion of cord 194 can be pulled through the spacing between the cam ratchet tooth surfaces 190, 192 in one direction, for example to the left in Figure 25, but the cams 186, 188 pivot toward each other and their ratchet tooth surfaces 190, 192 clamp the cord portion 194 between the surfaces when the cord portion is pulled in the opposite direction, for example to the right as shown in Figure 25.

[0108] Figure 26 shows a representation of a further embodiment of the “J” hook clasp 196 having a one-way clutch mechanism. In this embodiment, the one-way clutch mechanism is comprised of a toothed wheel 198 that engages with the cord portion 20 pulled through the claps 196. The tooth wheel 198 also has a smaller ratchet wheel 202 at its center. The ratchet wheel 202 engages against a resilient pawl 204. The ratchet wheel 202 and resilient pawl 204 function in the conventional manner allowing the toothed wheel 198 to rotate in one direction when the cord portion 200 is pulled through the clutch mechanism, for example to the right as shown in Figure 26, but prevent the rotation of the toothed wheel 198 and the movement of the cord portion 200 when the cord portion is pulled in the opposite direction, for example to the left as shown in Figure 26.

[0109] Figures 27-32 show several different representations of the possible constructions of the cord segments 14, 22, 38 of the apparatus of the invention. In Figures 27-32 the first and second tissue connectors are represented by needles, for example keith needles 80, 82. The third tissue connector is represented by a “T” bar

84. It should be understood that these are only examples of only three tissue connectors that could possibly be used with the apparatus of the invention, and that other forms of tissue connectors, for example the types described herein could be used as the three tissue connectors on the apparatus.

[0110] Figure 27 shows the first 14, second 22 and third 38 cord segments as being constructed of suture material.

[0111] Figure 28 shows the first 14 and second 22 cord segments being part of a single length of surgical tape or strap, and the third cord segment 38 being constructed of suture.

[0112] Figure 29 shows the first 14 and second 22 cord segments being constructed of lengths of suture inserted through lengths of surgical tubing. The third cord segment 38 is constructed of suture.

[0113] Figure 30 shows the apparatus as having first 14 and second 22 cord segments constructed of combinations of surgical tape and suture connected end to end. The third cord segment 38 is constructed of suture material.

[0114] Figure 31 shows the apparatus being constructed of first 14 and second 22 cord segments formed from a single length of suture material inserted through a single length of surgical tubing. The third cord segment 38 is constructed of suture material.

[0115] Figure 32 shows the apparatus as having the first 14 and second 22 cord segments constructed of a single continuous length of surgical tape having lengths of suture at opposite ends. The third cord segment 38 is constructed of suture material.

[0116] Figures 33-45 show examples of some of the various different types of tissue connectors that could be used as any one of the tissues connectors 32, 34, 36 of the apparatus. These are only some of the possible types of tissue connectors, and the connectors shown in Figures 33-45 should not be interpreted as limiting the apparatus to the particular tissue connectors shown.

[0117] Figure 33 shows a "T" bar 84 as one example of any one of the three tissue connectors 32, 34, 36.

[0118] Figure 34 shows a barbed needle 114 as any one of the three tissue connectors 32, 34, 36.

[0119] Figure 35 shows the two-piece rivet pin 126 and cap 130 connector that can be used as any one of the three tissue connectors 32, 34, 36.

[0120] Figure 36 shows the "J" hook locking clasp 112 that can be used as any one of the three tissue connectors 32, 34, 36.

[0121] Figure 37 shows the resilient, biased clasp 116 that could be used as any one of the three tissue connectors 32, 34, 36.

[0122] Figure 38 shows a cross-section of an embodiment of a "J" hook locking clasp. The embodiment shown is comprised of a cylindrical housing 206 that contains the "J" hook 208 and a coil spring 210 that biases the "J" hook 208 to its closed position.

[0123] Figures 39A-39C show a variation of the "J" hook locking clasp of Figure 38 where the coil spring 210 is replaced by a spiral band spring 212. Figure 39B shows the spiral and spring 212 in its extended configuration, and Figure 39C shows the spring in its compressed configuration.

[0124] Figures 40A and 40B show a tissue connector clasp that is comprised of a pair of resilient jaws 214, 216 that project from one end of a hollow housing 218, and a pin 220 connected to the jaws that projects from the opposite end of the housing. A spring 22 contained in the housing 218 biases the pin 220 and the jaws 214, 216 to the left as shown in Figure 40A. This causes the resilient jaws to move to their open position shown in Figure 40A. Pulling the pin 220 to the right against the bias of the spring 222 causes the housing to slide against the opposite sides of the jaws 214, 216 and move the jaws to their closed position.

[0125] Figure 41 shows a side view of the resilient biased clasp 116 described earlier. Compressing the opposite arms 118, 120 of the clasp 116 causes the jaws 122, 124 to separate. Releasing the compression force causes the jaws 122, 124 to move together under the bias of the resilience of the clasp 116.

[0126] Figure 42 shows an embodiment of a clasp comprised of a first jaw 224 and first arm 226 connected by a pivot connection 228 to a second jaw 230 and second arm 232. An oblong cam 234 on a toothed cam wheel 236 is positioned between the pair of arms 226, 232. A toothed actuator wheel 238 meshes with the toothed cam wheel 236. Rotation of the actuator wheel 238 will cause rotation of the cam wheel 236 and the cam 238. Rotation of the cam 234 to its position shown in Figure 42 pushes the pair of arms 226, 232 away from each other which in turn causes the pair of jaws 224, 230 to move toward each other. Rotation of the cam 234 90 degrees or one-quarter turn from its position shown in Figure 2 will cause the jaws 242, 230 to move away from each other.

[0127] Figure 43 shows an embodiment of a clasp comprised of a first jaw 240 and first arm 242 connected by a pivot connection 244 to a second jaw 246 and second arm 248. A spring 250 is positioned between the pair of arms 240, 248 and biases the arms away from each other. This in turn biases the first jaw 242 and second jaw 246 toward each other. The jaws 242, 246 are opened by applying a compression force to the opposite sides of the first arm 240 and second arm 248 that compresses the spring 250.

[0128] Figures 44A-44B show a side-sectioned view of a construction of the rivet assembly described earlier. As seen in the drawing figures, the pin head 128 is slightly larger in diameter than the cap hole 132. When the pin 126 is attached to the cap 130, there is a fixed gap or maximum distance between a circular head 252 of the pin 126 and the cap 130.

[0129] Figures 45A-45E show a further embodiment of a rivet assembly. In this assembly, the rivet pin 254 has several notches 256 along its length between the pin head 258 and the pin point 260. The rivet cap 262 is similar in construction to that of the previously-described embodiment with a center opening or hole 264 extending through the cap. However, the cap 262 is also formed with a transverse slot 266 that intersects the center hole 264 and a parallel slot 268 that extends into the cap 262 parallel to the center hole 264 and intersects the transverse slot 266. A locking tab 270 with a pin hole 272 and a spring hole 274 is inserted in the transverse slot 266 for sliding movement therein. A resilient wire spring 276 is inserted downwardly into the parallel slot 268 and through the tab pin hole 272. Inserting the rivet pin 254 into the cap center hole 264 and through the tab pin hole 272 causes the pin to slide the

tab to the left as shown in Figure 45A against the bias of the wire spring 276. As a pin notch 256 passes through the tab hole 272, the bias of the spring 276 causes the tab 270 to move to the right and into the notch 256. This locks the pin 254 in place relative to the cap 262. With the pin 254 having a number of notches, and in the example of Figure 45A having three notches, the position of the pin head 258 relative to the cap 262 can be adjusted between three positions. This provides an adjustable gap or an adjustable distance between the pin head 258 and the cap 262.

[0130] Figures 46A-46E represent a further embodiment of the apparatus of the invention. This embodiment is comprised of a length of cord 278 having a needle 280 at one end and a loop 282 formed at the opposite end. A circular pledget 284 is provided on the length of cord 278 toward the loop end of the cord. The apparatus also includes a locking collar having a hollow cylindrical housing 286 that contains a tubular one-way suture lock 288. The suture lock 288 is basically cylindrical but is formed with a resilient tab 290 that projects toward the center of the cylindrical configuration of the suture lock. Figure 46E shows a cross-section representation of the collar cylindrical housing 286 containing the one-way suture lock 288 and a portion of the length of cord 278 extending through the collar. The method of using this embodiment of the apparatus is shown in Figure 46C. In use in the abdominal cavity 46, the needle 280 is first passed through the tissue 52 in the area of the diaphragm crus, and then is passed a first time through the inner abdominal wall 42. The needle 280 is then moved across the inner abdominal wall 42 and is again passed a second time through the inner abdominal wall. The needle is then inserted through the loop 282 and is pulled tight. This causes the length of cord 278 to form a

triangular loop in the abdominal cavity that moves the first internal organ away from the second internal organ and holds the first internal organ in the displaced position in the same manner as previously-described methods of using the apparatus of the invention. The needle 280 is then passed through the collar cylindrical housing 286 and the housing 286 is moved tight against the cord loop 282. The cord loop 282 is smaller than the housing 286 so that the housing cannot pass through the loop 282. As the length of cord 278 is pulled through the collar housing 286, the locking tab 290 engages against the side of the cord 278 as shown in Figure 46E. This allows the cord 278 to move through the collar housing 286 in the direction to the right shown in Figure 46E, but prevents movement of the cord to the left as shown in the figure. In this manner, the apparatus of Figures 46A-46E holds the length of cord tight in its triangular loop configuration.

[0131] Figures 47A and 47B show a further embodiment of the apparatus of the invention and its method of use. The apparatus is comprised of a length of cord 294 having a pledget 296 secured at one end and a needle 298 secured at the opposite end. The apparatus also includes a one-way locking mechanism 300 having a pair of channels 302, 304 through the mechanism dimensioned to receive the length of cord 294. One of the channels 302 allows the length of cord 294 to move through the channel in one direction, but prevents the opposite direction of movement. The other channel 304 allows the length of cord 294 to move through the channel in one direction, but also prevents the opposite direction of movement of the cord 294. As represented in Figure 47A, the method of using the apparatus first involves the needle 298 passing through the inner abdominal wall until the pledget 296 is

positioned up against the wall. The needle 298 then passes through the tissue 52 in the area of the diaphragm crus. The needle 298 is then inserted through the first channel 302 of the one-way locking mechanism 300. The needle 298 is then against passed through the inner abdominal wall at a location spaced from the first insertion site and is then passed through the second channel 304 of the one-way locking mechanism 300. The needle 298 with the length of cord 294 are then pulled tight and the locking mechanism 300 is moved up against the inner abdominal wall at the second needle insertion site. This causes the length of cord 294 to move the first internal organ and hold the first internal organ in its moved position away from the second internal organ in a similar manner to that of earlier-described embodiments.

[0132] Figures 47C and 47D show the interior of one embodiment of the one-way locking mechanism 300. The mechanism 300 includes a housing first half 306 and a second half 308 that are connected together by a living hinge 310. The open position of the locking mechanism is shown in Figure 47D. The interior of the two halves 306, 308 of the locking mechanism are formed with grooves 312, 314 that form the two channels 302, 304 through the locking mechanism when the two halves 306, 308 of the locking mechanism are pivoted about the living hinge 310 and snapped together. A "U" shaped spring member 316 is positioned in the first locking mechanism half 306. The spring member 316 has a pair of arms 318, 320 that project from opposite sides of the spring member. Each arm 318, 320 in turn has a resilient locking tab 322, 324 that projects outwardly at an angle from its respective arm 318, 320. The resilient tabs 322, 324 are positioned to engage in sliding engagement along portions of the cord 294 that pass through the channels 302, 304.

As shown in Figure 47D, the one tab 322 will allow the cord 294 to slide across the tab in a direction from right to left as shown in the drawing figure, but will prevent the reverse sliding movement of the cord. The other tab 324 will allow sliding movement of the cord 294 across the tab 324 in a left to right direction as shown in Figure 47D, but will prevent the reverse movement of the length of cord 294.

[0133] Figures 48A-48D show a variant embodiment of the one-way locking mechanism 300. As shown in Figure 48A, the length of cord is passed through the locking mechanism 328 in much the same manner as the earlier-described locking mechanism 300. However, the second channel 330 of the locking mechanism 328 of Figure 48A has a block 332 with a hole 334 positioned along the channel. An inclined tooth 336 is positioned in the block hole 334. The portion of the cord length 338 that extends through the locking mechanism channel 330 also extends through the block hole 334. A spring 340 in the locking mechanism 328 biases the block 332 and the tooth 336 toward the portion of cord 338 extending through the locking mechanism channel 330. Due to the inclination of the tooth 336, with the spring 340 biasing the tooth 336 into engagement with the cord portion 338, the cord portion 338 can slide over the tooth 336 as it is moved in a left to right direction as shown in Figure 48C, but is prevented from moving in the opposite direction. Pressing the block 332 into the locking mechanism 328 against the bias of the spring 340 disengages the tooth 336 from the cord portion 338 and permits the cord portion to move in either direction through the locking mechanism 328.

[0134] Figures 49A and 49B show a further embodiment of a cord locking mechanism 344 that is similar to that of Figure 48A. A cross-section of a channel

346 extending through the locking mechanism 344 is shown in Figure 49A. The channel 346 is formed with pairs of ridges 348, 350 on opposite sides of the channel. A wave form spring 352 is positioned in the channel 346. The spring 352 has grooves 354 formed through peaks formed in the wave form spring. The portion of the cord 356 passing through the locking mechanism channel 346 also passes through the grooves 354 in the wave form spring 352. A button hole 358 is provided in the top of the cord locking mechanism 344 and a release button 360 is positioned in the hole. When the release button 360 is pressed in the hole 358, it engages with the wave form spring 352 and compresses the spring to the position shown in Figure 49A. In this position of the spring 352 the cord 356 is free to move in opposite directions through the locking mechanism 344. When the button 360 is released, the spring 352 moves upwardly from its position shown in Figure 49A and portions of the spring 362 engage with the cord portion 356 extending through the lock mechanism channel 346 and hold the cord portion against the ridges 348 at the top of the channel 346. This locks the cord portion 356 in the locking mechanism 344.

[0135] Figures 50A and 50B show a further embodiment of a one-way cord locking mechanism. The mechanism includes a housing 364 having a hole 366 extending through the housing that is defined by a cone-shaped interior surface 368. A pair of lock members 370, 372 are positioned in the housing hole 366. Each of the lock members 370, 372 have exterior surfaces 374, 376 that when the locking members are positioned together, define a truncated cone shape that fits within the cone-shaped interior surface 368 of the housing 364. The opposing interior surfaces 378, 380 of the lock members 370, 372 are formed with mating peaks and valleys. As

shown in Figure 50B, a spring 382 biases the two lock members 370, 372 into the cone-shaped interior surface 368 of the housing 364, thereby causing the lock member interior surfaces 378, 380 to move toward each other. A portion of a cord length 384 extending through the opposing interior surfaces 378, 380 of the lock members 370, 372 is prevented from moving in the upward direction as shown in Figure 50B due to the bias of the spring 382. However, when the cord portion 384 is moved in the opposite downward direction as shown in Figure 50B, the movement of the cord portion 384 causes the lock members 370, 372 to compress the spring 382. This allows the lock member interior surfaces 378, 380 to move away from each other and release the portion of the cord 384 for movement through the lock mechanism.

[0136] Figures 51A-51E show one method of inserting the apparatus of the invention into the tubular insertion device 86 described earlier. As shown in these drawing figures, a length of suture 386 is looped around the apparatus and is then pulled through the interior of the insertion device 86. The first 14 and second 22 cord segments are folded flat against each other and the additional cord segment 38 is folded over parallel with the first cord segment 14 and second cord segment 22. The apparatus is then pulled by the suture loop 386 into the interior of the insertion device 86 to the position shown in Figure 51E.

[0137] Figures 52A and 52B show a further embodiment of an insertion device 390. The insertion device 390 has the configuration of an elongate narrow rod with a pair of opposed grooves 392, 394 extending up one side of the rod from a distal end 396 of the rod. A third groove 398 is formed in a side of the rod toward a proximal end of

the rod. The third groove 398 is positioned between the opposed pair of grooves 392, 394. According to the method of using the insertion device 390, the first cord segment 14 and second cord segment 22 of the apparatus 12 are positioned in the opposed pair of grooves 392, 394 that extend from the insertion device distal end 396. The additional cord segment 38 of the apparatus 12 is positioned in the third groove 398 in the side of the rod. With the cords of the apparatus held in these grooves, the insertion device 390 is then inserted through a cannula 44 to insert the apparatus 12 into the abdominal cavity.

[0138] Figure 53 shows a representation of a further embodiment of the insertion device 402 that is similar in construction to the previously-described embodiment of the insertion device 390. The insertion device 402 of Figure 54 is also comprised of a pair of opposed grooves 404, 406 that receive the first 14 and second 22 cord segments of the apparatus 12, and a third groove 408 that receives the additional cord segment 38 of the apparatus.

[0139] Figure 54 shows a still further embodiment of an insertion device 410. The insertion device 410 has a rod-shaped length with a hollow distal end. The rod distal end is comprised of a first half 412 and a second half 414 that are connected together by a living hinge assembly 416. According to the method of using the insertion device 410 of Figure 54, the apparatus 12 is positioned in the interior of the first half 412 with the first cord segment 14 and second cord segment 22 extending parallel to each other, and the third cord segment 38 folded over the first cord segment 14 and second cord segment 22. The second half 414 of the insertion

device is then folded over the hinge assembly 416 and snapped closed to prepare the insertion device 410 for insertion of the apparatus 12.

[0140] Figures 55A-55C show a mesh apparatus 420 that is designed to be used as a part of the apparatus of the invention. The mesh apparatus 420 is basically comprised of a generally rectangular or trapezoidal-shaped panel of surgical mesh 422 with a pair of axially aligned tubes 424 at one side and a pair of axially aligned tubes 426 at the opposite side. As shown in Figure 55B, the mesh apparatus 420 can be rolled up around the pairs of tubes 424, 426 to reduce the size of the apparatus for insertion through a cannula and into the abdominal cavity. Figure 55C shows the mesh apparatus 420 positioned in the abdominal cavity 46 and held in place against the first internal organ 48 by one of the previously-described embodiments of the apparatus. It should be understood that any of the previously-described embodiments of the apparatus may be employed according to the method of the invention to hold the surgical mesh 420 in its position as shown in Figure 55C.

[0141] As various modifications could be made in the constructions of the apparatus and the methods herein described and illustrated without departing from the scope of the invention, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative rather than limiting. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims appended hereto and their equivalents.

What is Claimed Is:

1. An apparatus for intra-abdominally moving a first internal organ to a position away from a second internal organ and then holding the first internal organ in the position without manual input, the apparatus comprising:

a cord having a flexible length with opposite first and second ends;

a first tissue connector attached to the cord first end;

a second tissue connector attached to the cord second end; and

a third tissue connector attached to the cord at an intermediate position of the cord between the cord first and second ends;

the first, second and third tissue connectors each being intra-abdominally connectable to intra-abdominal tissue to position the cord in engagement with the first internal organ whereby the cord moves the first internal organ to the position away from the second internal organ and the cord holds the first internal organ in the displaced position.

2. The apparatus of Claim 1, further comprising: the first, second and third tissue connectors each being removably connectable to intra-abdominal tissue.

3. The apparatus of Claim 1, further comprising: the cord being a single continuous cord that extends between the first and second tissue connectors.

4. The apparatus of Claim 1, further comprising: the cord being comprised of a plurality of distinct cord segments connected end to end.

5. The apparatus of Claim 1, further comprising: the cord having a configuration of a strip.

6. The apparatus of Claim 1, further comprising: the cord being elastic.

7. The apparatus of Claim 1, further comprising: the cord being branchless.

8. An apparatus for moving a first internal organ tissue to a position away from a second internal organ and then holding the first internal organ tissue at the position without manual input, the apparatus comprising:

a first cord segment having a flexible length with opposite ends;

a second cord segment having a flexible length with opposite ends;

a first tissue connector;

a second tissue connector;

a third tissue connector;

the first and third tissue connectors being attached to the opposite ends of the first cord segment and the second and third tissue connectors being attached to the opposite ends of the second cord segment; and

the first, second and third tissue connectors each being removably connectable to intra-abdominal tissue.

9. The apparatus of Claim 8, further comprising: the first and second cord segments being continuous cord segments with an end of the first cord segment being attached to an end of the second cord segment.

10. The apparatus of Claim 8, further comprising: the first and second cord segments each having a configuration of a strip.

11. The apparatus of Claim 8, further comprising: the first and second cord segments being elastic.

12. The apparatus of Claim 8, further comprising: the first and second cord segments each being branchless.

13. A method of intra-abdominally moving a first internal to a position away from a second internal organ and then holding the first internal organ at the position without manual input, the method comprising:

providing a first cord segment having a flexible length with opposite ends and a second cord segment having a flexible length with opposite ends;

inserting the first and second cord segments through an abdominal wall and into an abdominal cavity containing the first and second internal organs;

connecting one end of the first cord segment to tissue adjacent the first internal organ and on an opposite side of the first internal organ from the abdominal wall and connecting the other end of the first cord segment to the abdominal wall with the length of the first cord segment engaging across and moving the first internal organ toward the position away from the second internal organ;

connecting one end of the second cord segment to tissue adjacent the first internal organ and on an opposite side of the first internal organ from the abdominal wall and connecting the other end of the second cord segment to the abdominal wall with the length of the second cord segment engaging across and moving the first internal organ toward the position away from the second internal organ;

whereby the first and second cord segments engaging across the first internal organ hold the first internal organ at the position away from the second internal organ without manual input.

14. The method of Claim 13, further comprising: the first internal organ being a human liver and the second internal organ being a human stomach.

15. The method of Claim 13, further comprising: providing the first and second cord segments as parts of a single cord with the one end of the first cord segment being connected to the one end of the second cord segment.

16. The method of Claim 13, further comprising:

providing the first and second cord segments as parts of a single cord with the other end of the first cord segment being attached to the other end of the second cord segment by a third cord segment having a flexible length that extends between the other ends of the first and second cord segments.

17. The method of Claim 16, further comprising: attaching the one end of the first cord segment to the one end of the second cord segment by tying a knot between the one end of the first cord segment and the one end of the second cord segment.

18. The method of Claim 13, further comprising: providing a tissue connector at the one end of the first cord segment and the one end of the second cord segment and using the tissue connector to connect both the one end of the first cord segment and the one end of the second cord segment to the tissue.

19. The method of Claim 18, further comprising: providing a further tissue connector at the other end of the first cord segment and using the further tissue connector to connect the other end of the first cord segment to the abdominal wall.

20. The method of Claim 19, further comprising: providing a still further tissue connector at the other end of the second cord segment and using the still further tissue connector to connect the other end of the second cord segment to the abdominal wall.

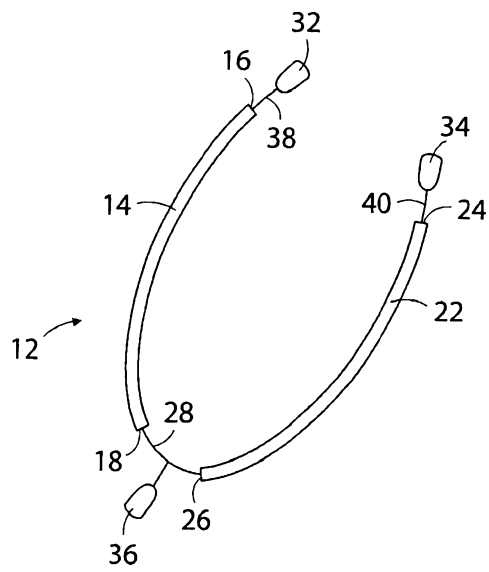


FIG. 1

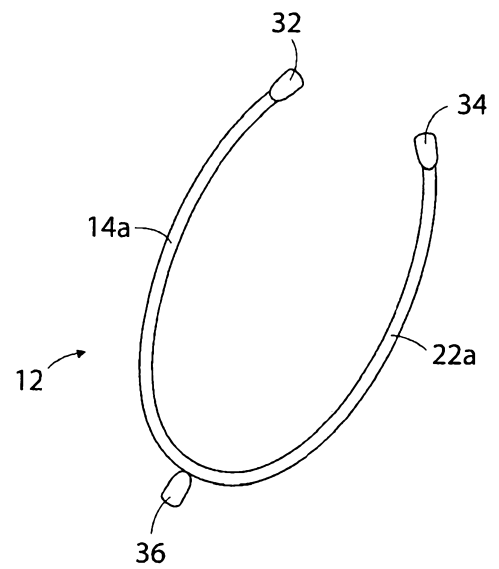


FIG. 2

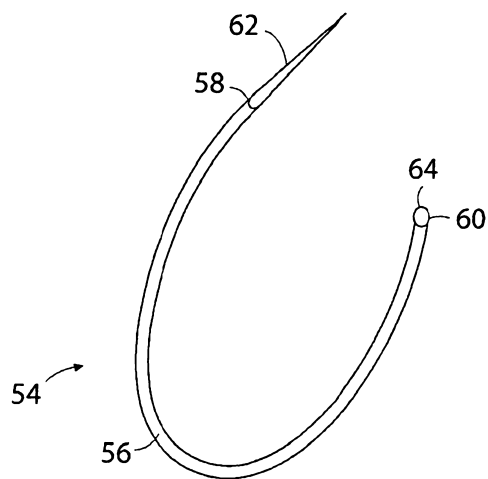


FIG. 3

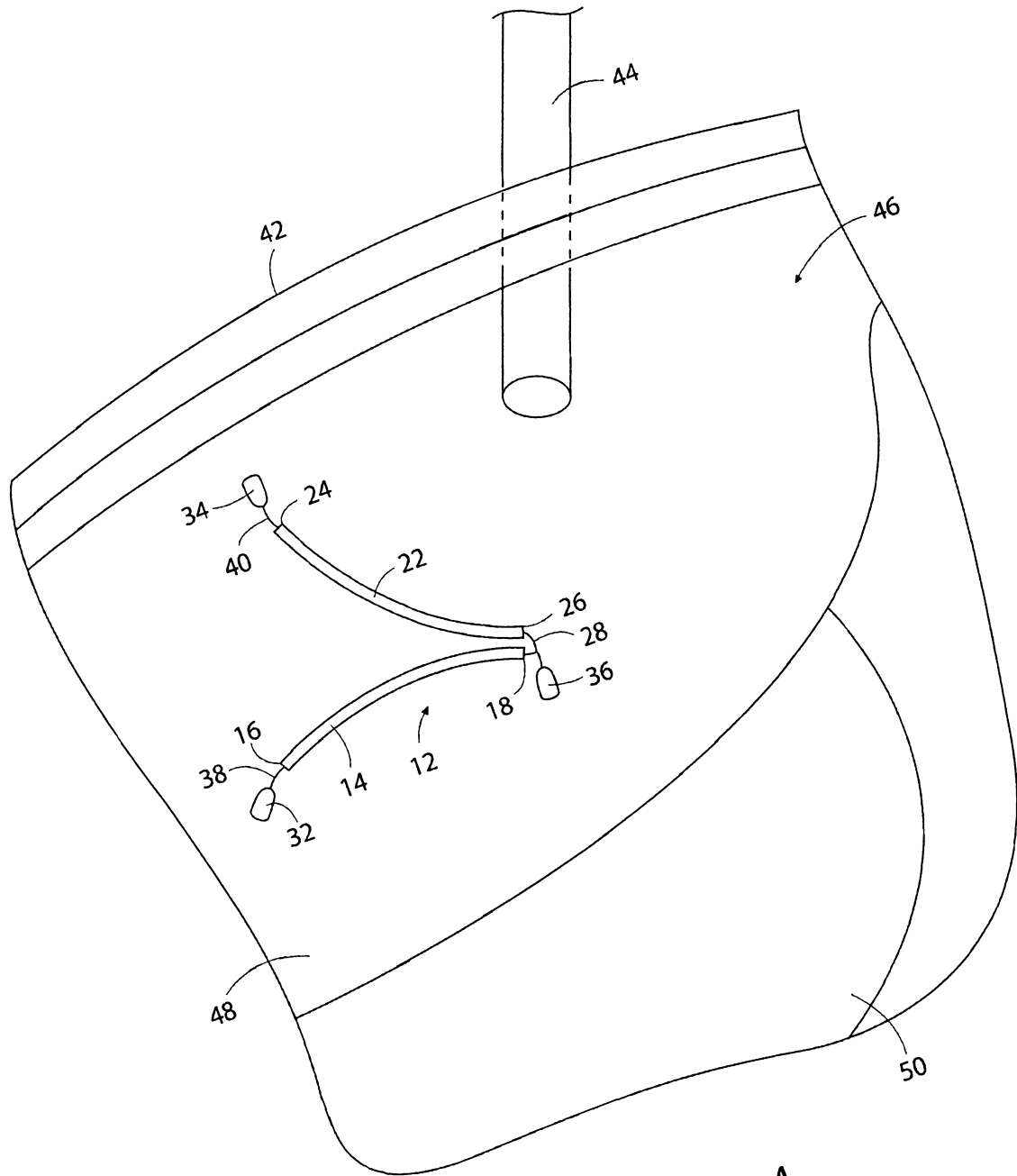


FIG. 4

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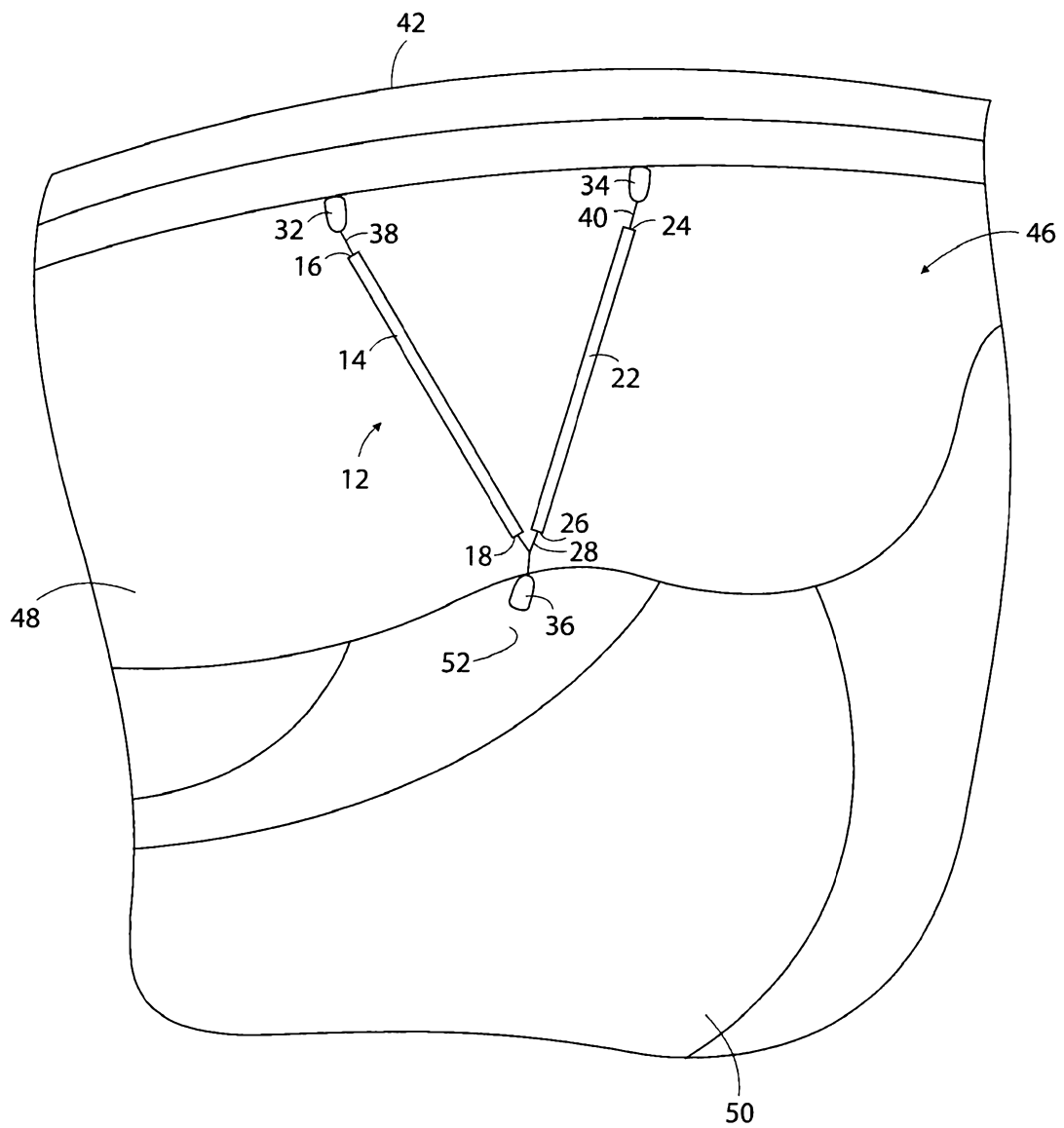


FIG. 5

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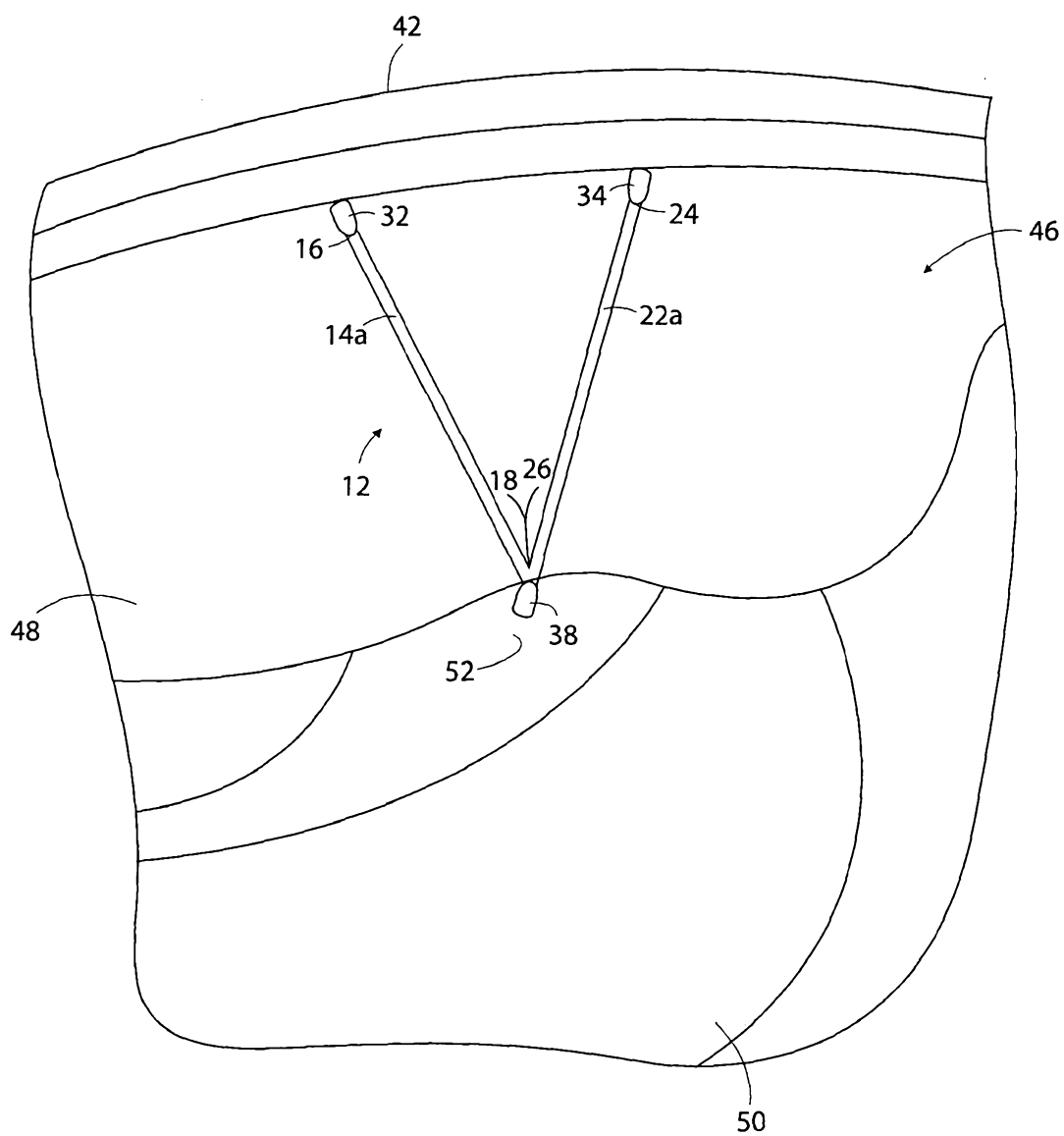


FIG. 6

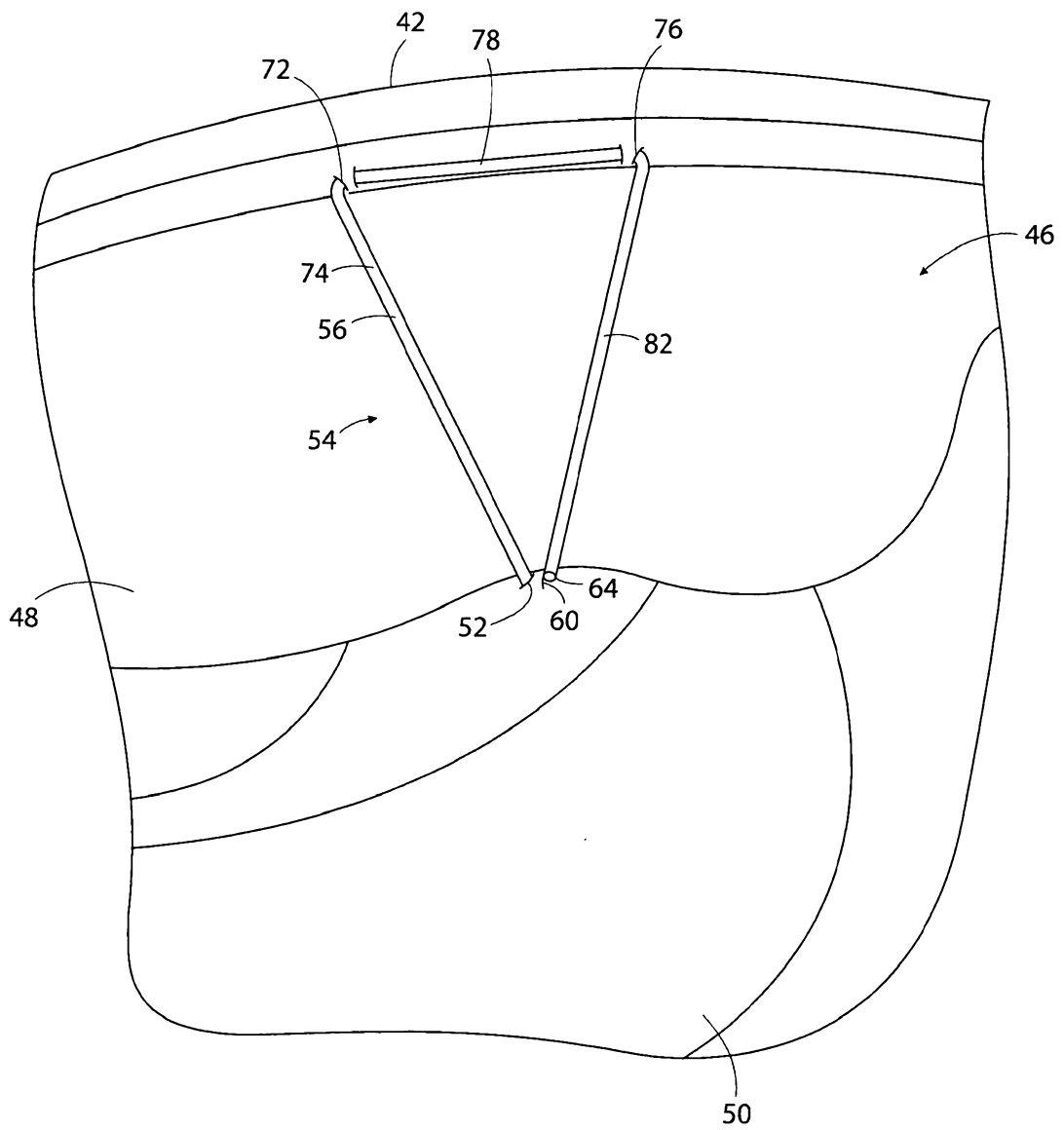
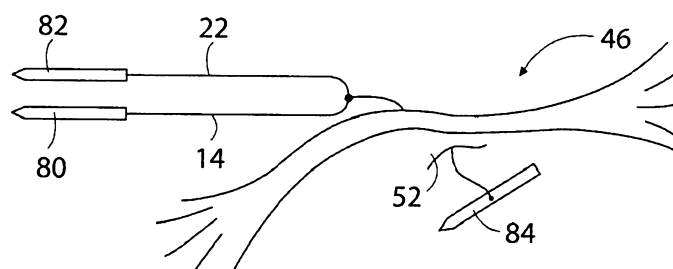
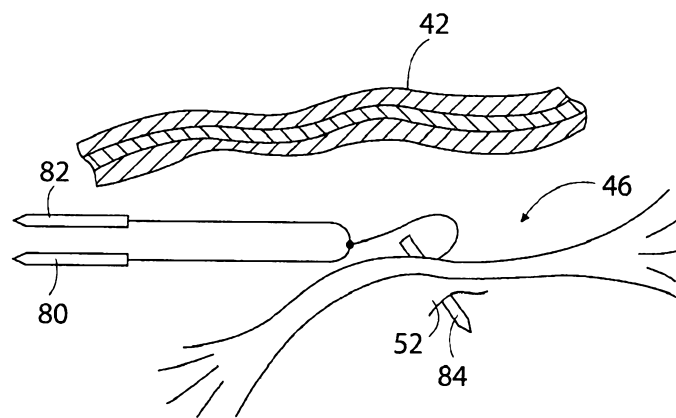
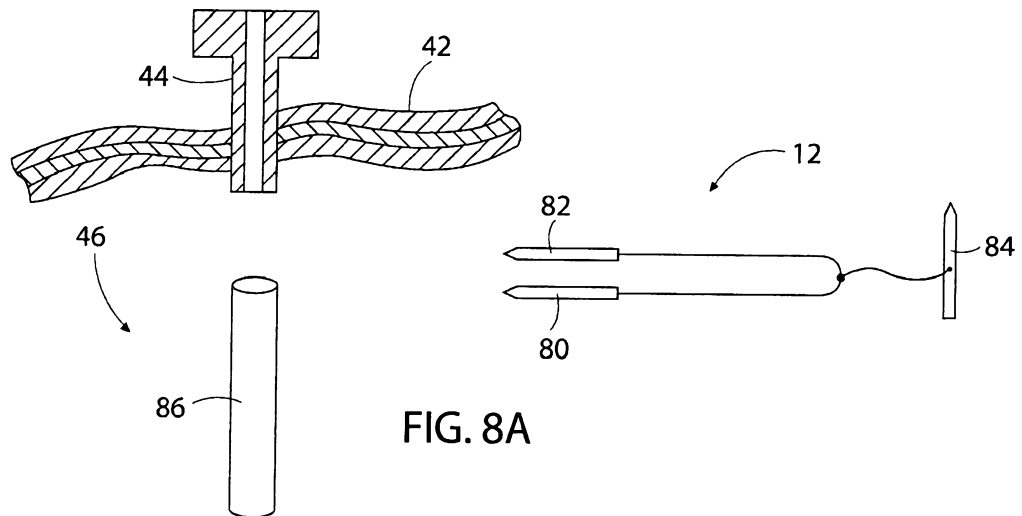


FIG. 7

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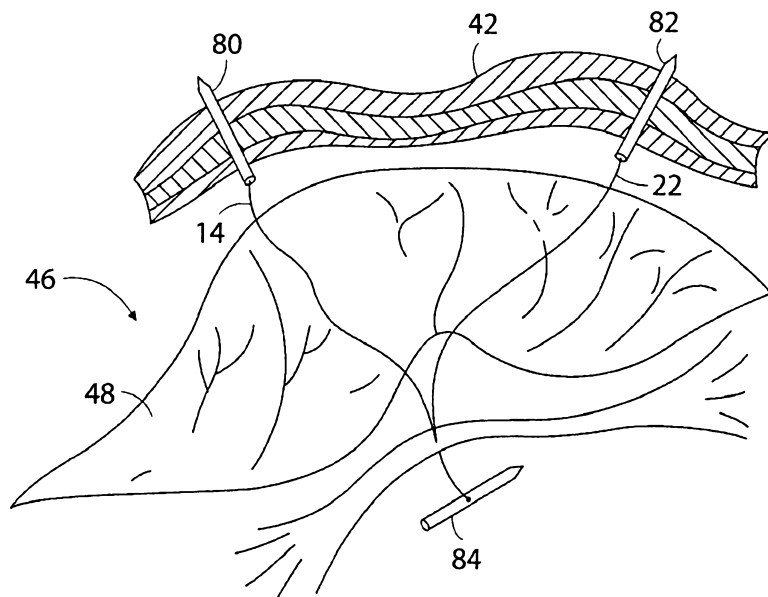


FIG. 8D

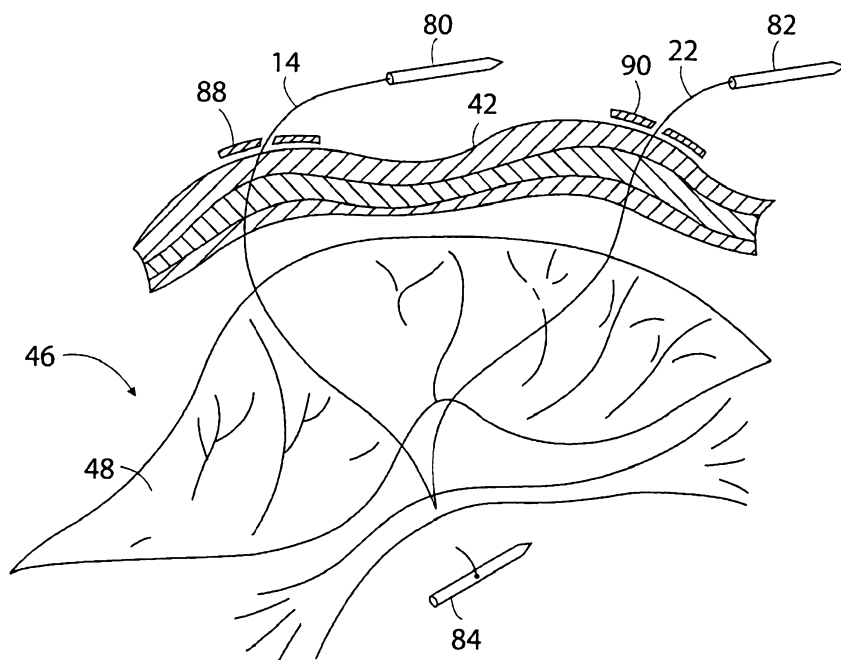
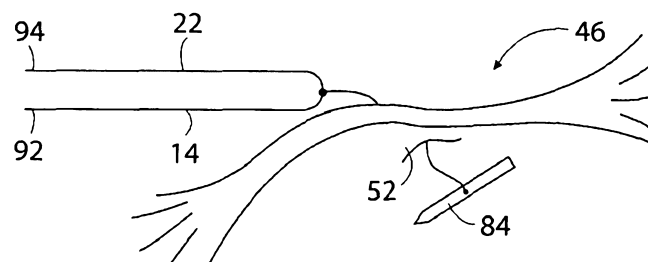
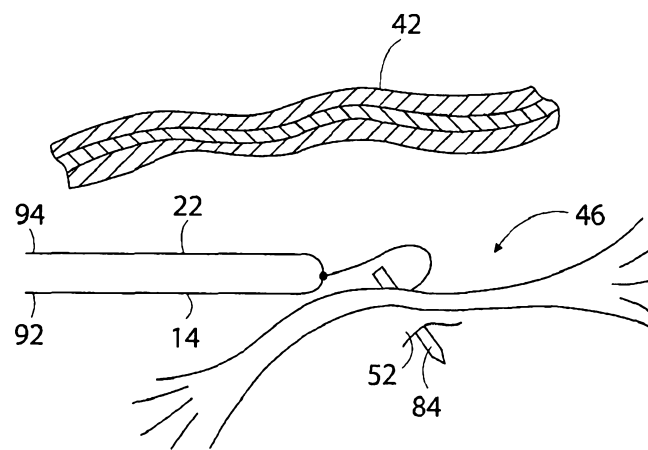
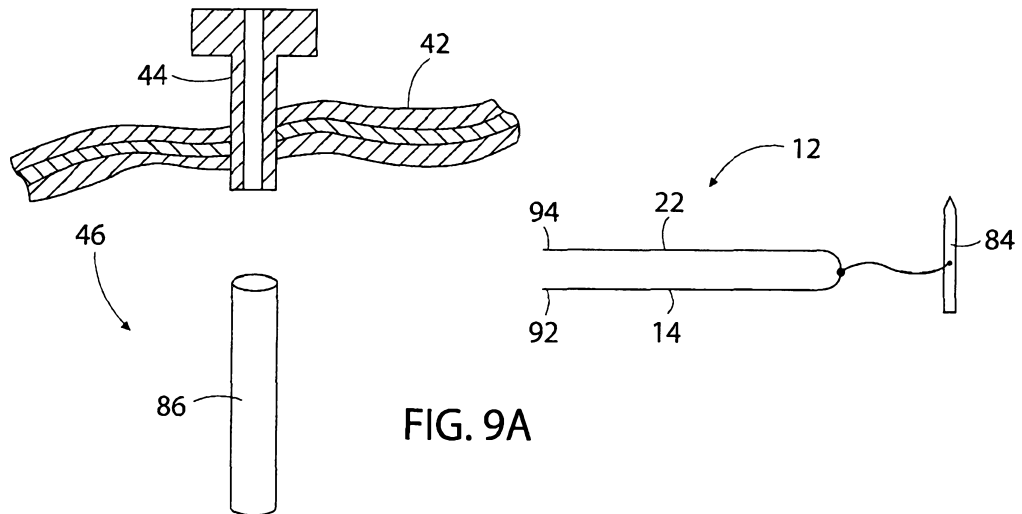


FIG. 8E

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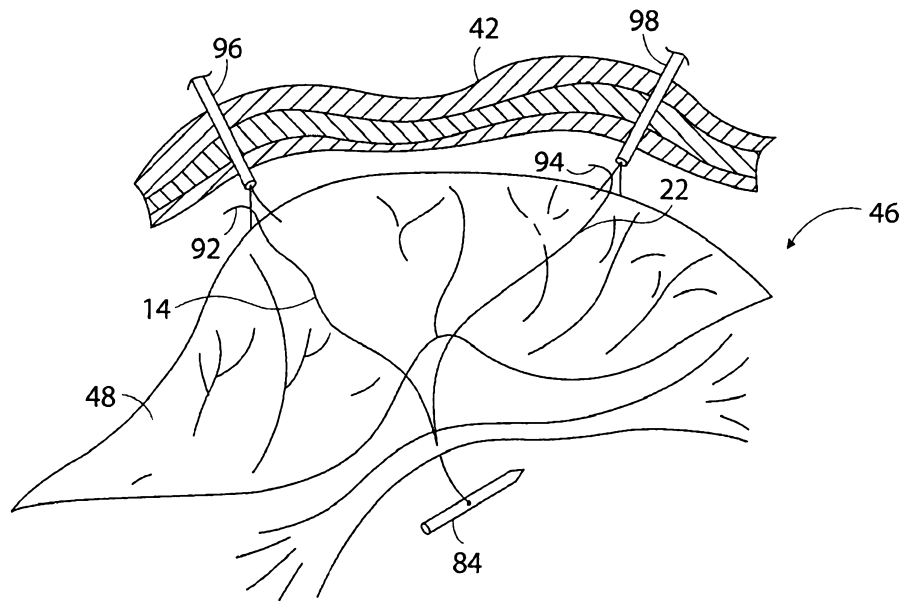


FIG. 9D

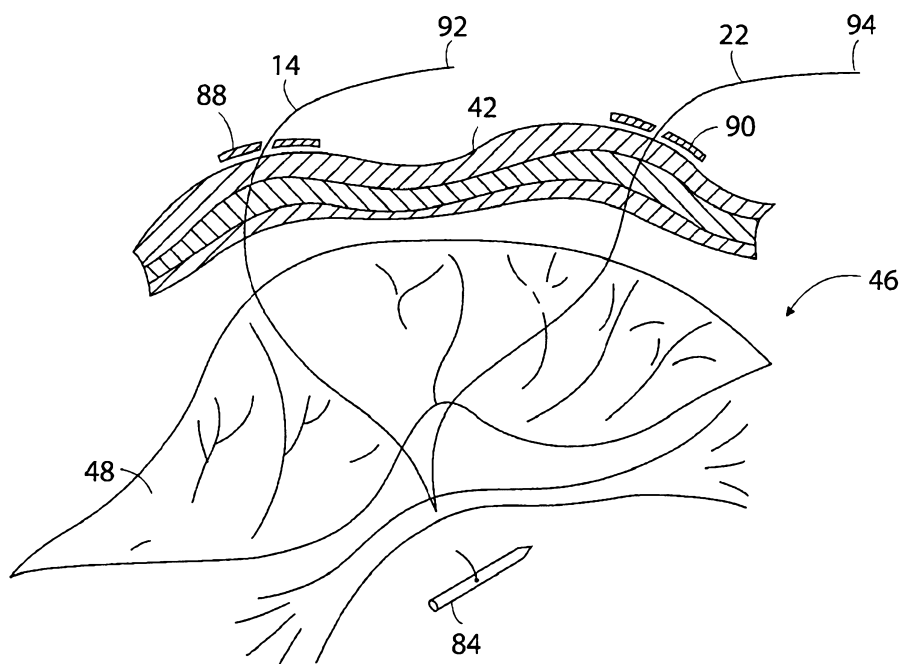


FIG. 9E

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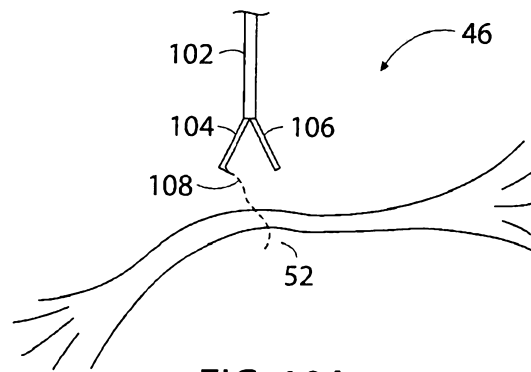
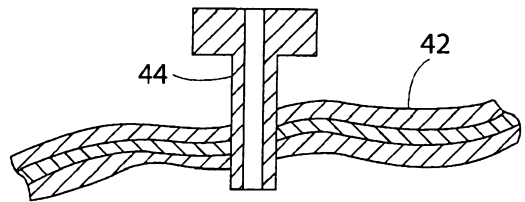


FIG. 10A

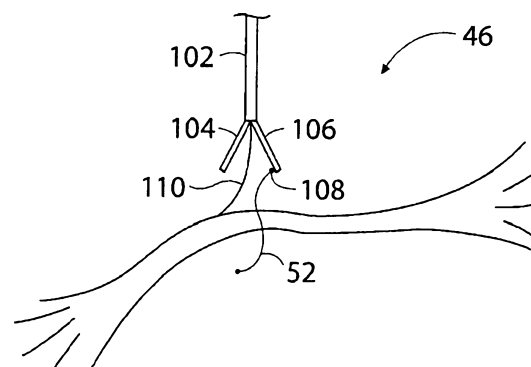
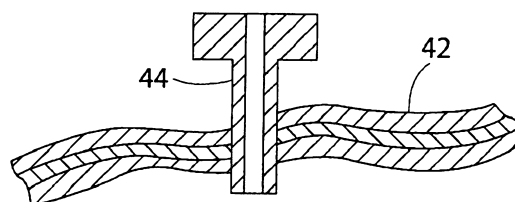


FIG. 10B

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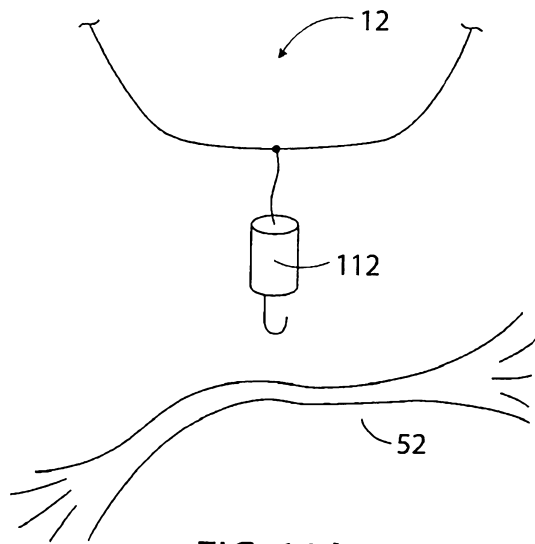


FIG. 11A

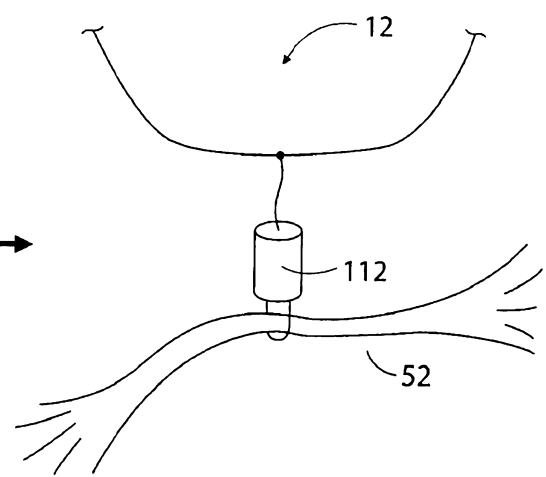


FIG. 11B

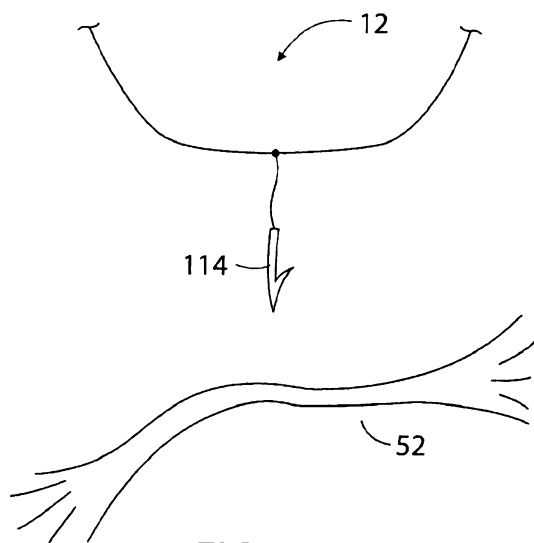


FIG. 12A

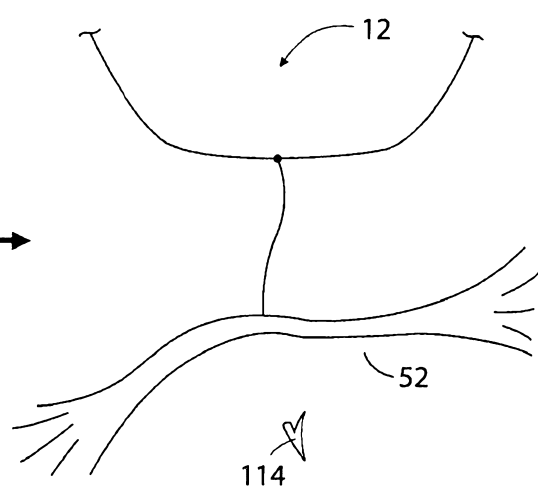
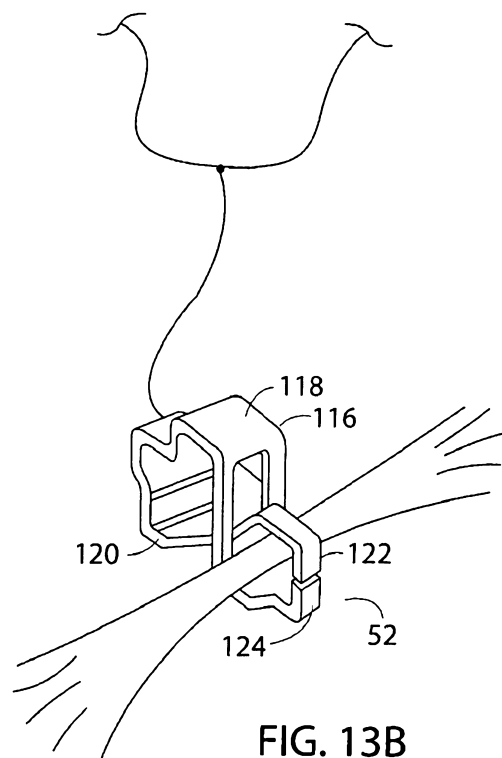
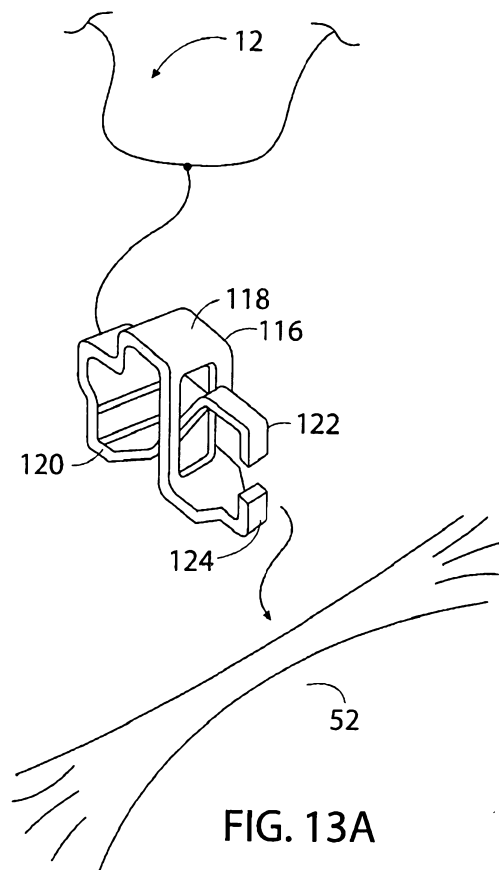
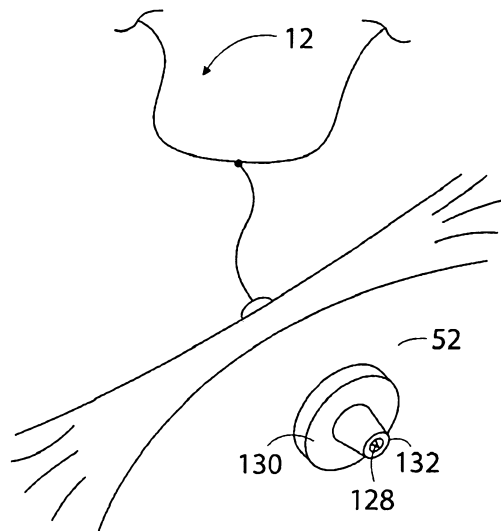
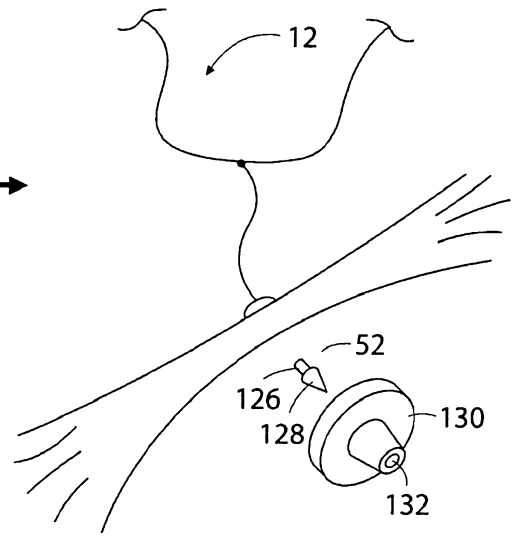
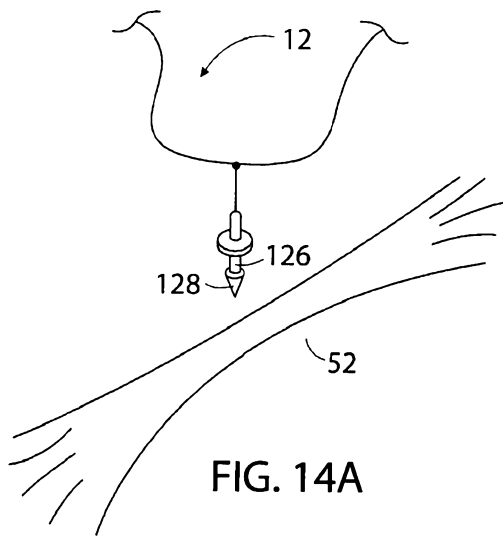


FIG. 12B

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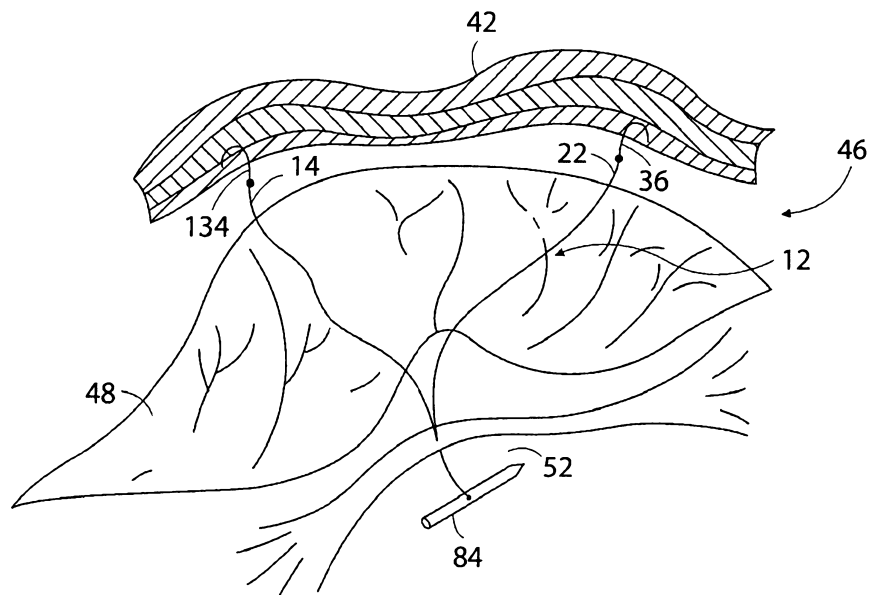


FIG. 15B

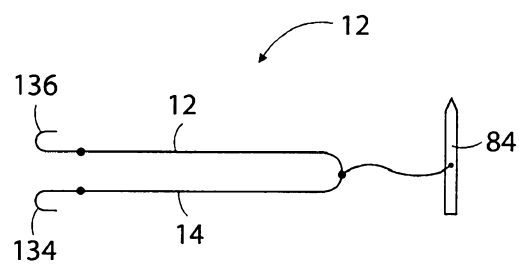


FIG. 15A

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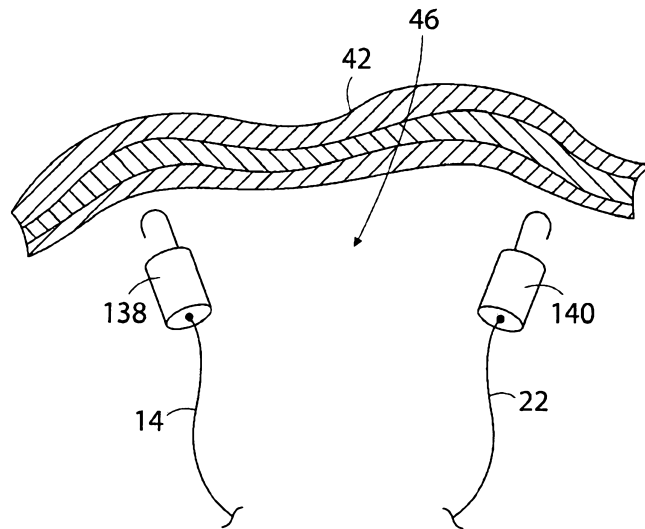


FIG. 16A

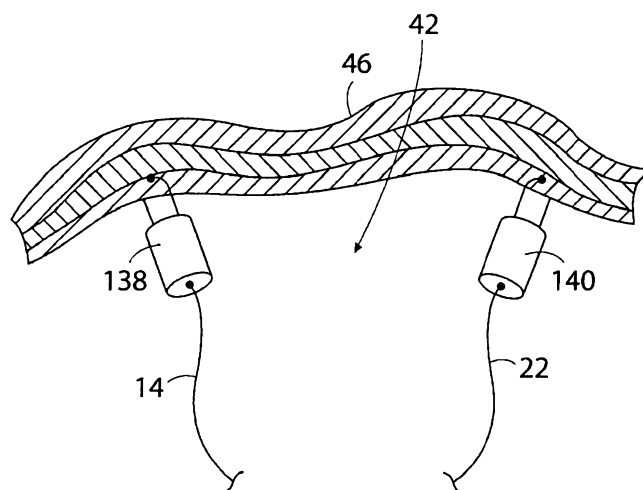


FIG. 16B

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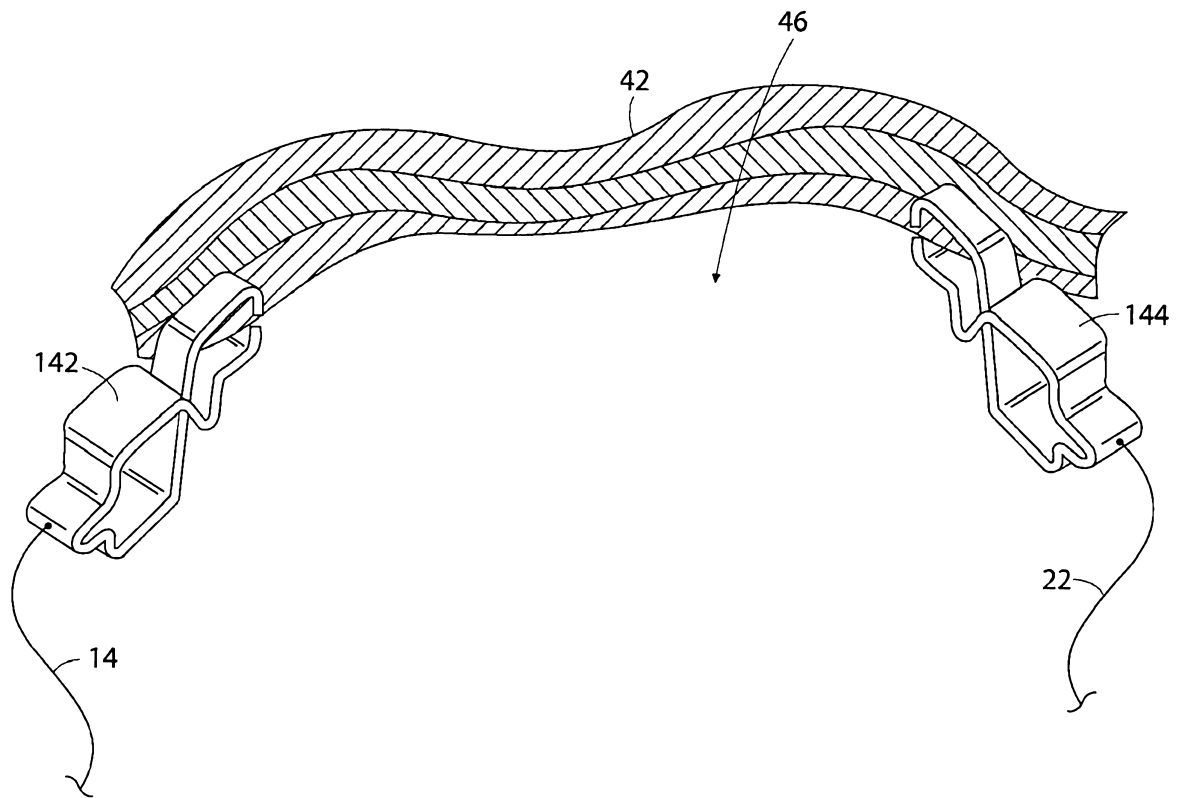


FIG. 17

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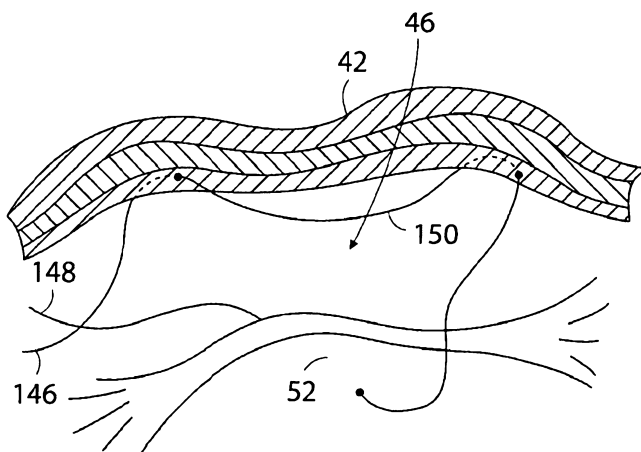


FIG. 18A

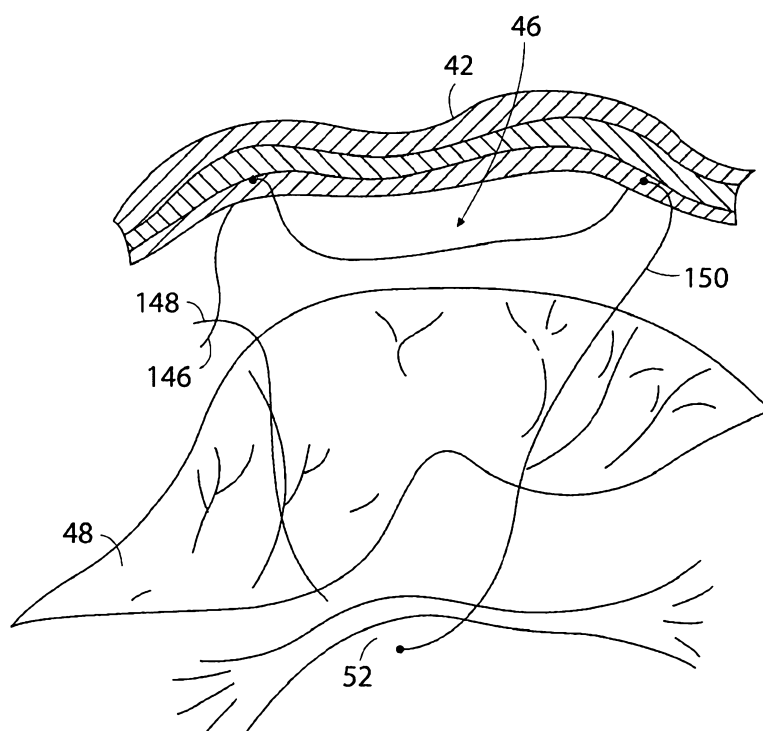
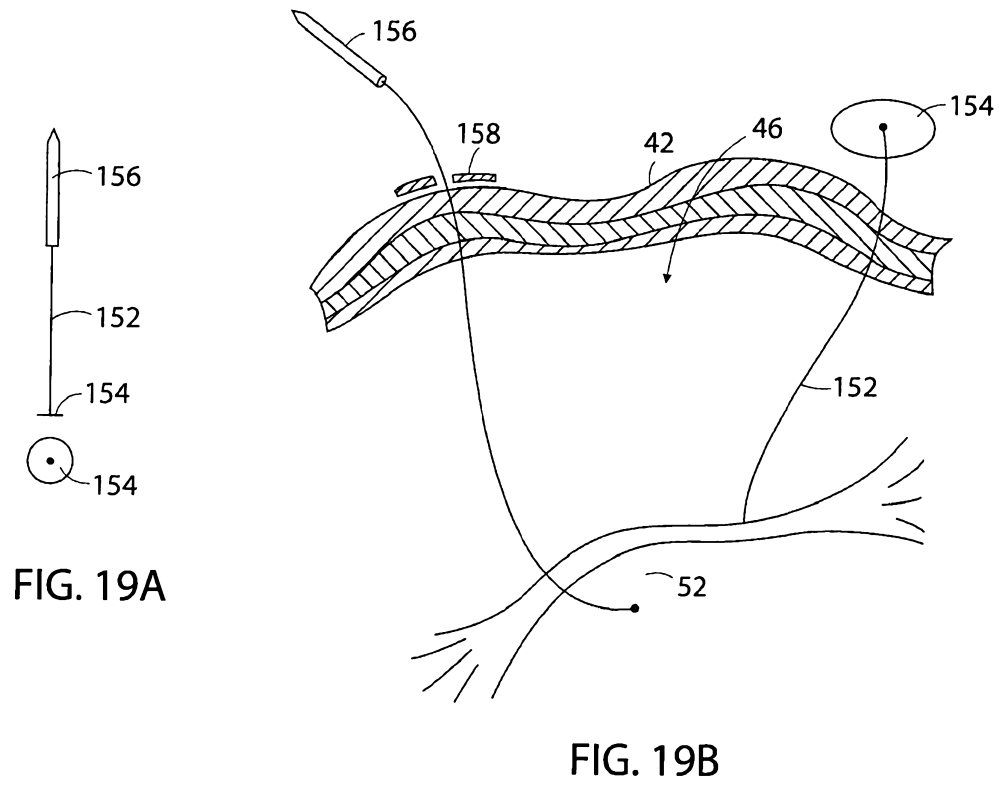


FIG. 18B



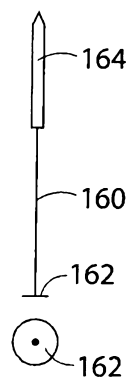


FIG. 20A

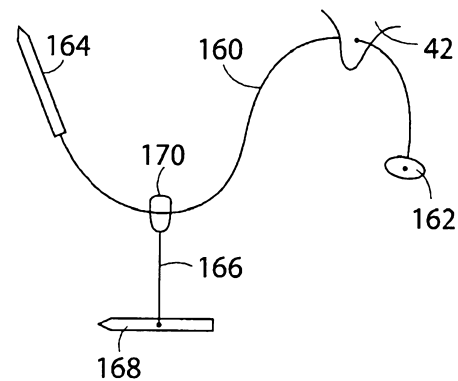
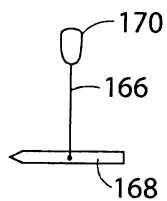


FIG. 20B

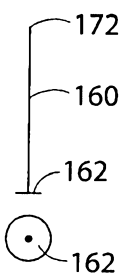


FIG. 21A

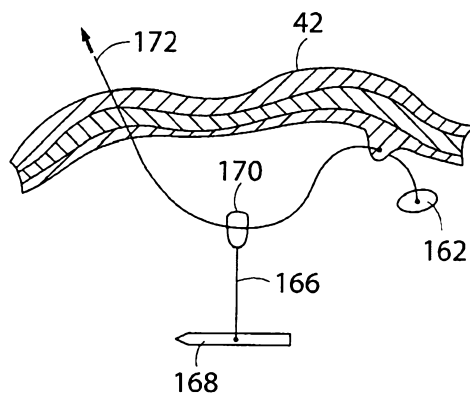
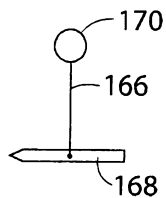


FIG. 21B

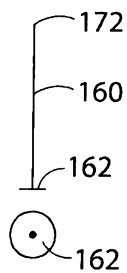


FIG. 22A

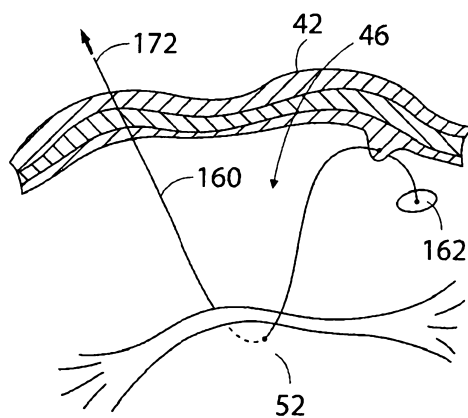


FIG. 22B

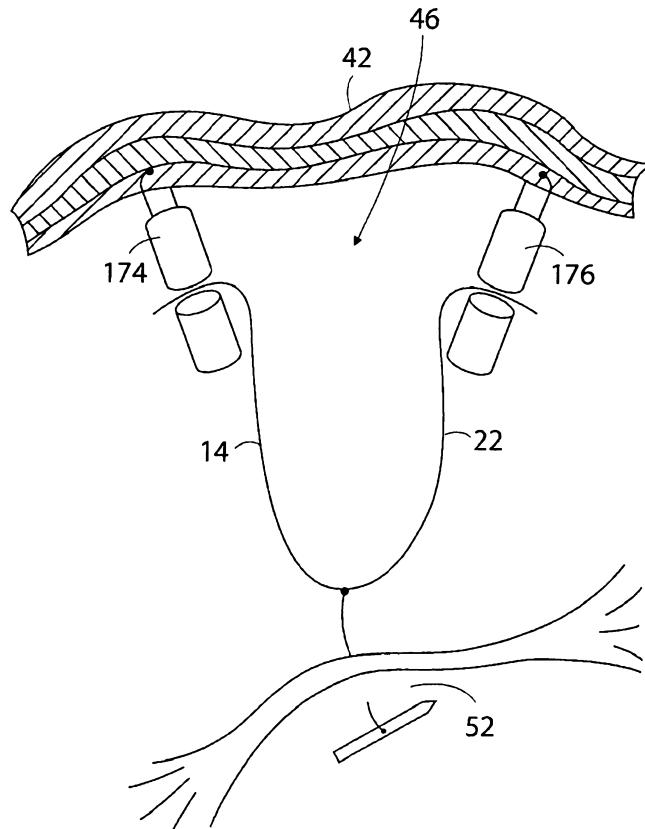


FIG. 23

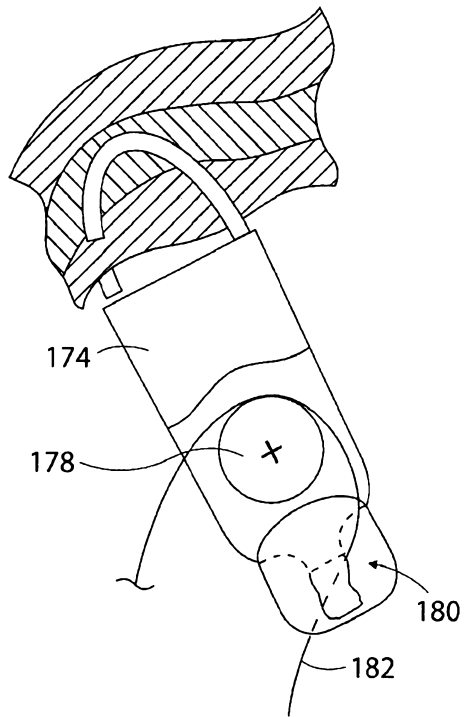


FIG. 24A

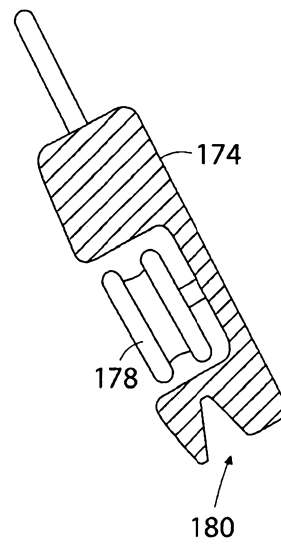


FIG. 24B

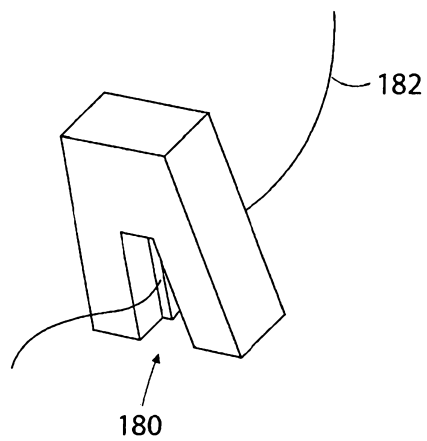


FIG. 24C

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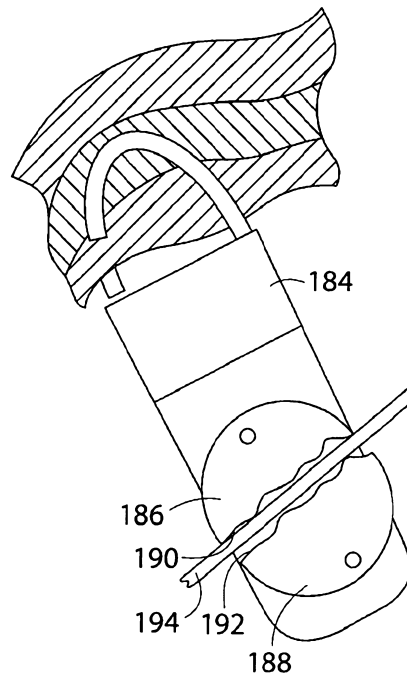


FIG. 25

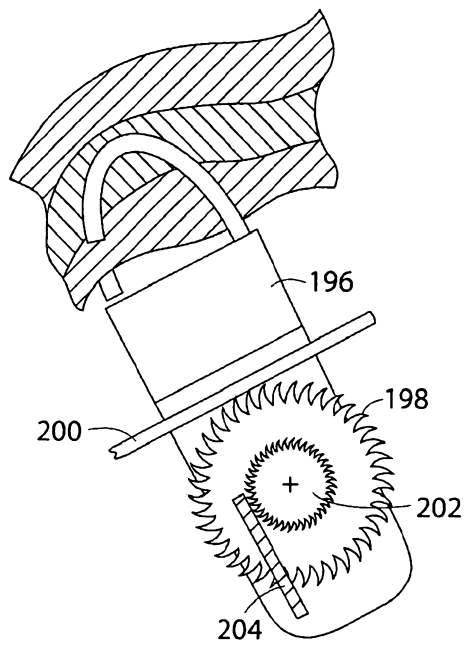


FIG. 26

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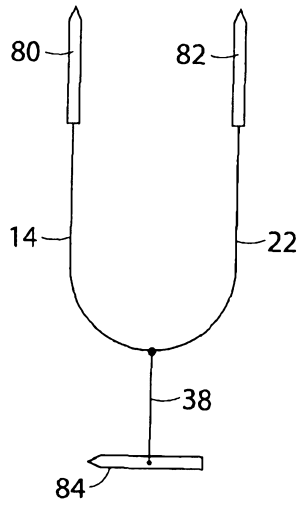


FIG. 27

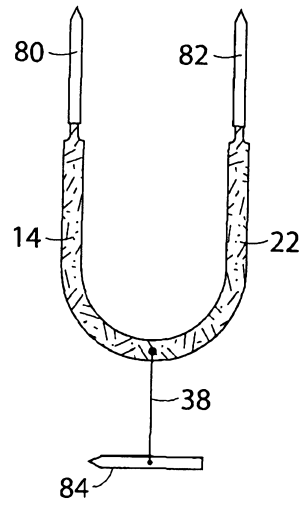


FIG. 28

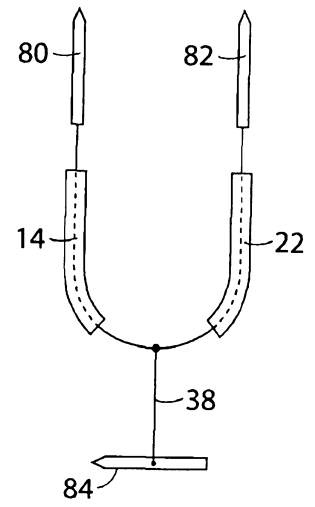


FIG. 29

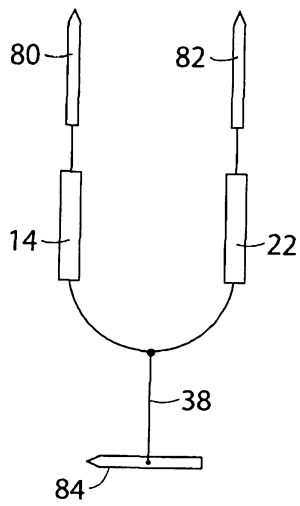


FIG. 30

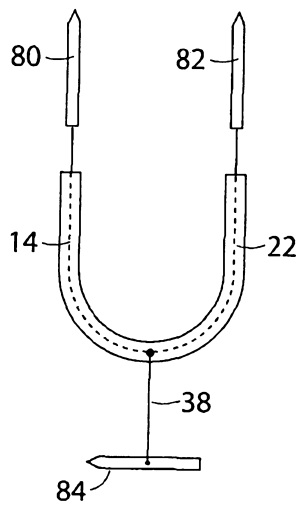


FIG. 31

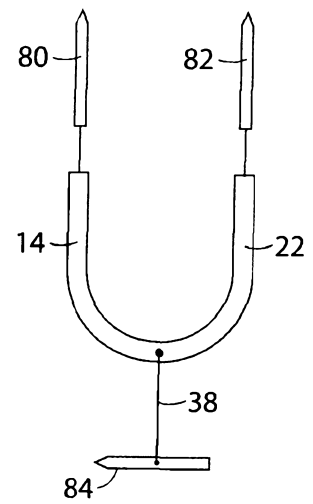


FIG. 32

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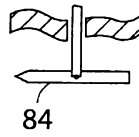


FIG. 33

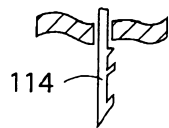


FIG. 34

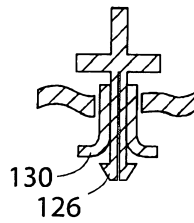


FIG. 35

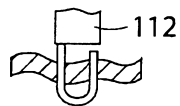


FIG. 36

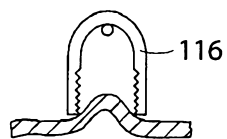


FIG. 37

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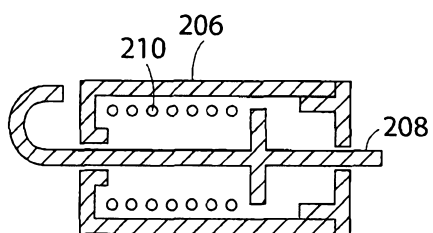


FIG. 38

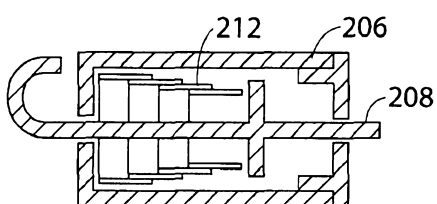


FIG. 39A

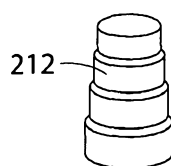


FIG. 39B

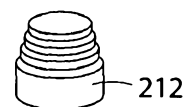


FIG. 39C

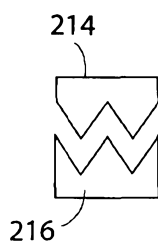


FIG. 40B

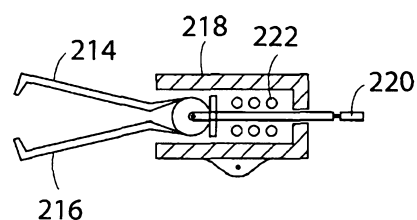


FIG. 40A

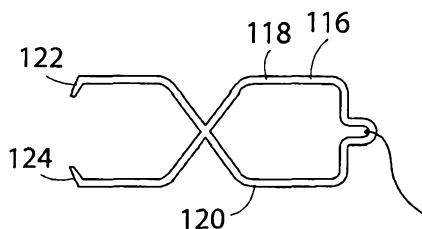


FIG. 41

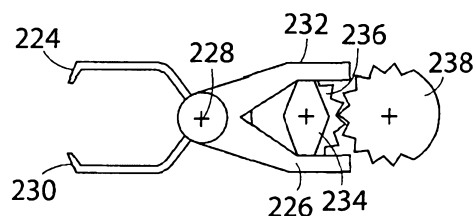


FIG. 42

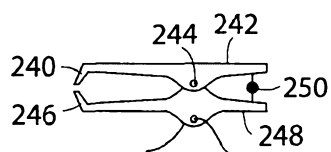


FIG. 43

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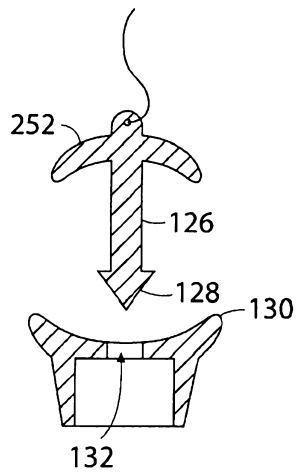


FIG. 44A

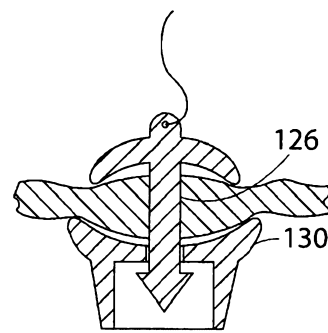


FIG. 44B

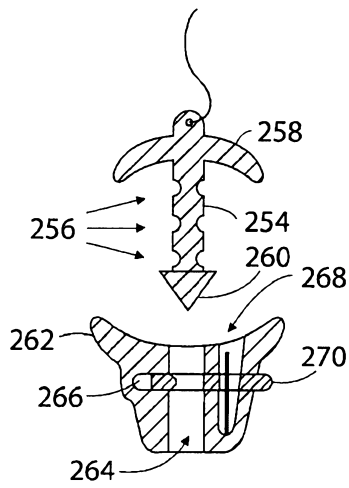


FIG. 45A

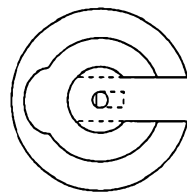


FIG. 45B

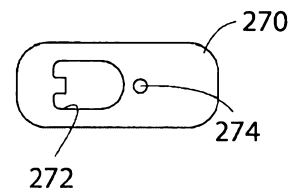


FIG. 45C

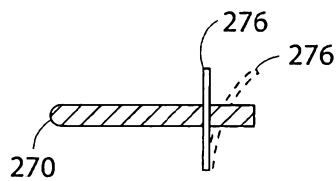


FIG. 45D

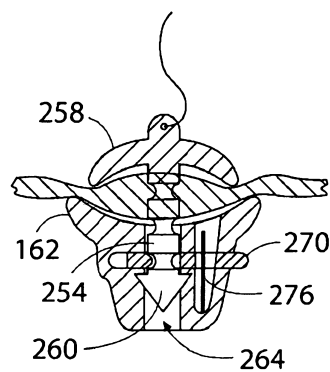
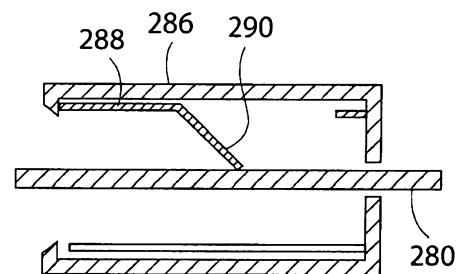
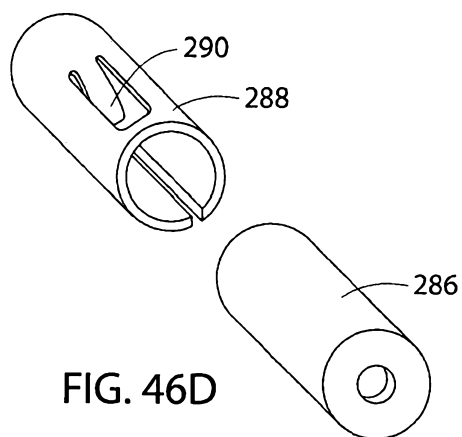
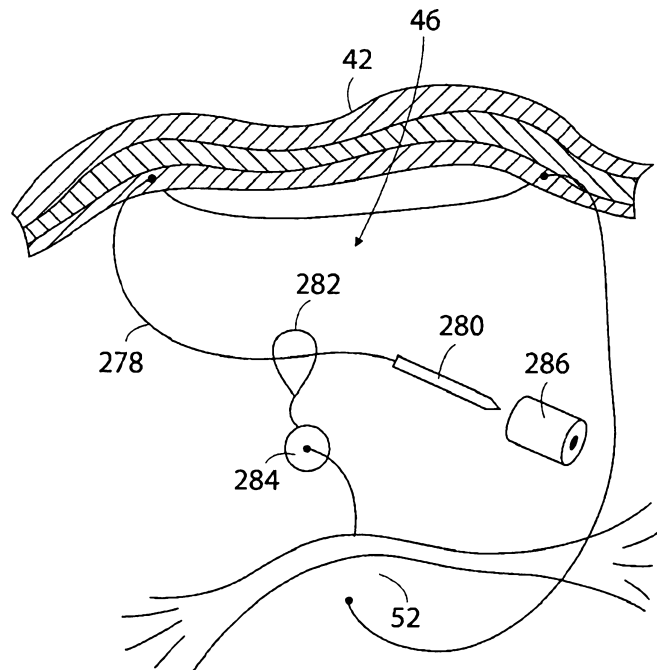
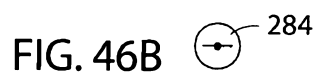
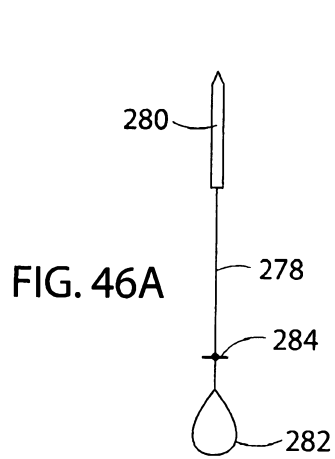


FIG. 45E



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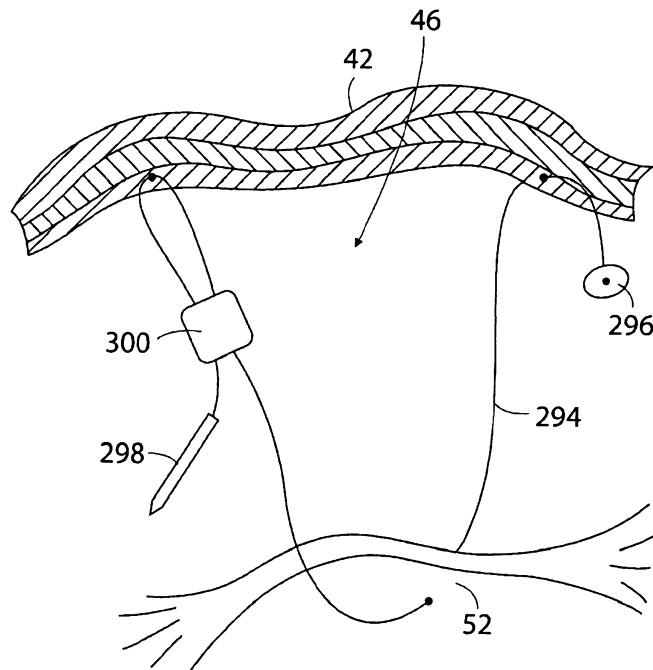


FIG. 46C

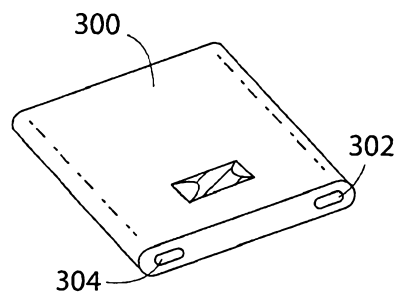
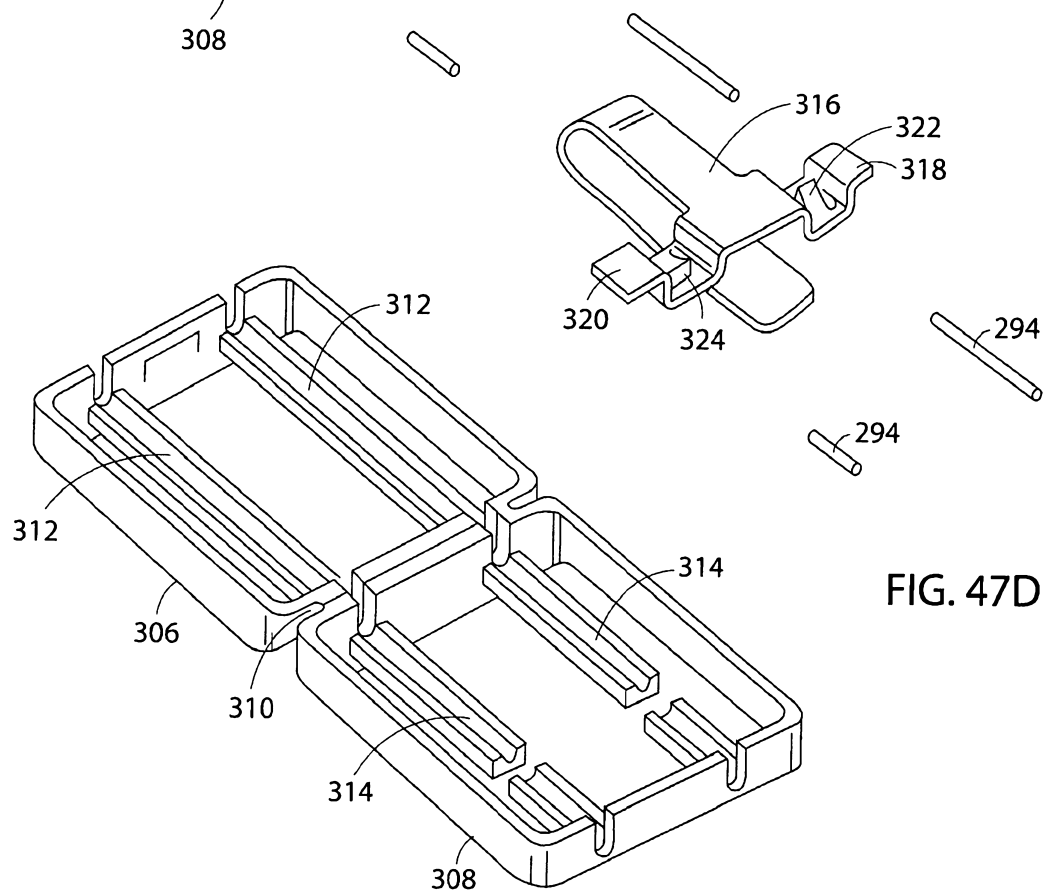
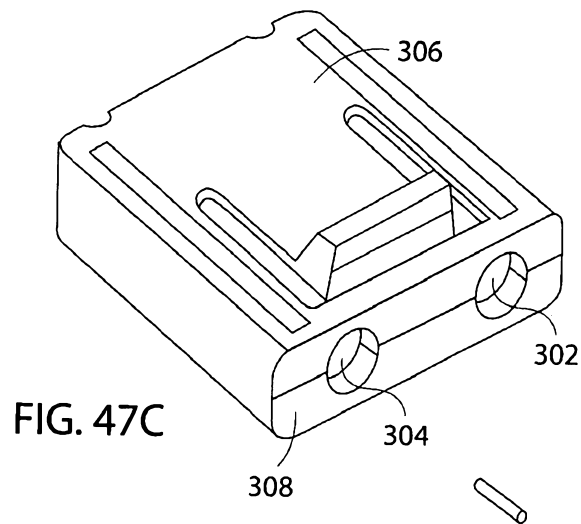


FIG. 47B

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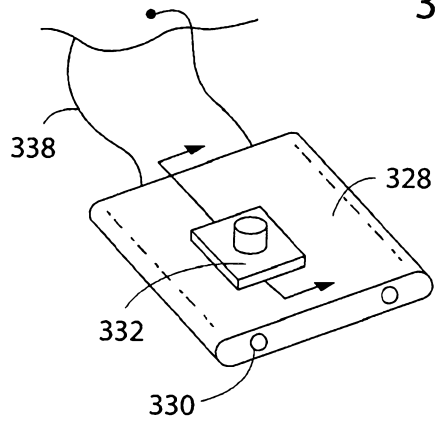


FIG. 48A

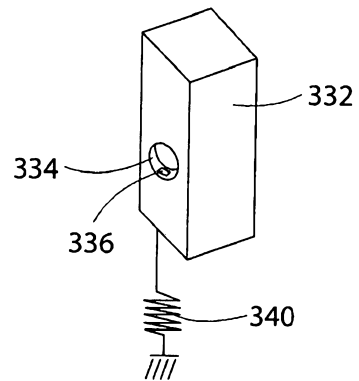


FIG. 48B

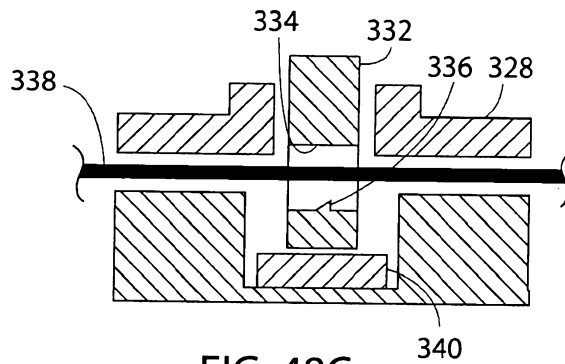


FIG. 48C

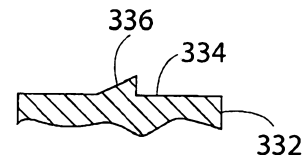


FIG. 48D

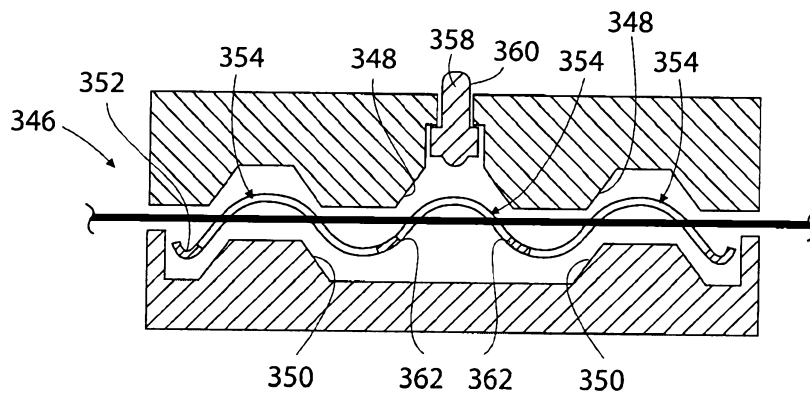


FIG. 49A

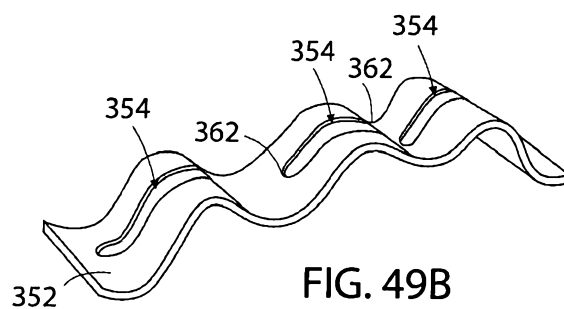


FIG. 49B

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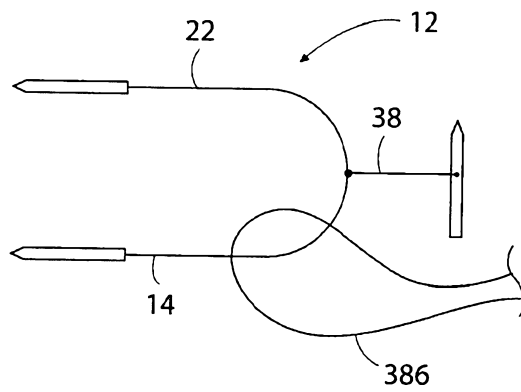


FIG. 51A

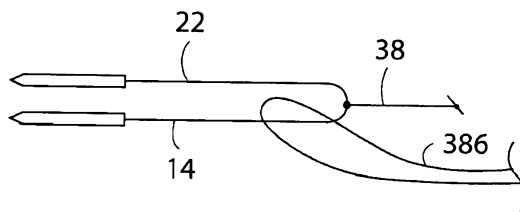


FIG. 51B

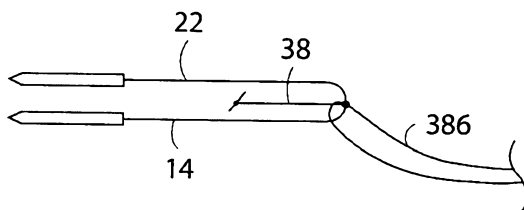


FIG. 51C

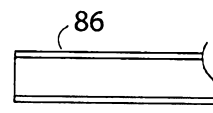
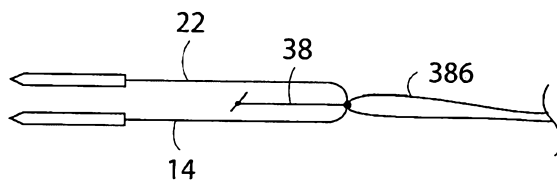


FIG. 51D

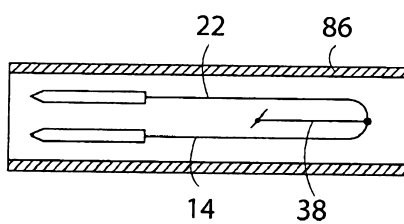


FIG. 51E

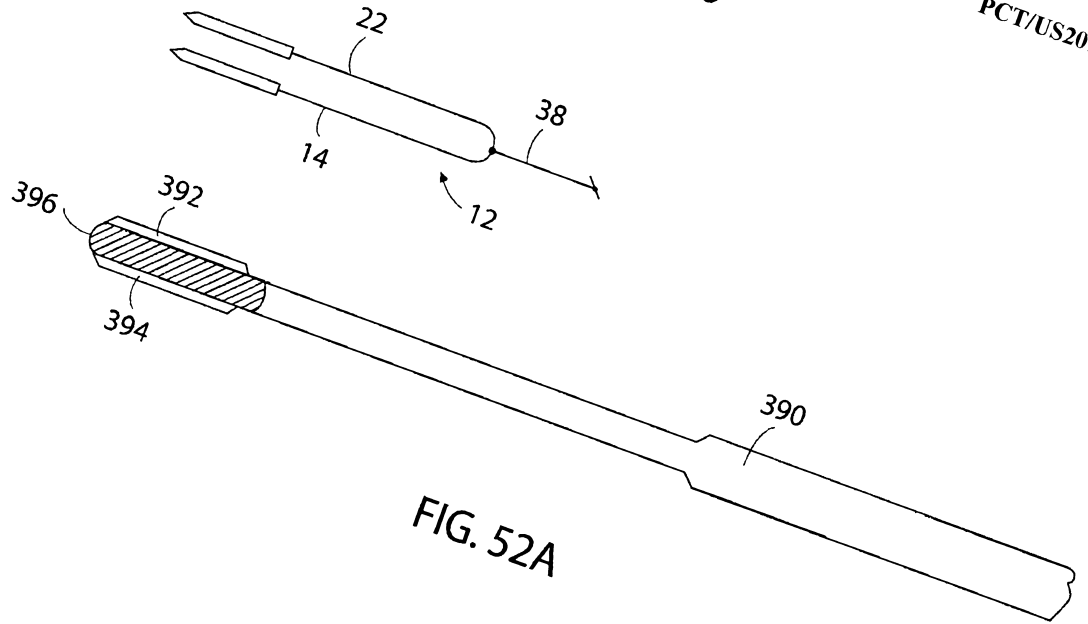


FIG. 52A

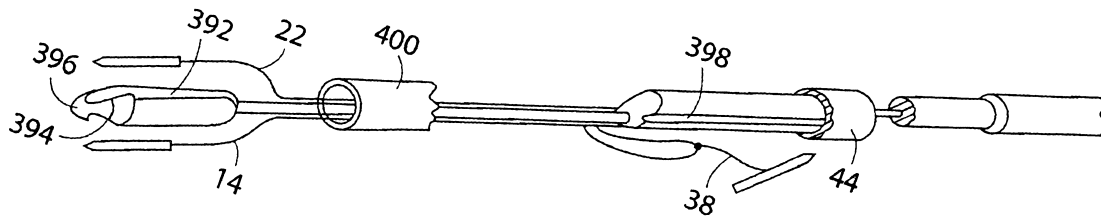


FIG. 52B

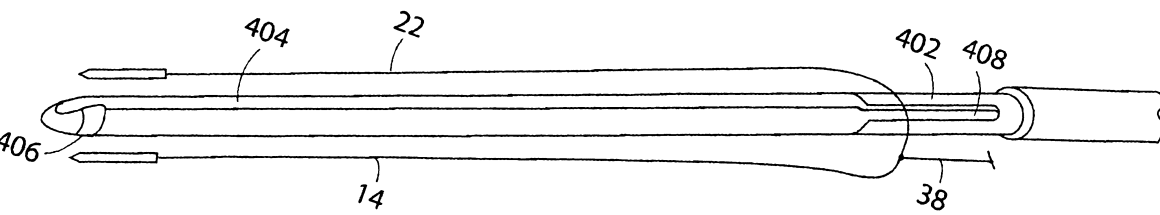


FIG. 53

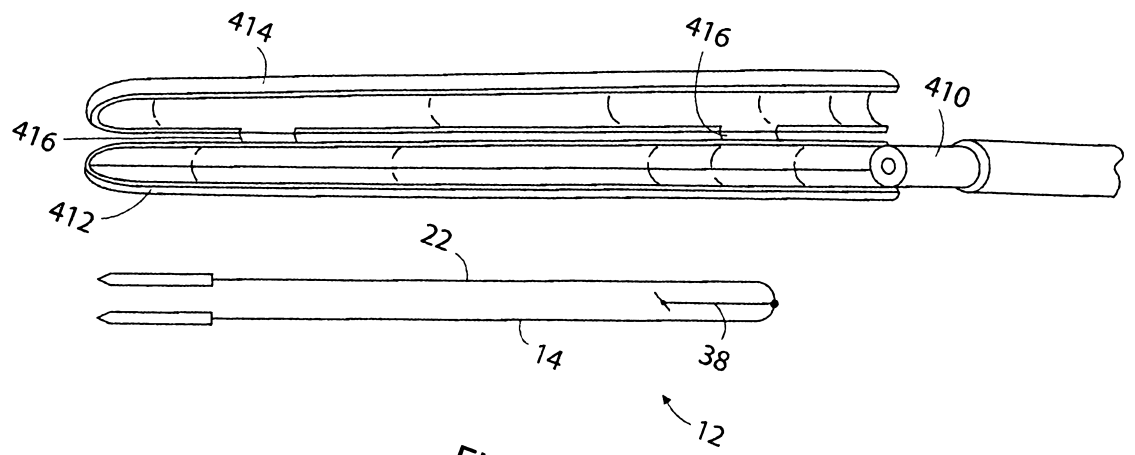


FIG. 54

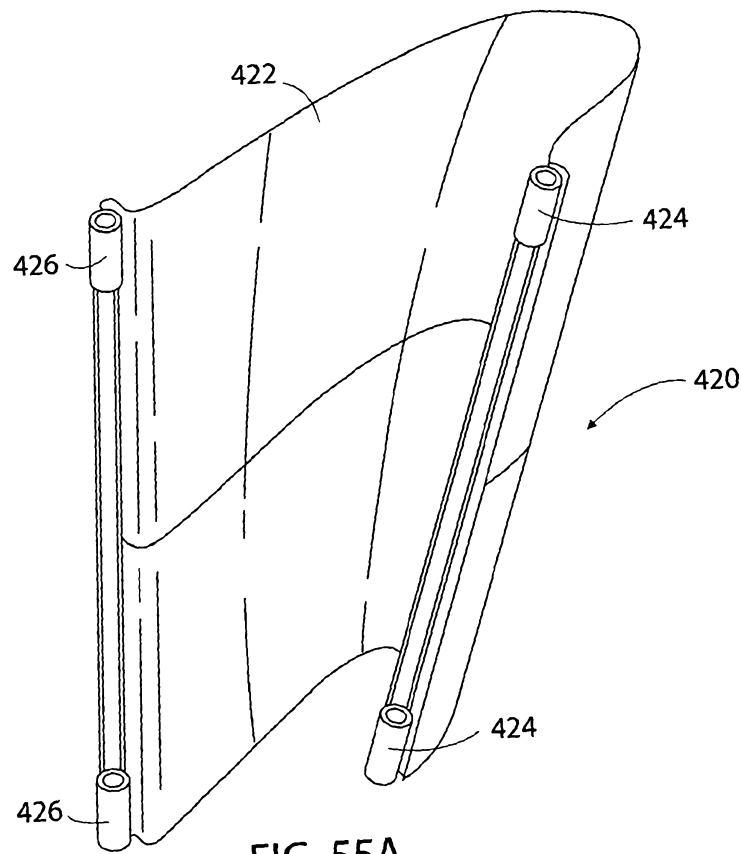


FIG. 55A

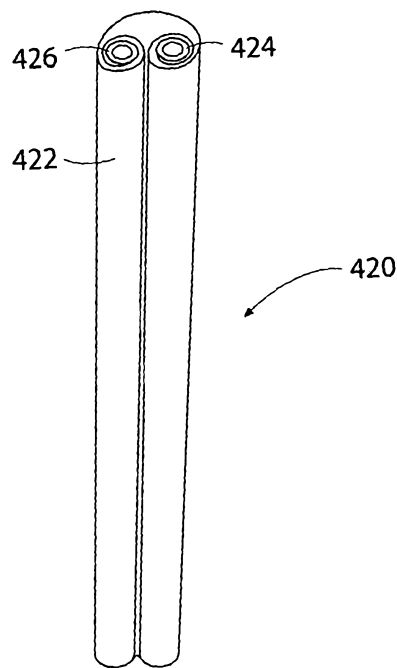


FIG. 55B

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