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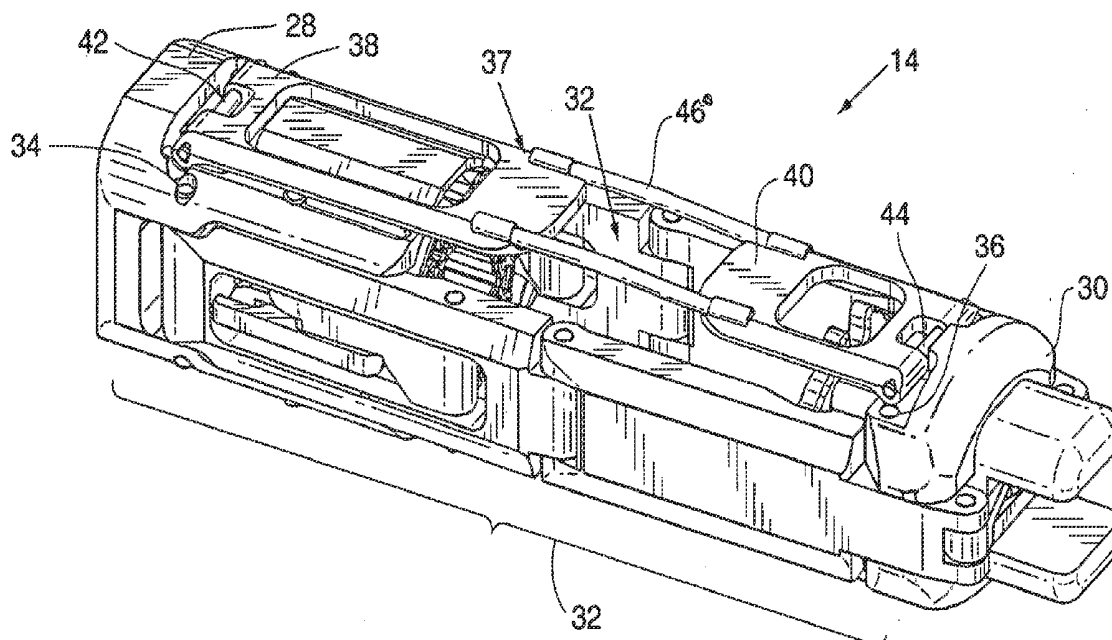
(19) **United States**(12) **Patent Application Publication**
Cole et al.(10) **Pub. No.: US 2011/0174864 A1**(43) **Pub. Date: Jul. 21, 2011**(54) **ENDOSCOPIC STAPLING DEVICES AND METHODS**

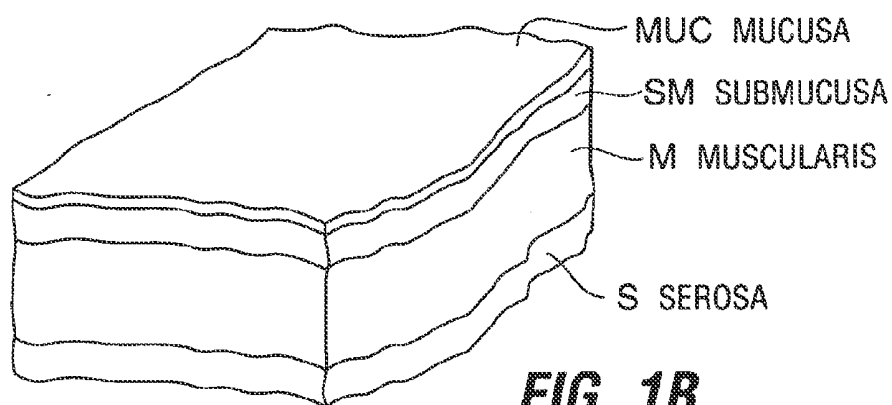
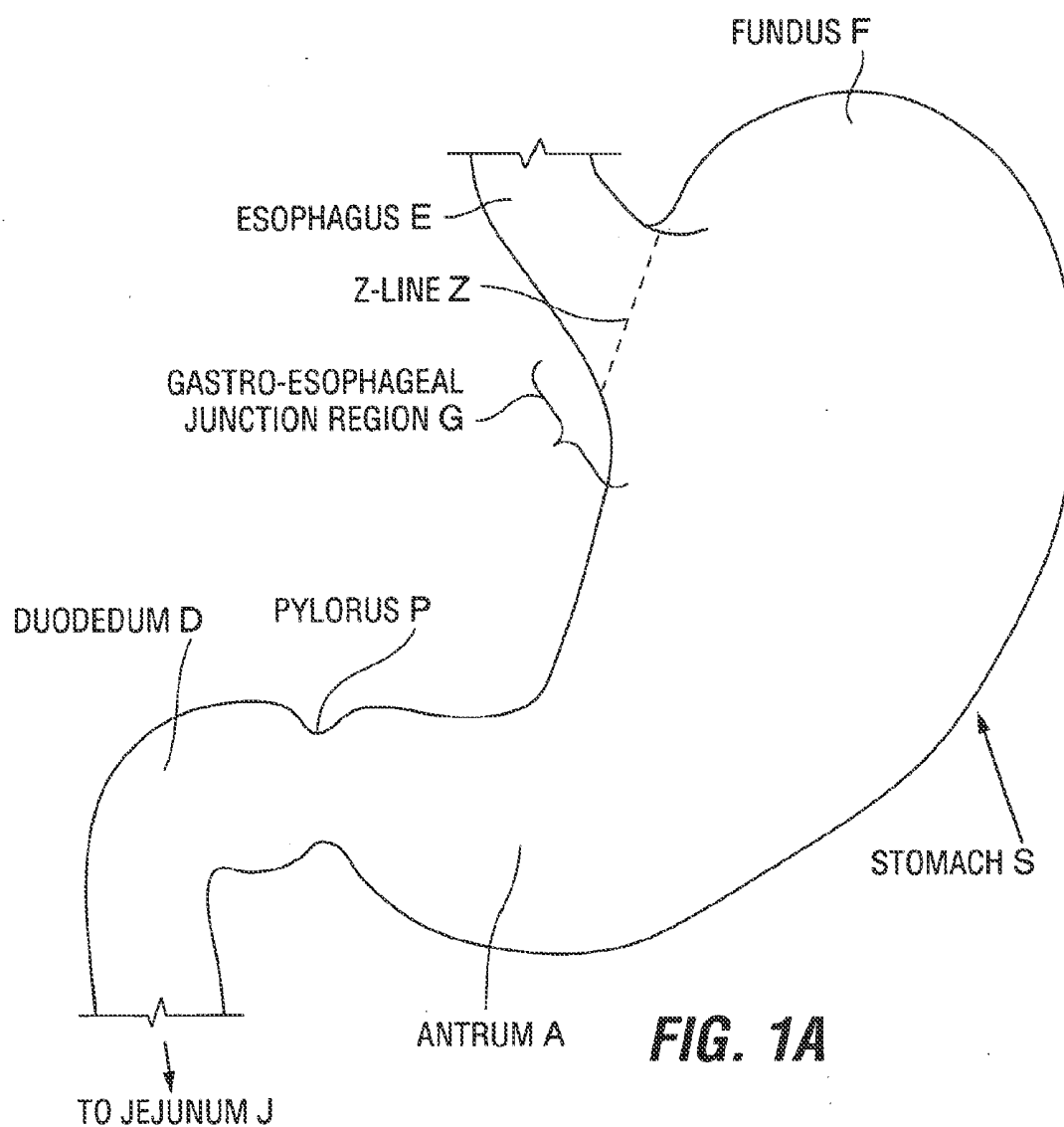
182, filed on Mar. 21, 2008, now Pat. No. 7,913,892, which is a division of application No. 12/050,169, filed on Mar. 18, 2008.

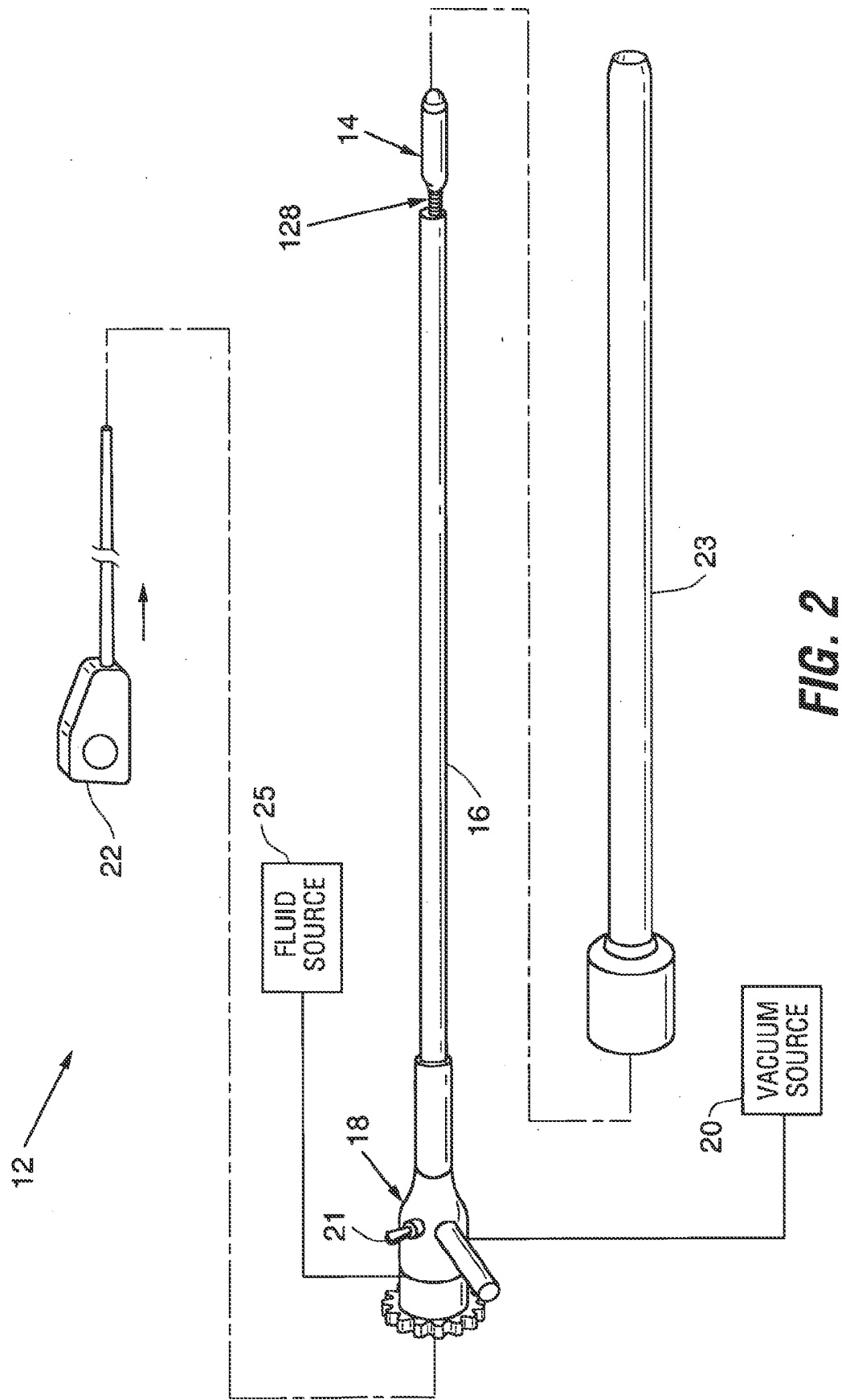
(75) Inventors: **David Cole**, San Mateo, CA (US);
Andrew Smith, San Francisco, CA (US)**Publication Classification**(73) Assignee: **Barosense, Inc.**(51) **Int. Cl.**
A61B 17/068 (2006.01)(21) Appl. No.: **13/053,133**(52) **U.S. Cl.** **227/180.1**(22) Filed: **Mar. 21, 2011**(57) **ABSTRACT****Related U.S. Application Data**

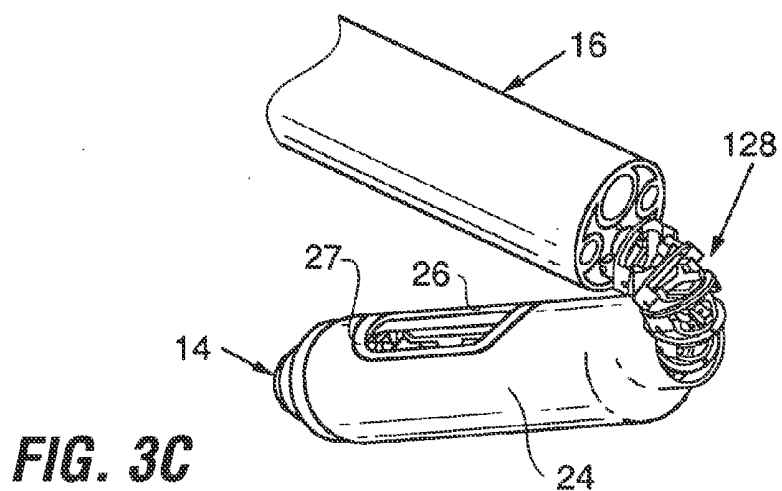
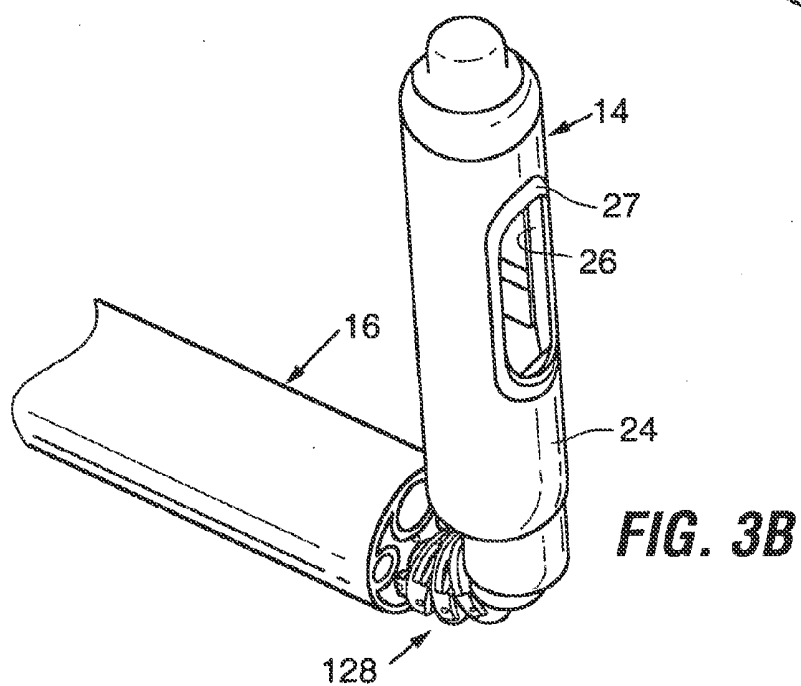
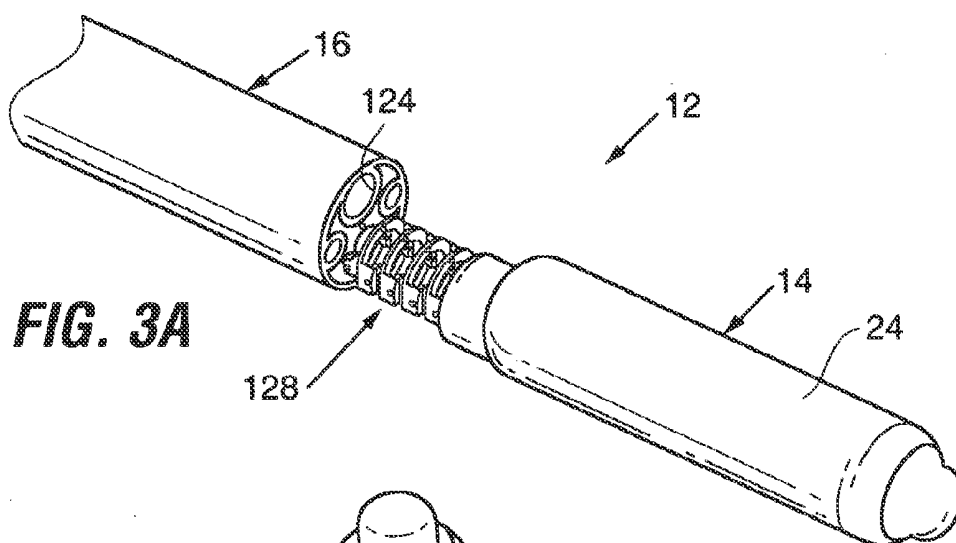
(60) Continuation of application No. 12/050,169, filed on Mar. 18, 2008, Division of application No. 12/052,997, filed on Mar. 21, 2008, now Pat. No. 7,909,222, which is a division of application No. 12/050,169, filed on Mar. 18, 2008, Division of application No. 12/053,010, filed on Mar. 21, 2008, now Pat. No. 7,922,062, which is a division of application No. 12/050,169, filed on Mar. 18, 2008, Division of application No. 12/053,027, filed on Mar. 21, 2008, now Pat. No. 7,909,219, which is a division of application No. 12/050,169, filed on Mar. 18, 2008, Division of application No. 12/053,066, filed on Mar. 21, 2008, now Pat. No. 7,909,223, which is a division of application No. 12/050,169, filed on Mar. 18, 2008, Division of application No. 12/053,

Described herein are endoscopic staplers and methods used to apply one or more fasteners to body tissue. In one embodiment, a fastener-applying device, which is preferably a stapler, is passed transorally into the stomach to plicate stomach tissue by engaging tissue from inside the stomach and drawing it inwardly. In the disclosed embodiments, the tissue is drawn into a tissue chamber, causing sections of serosal tissue to be positioned facing one another. The disclosed staplers allow opposed sections of tissue to be moved into contact with another, and preferably deliver staples for maintaining contact between tissue sections at least until serosal bonds form. Each of these steps may be performed wholly from the inside of the stomach and thus can eliminate the need for any surgical or laparoscopic intervention. After one or more plications are formed, medical devices may optionally be coupled to the plication(s) for retention within the stomach.









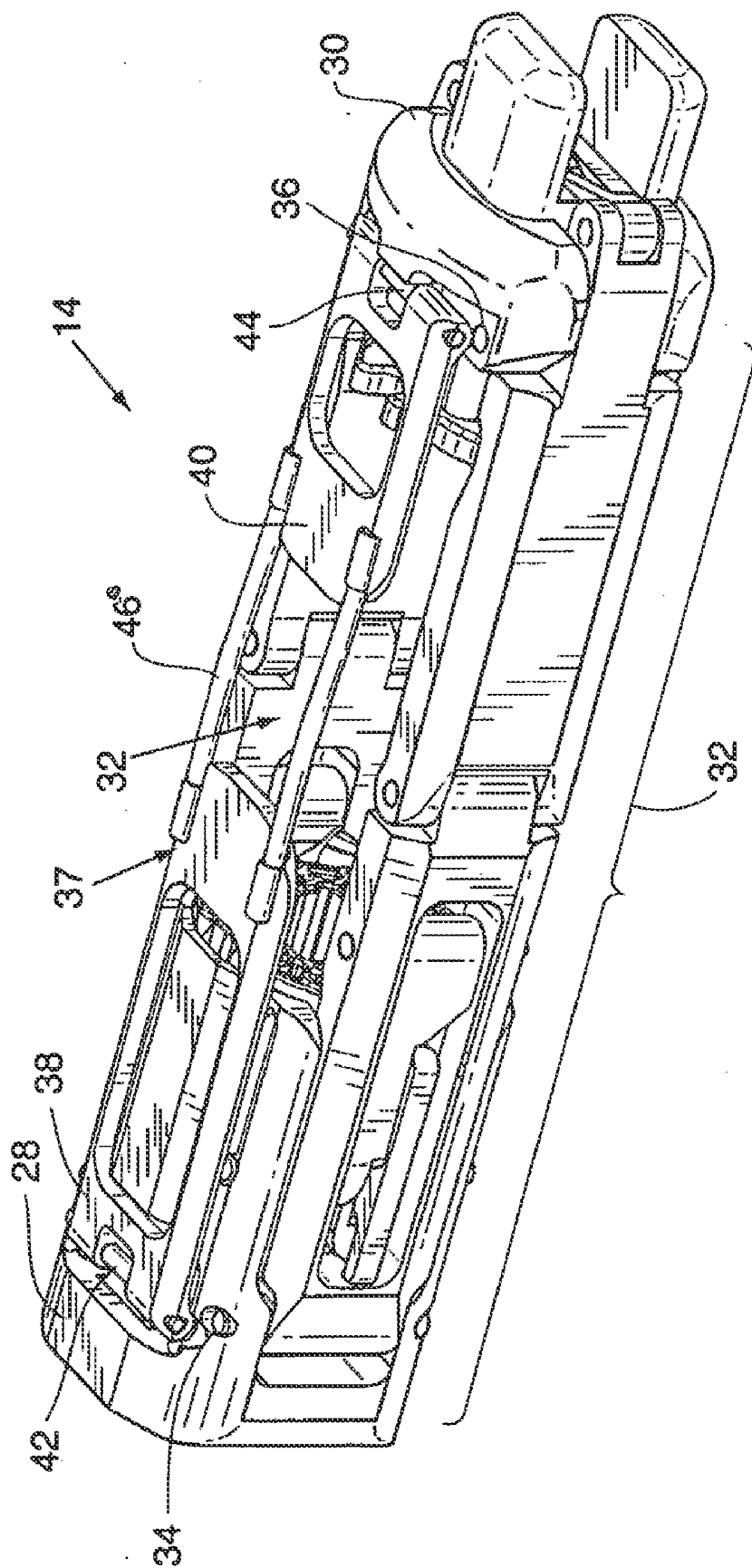


FIG. 4

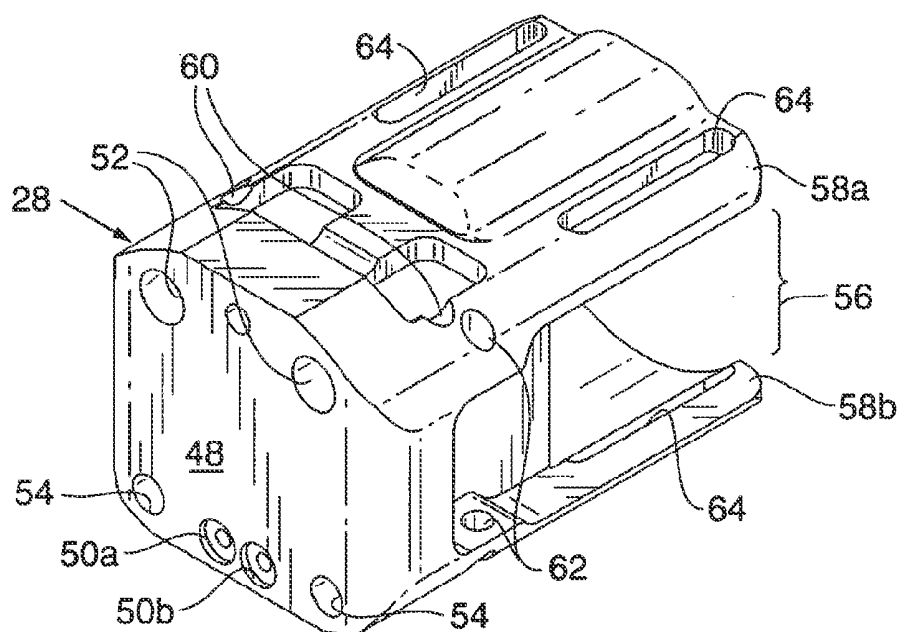


FIG. 5

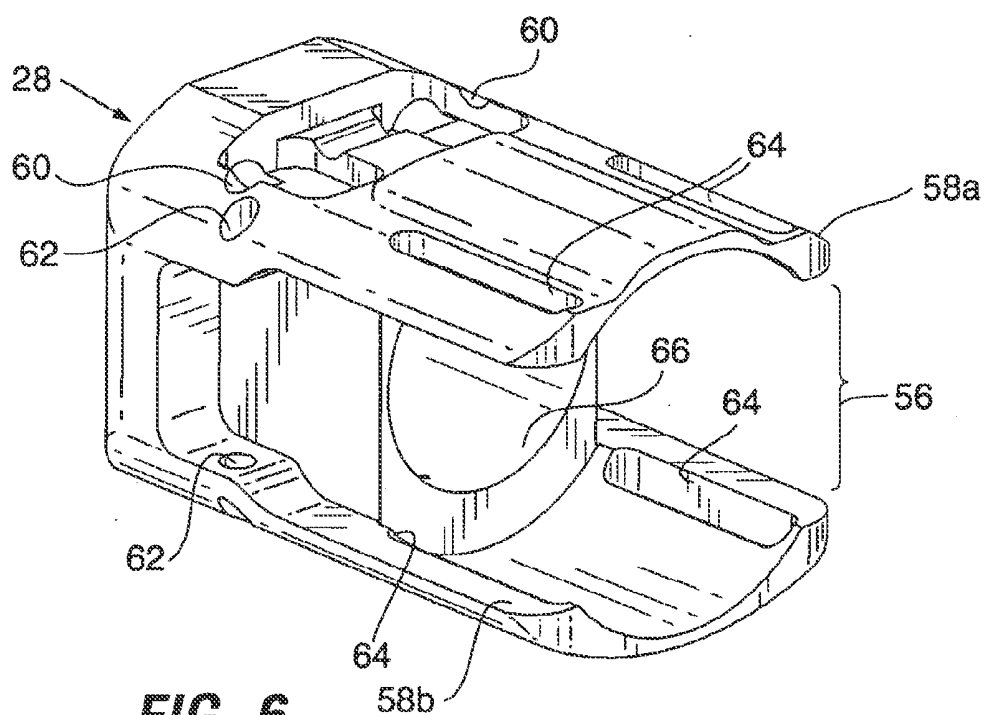
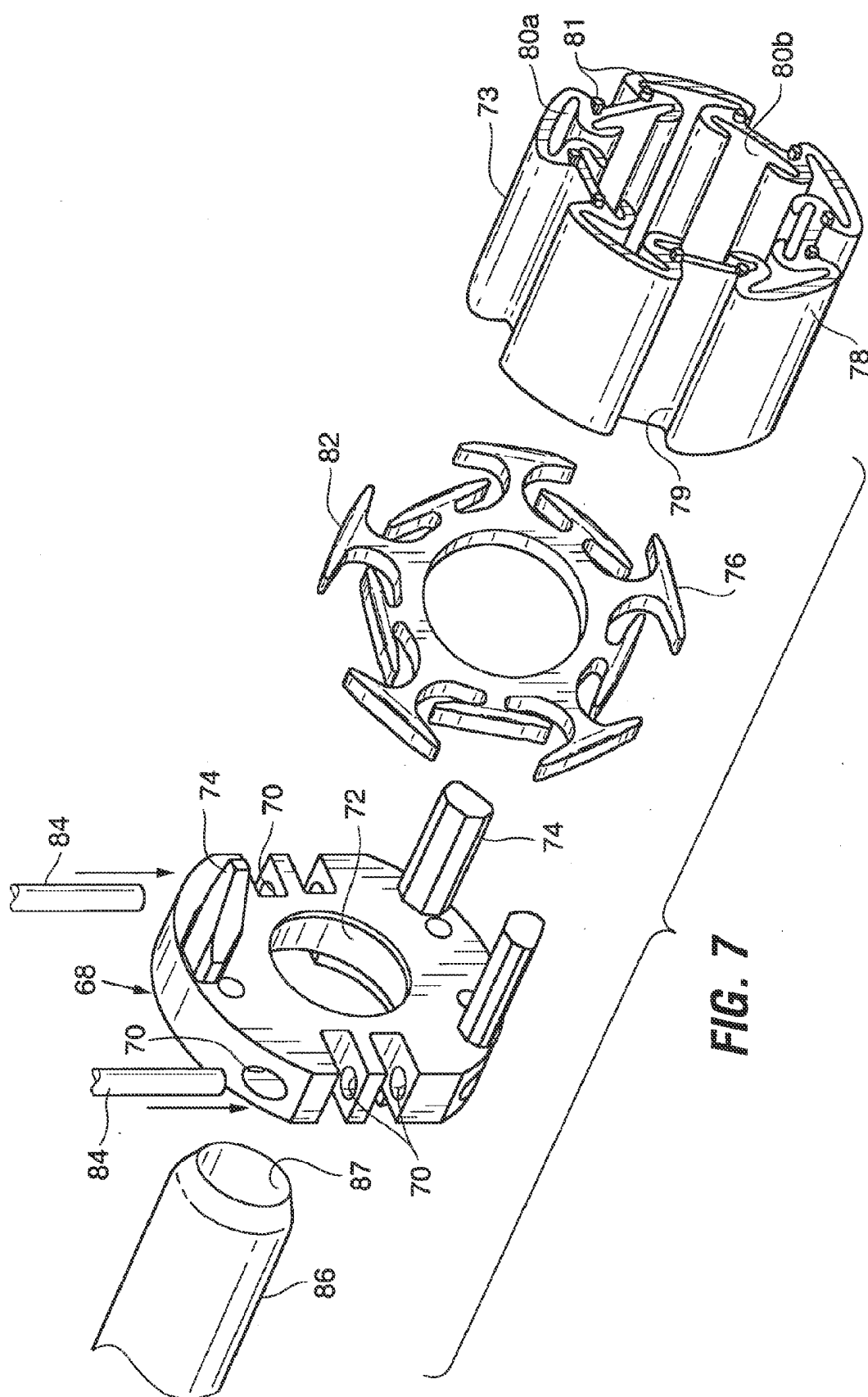


FIG. 6



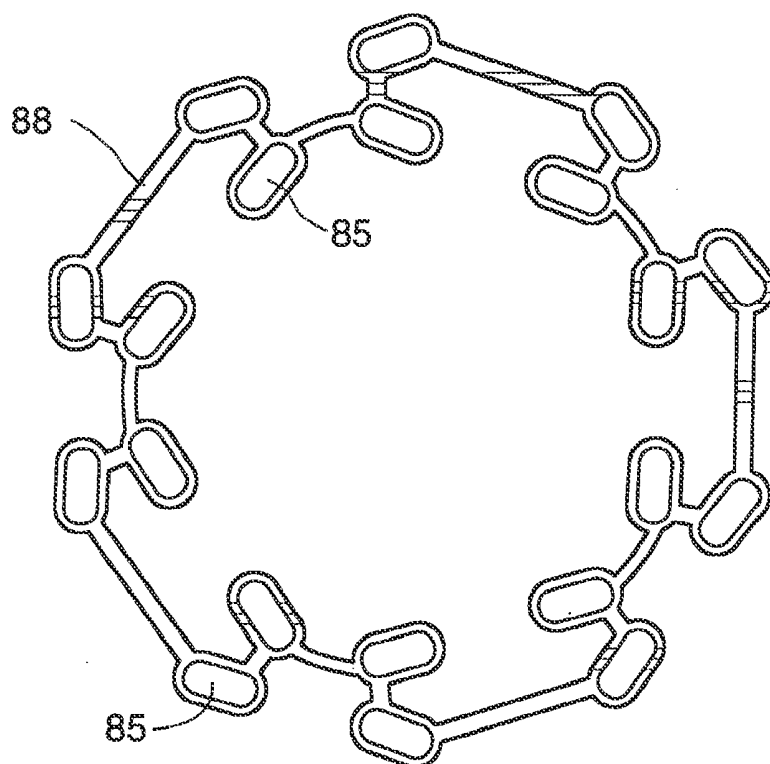


FIG. 8

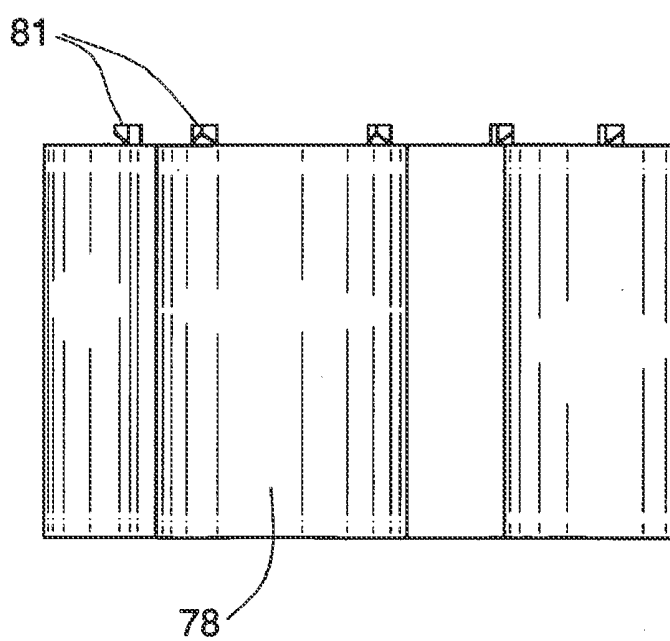
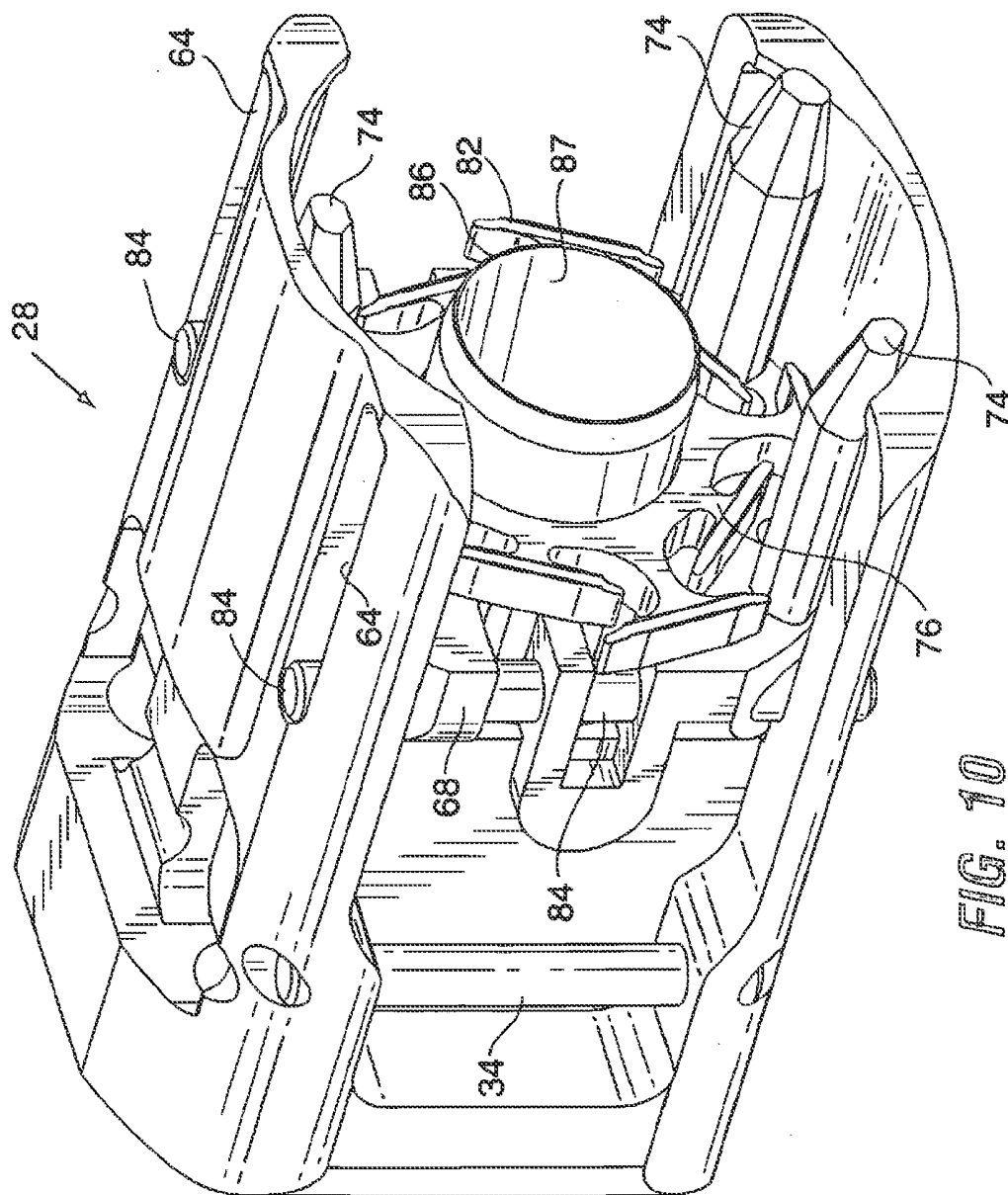


FIG. 9



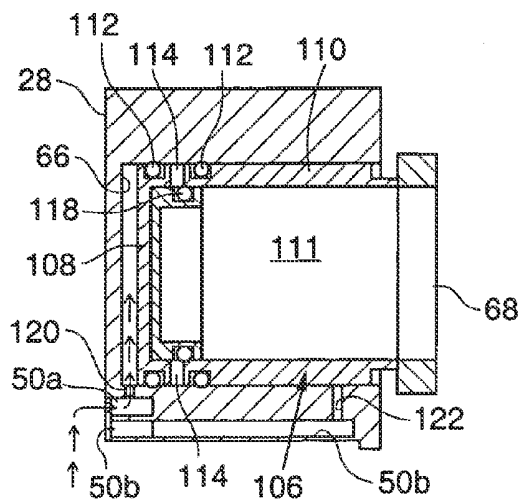


FIG. 11A

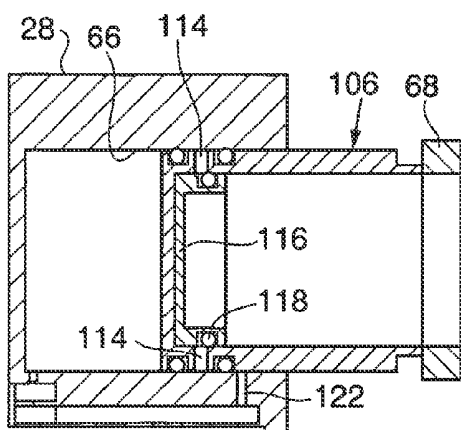


FIG. 11B

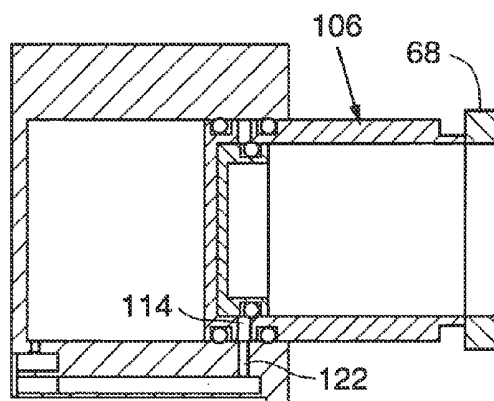


FIG. 11C

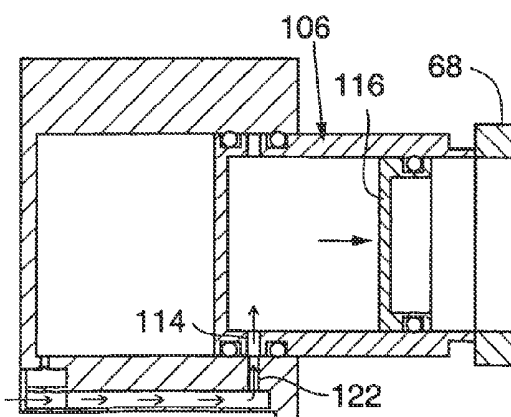


FIG. 11D

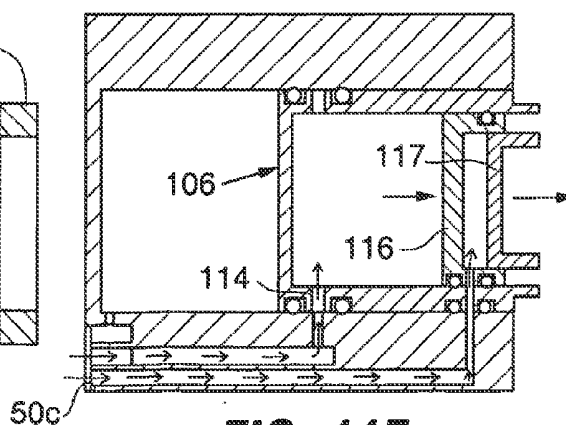
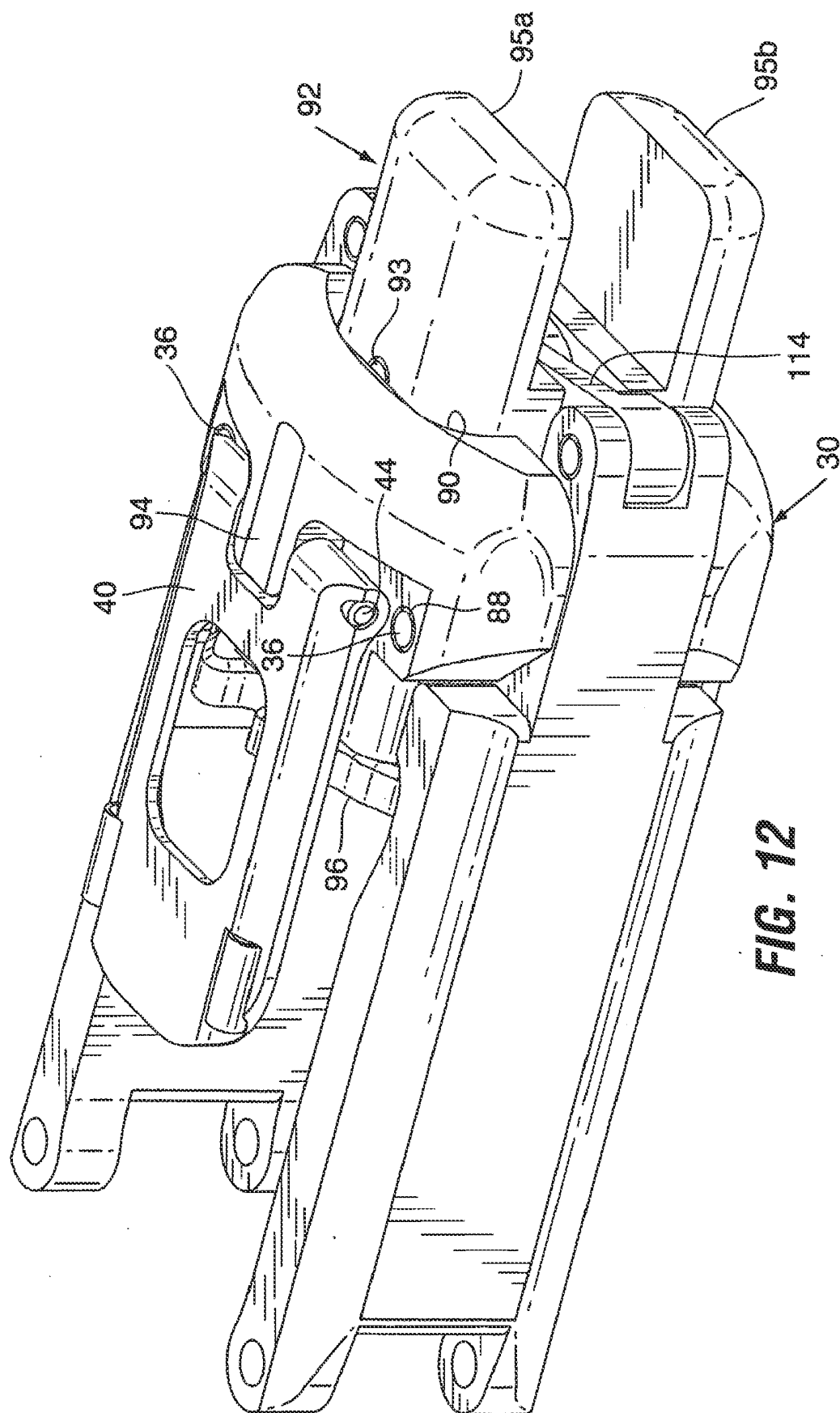
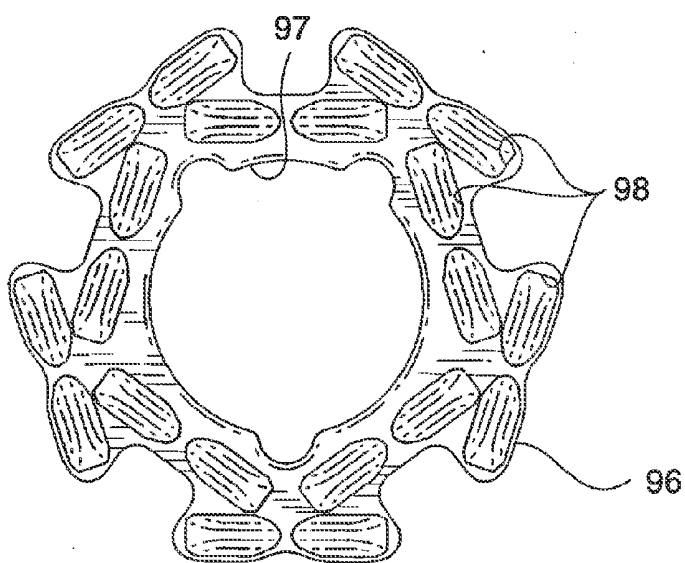
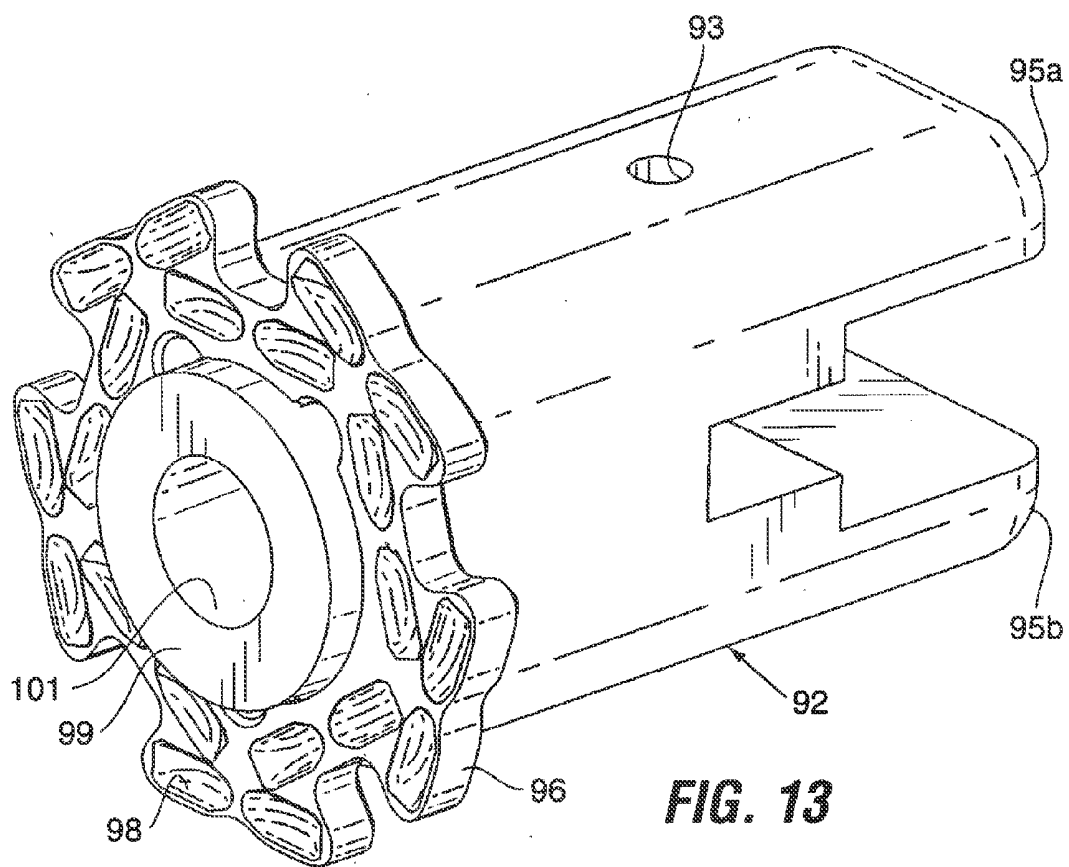


FIG. 11E





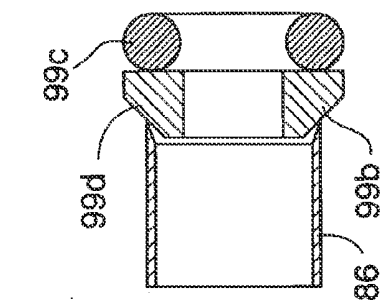


FIG. 15B

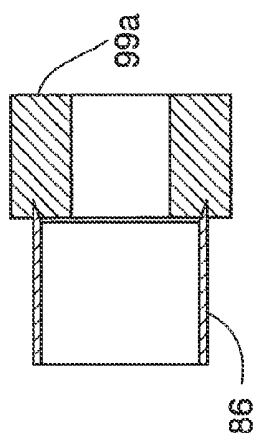


FIG. 15A

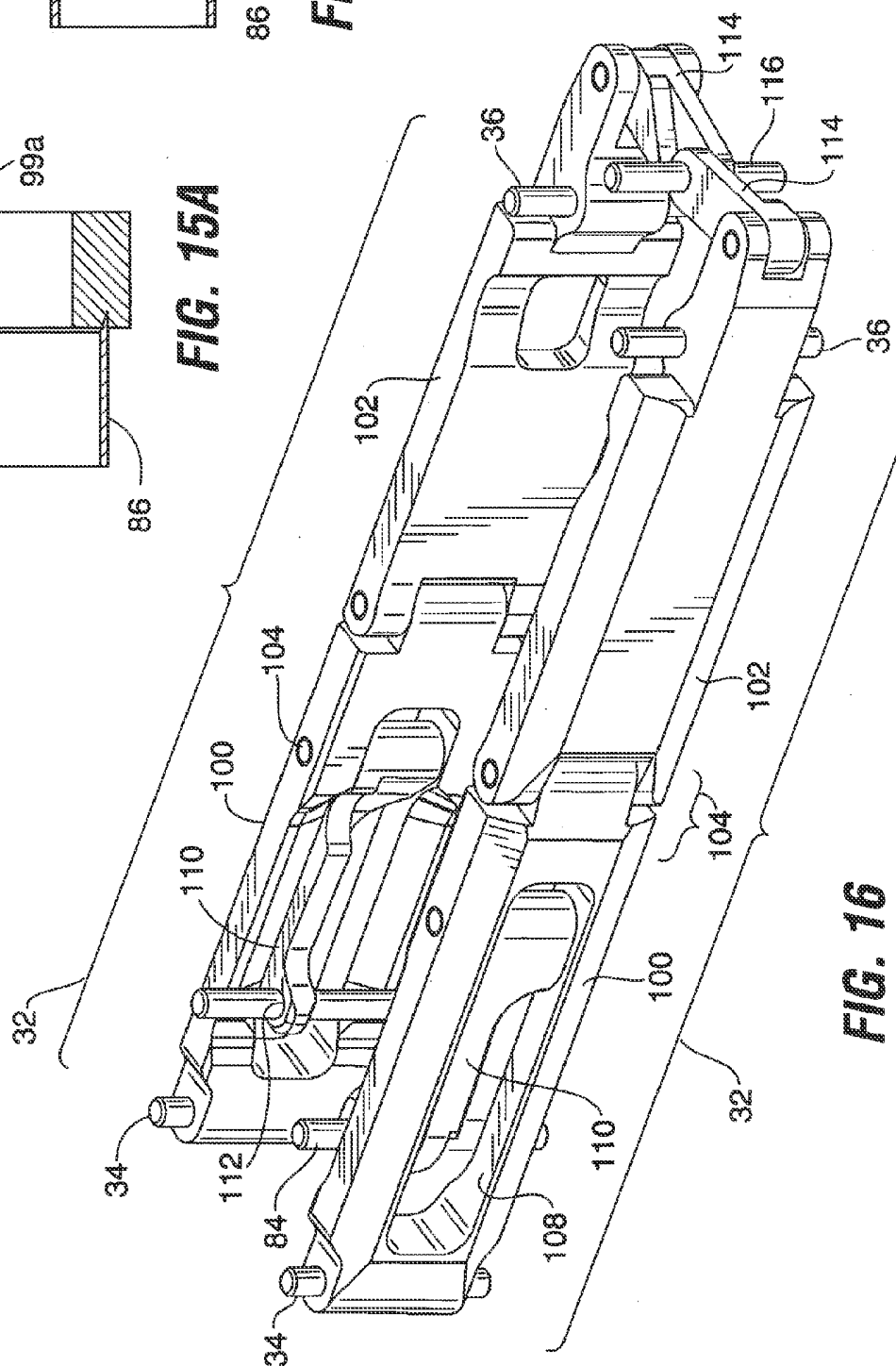


FIG. 16

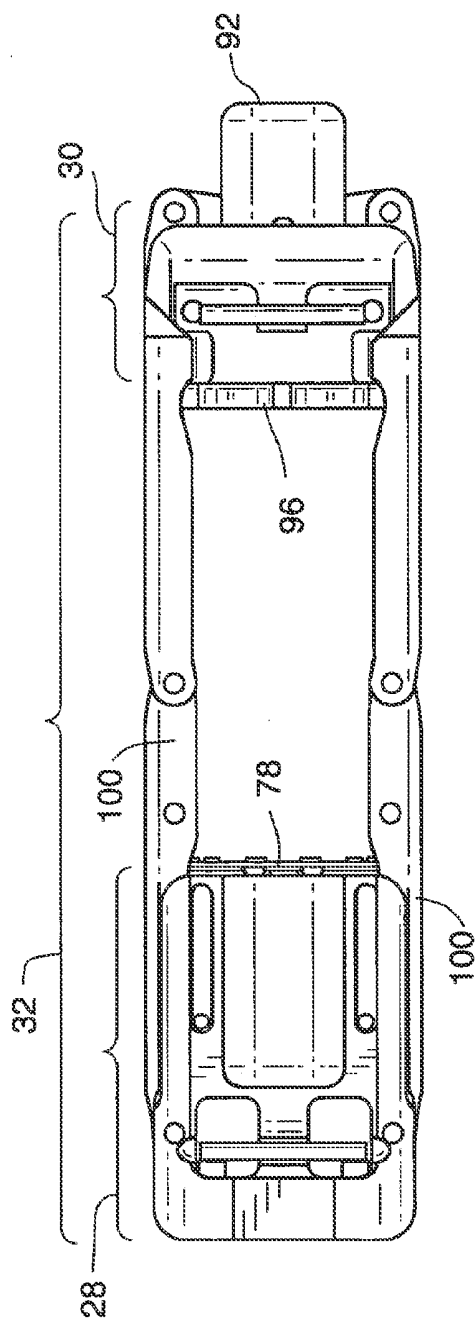


FIG. 17

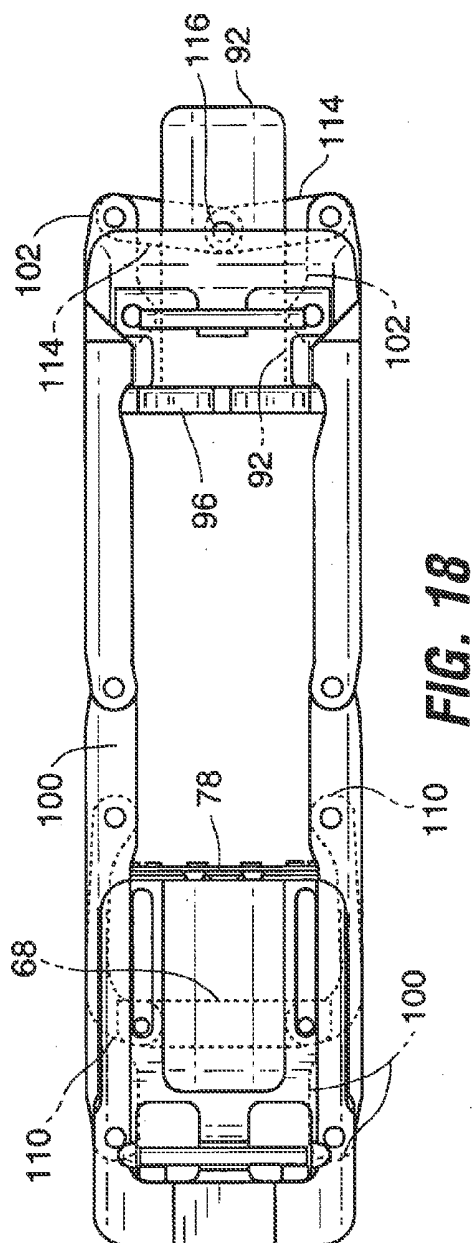


FIG. 18

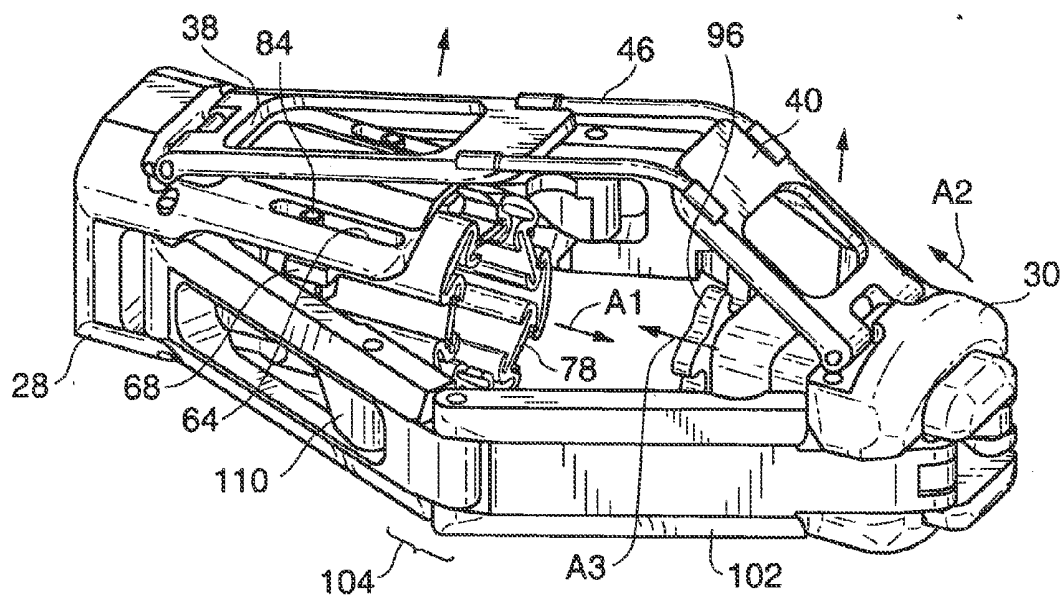


FIG. 19

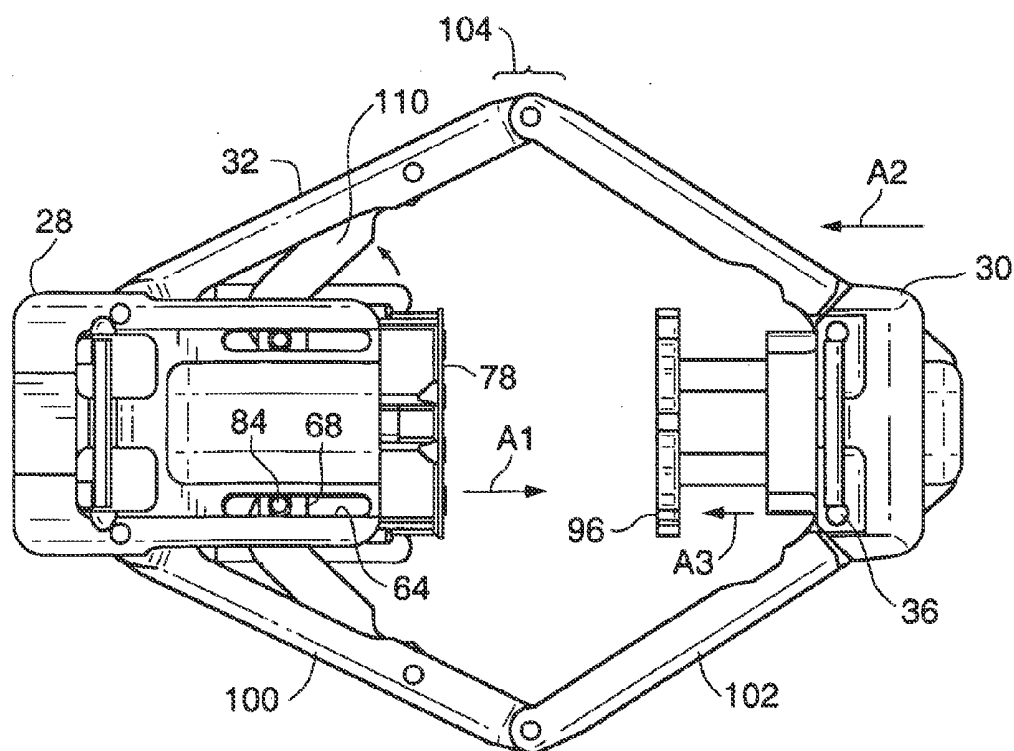


FIG. 20

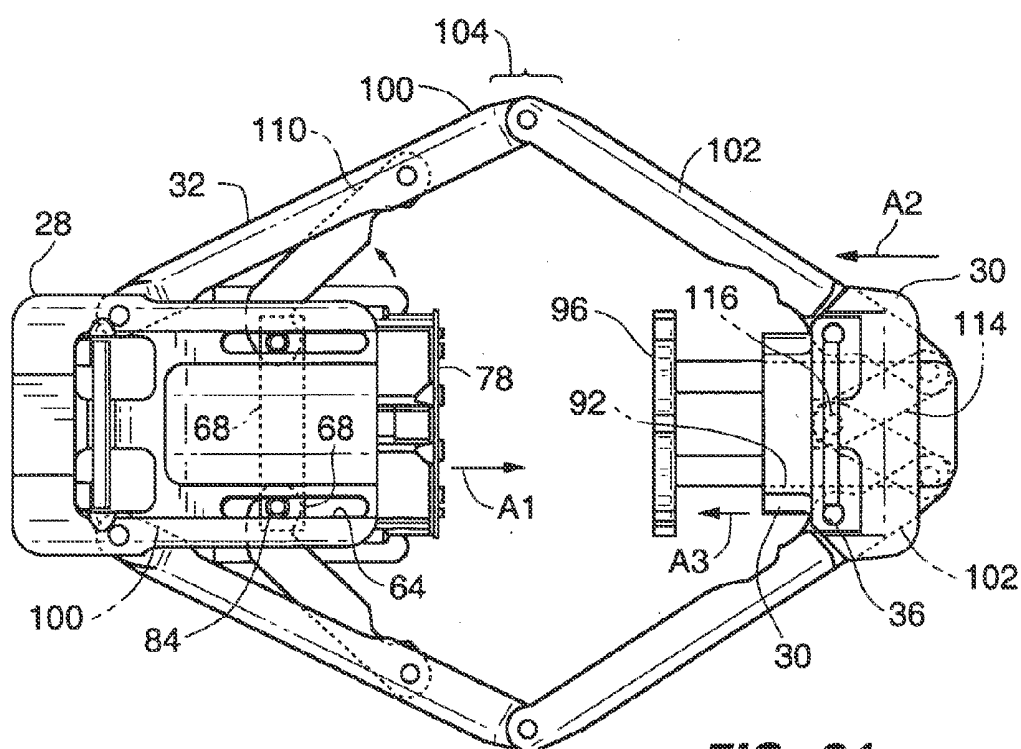


FIG. 21

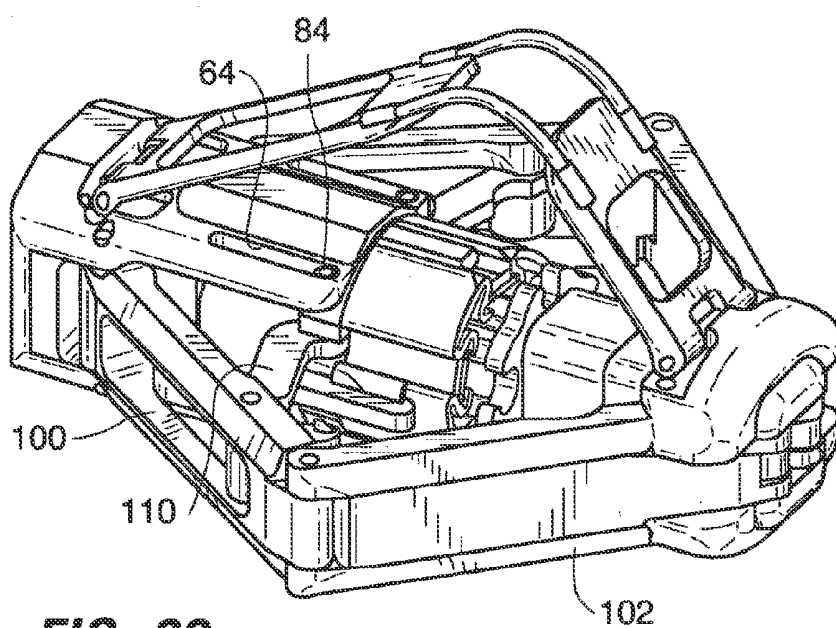
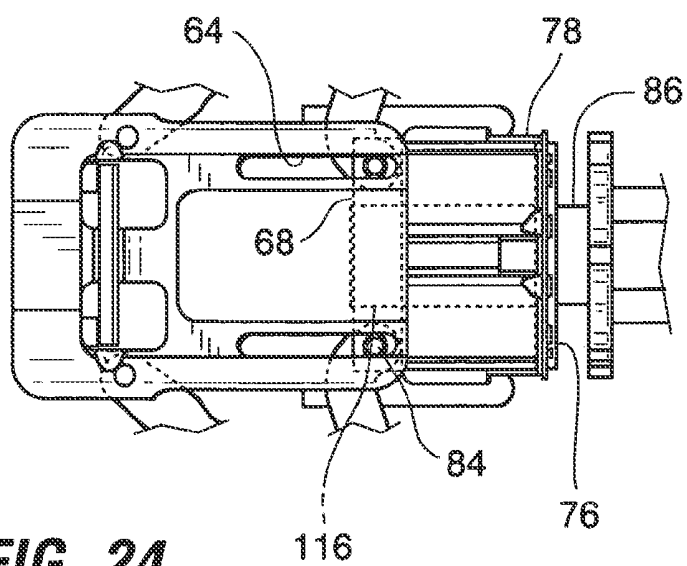
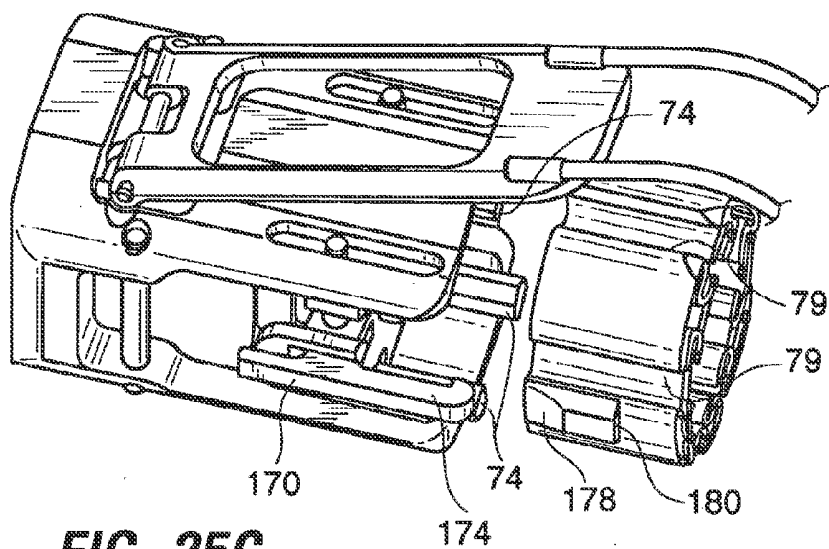
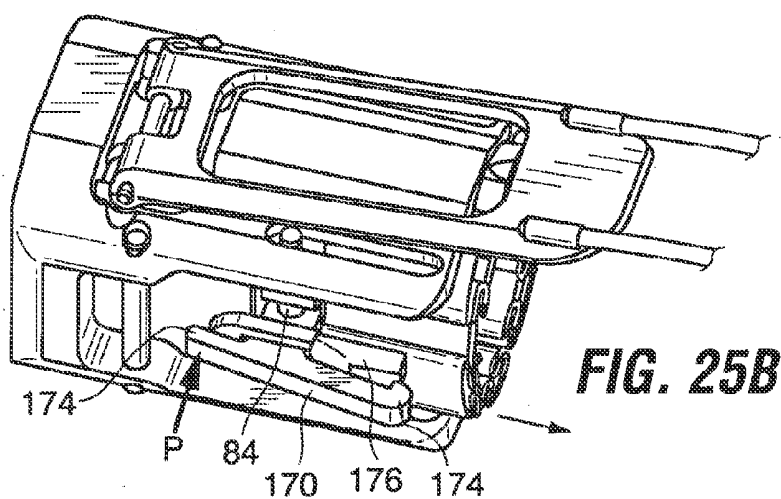
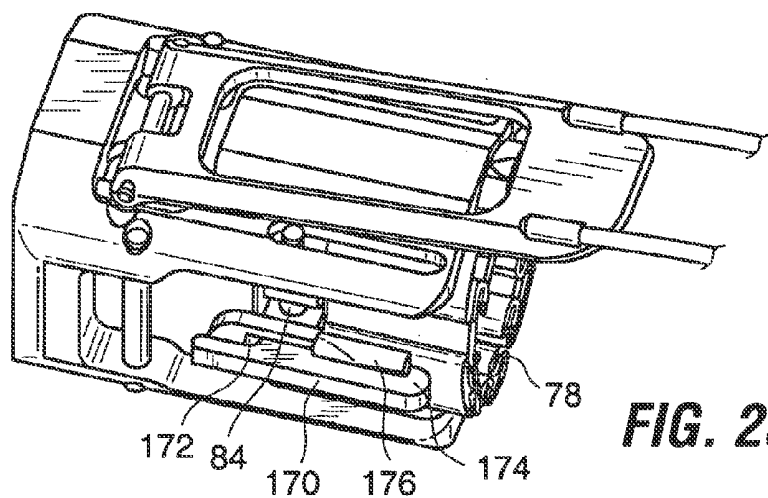


FIG. 22





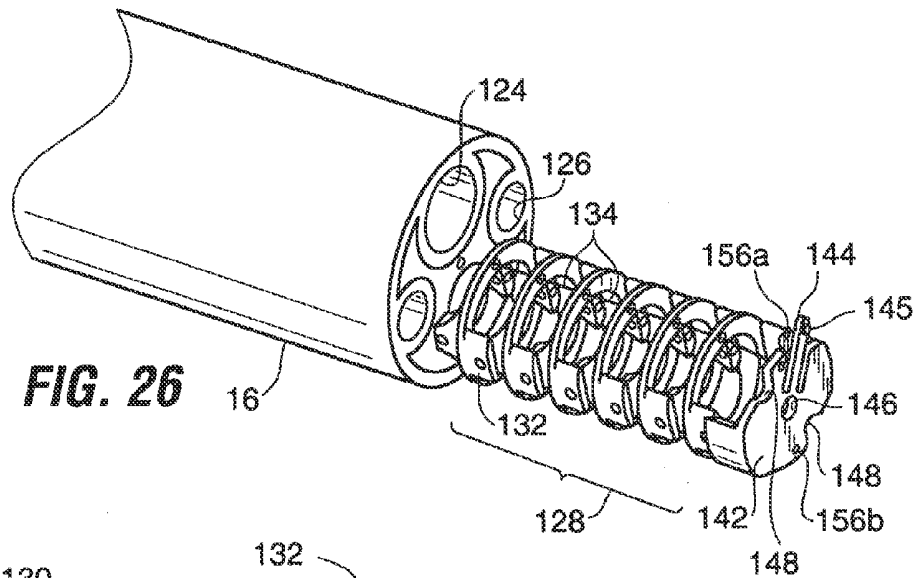


FIG. 26

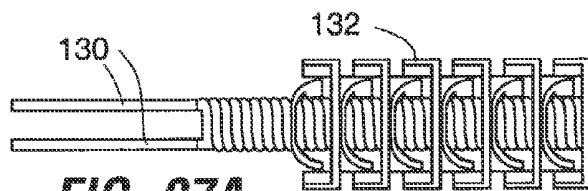


FIG. 27A



FIG. 27B

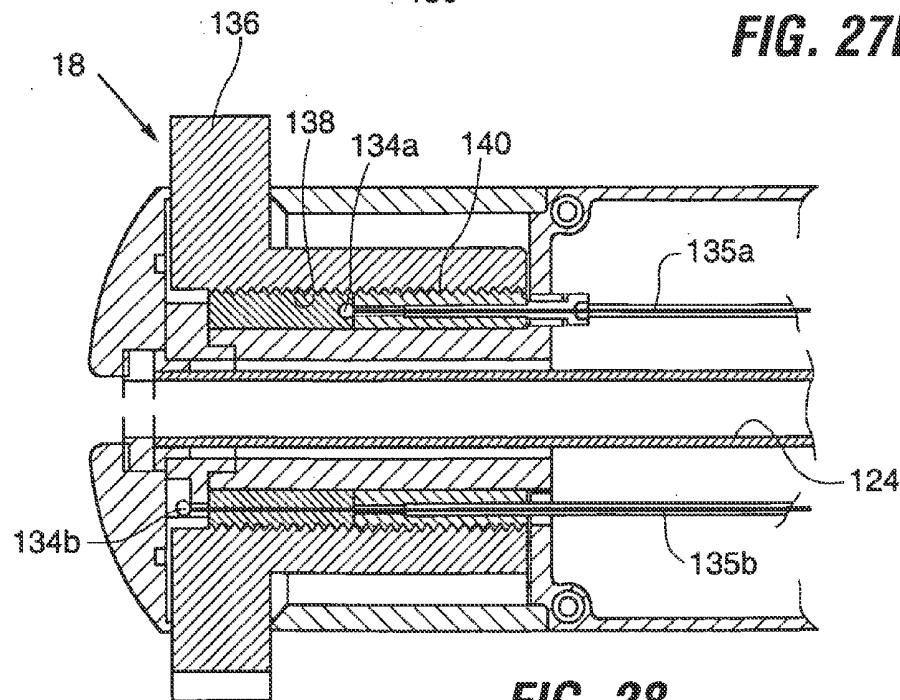


FIG. 28

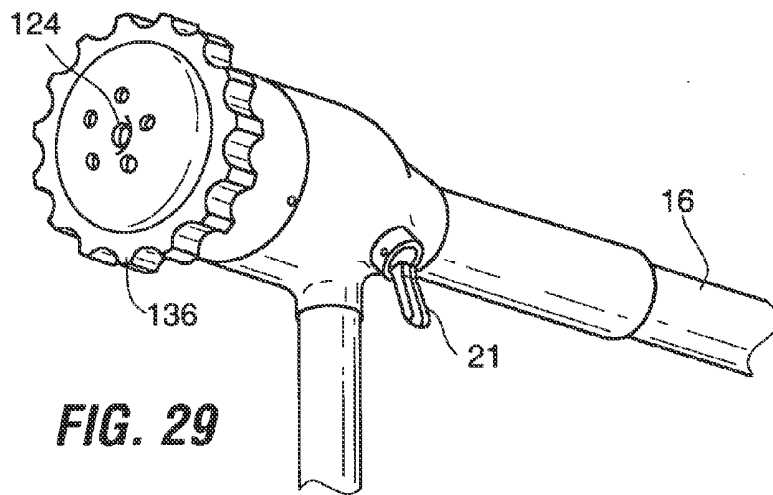


FIG. 29

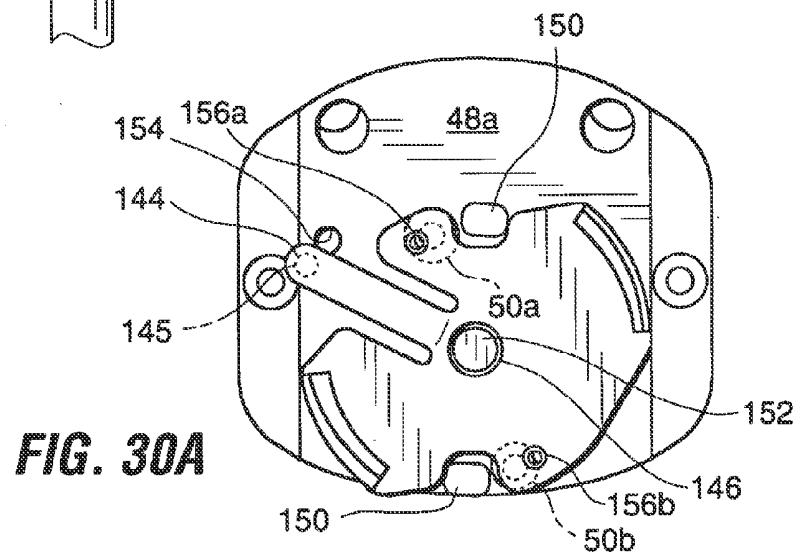


FIG. 30A

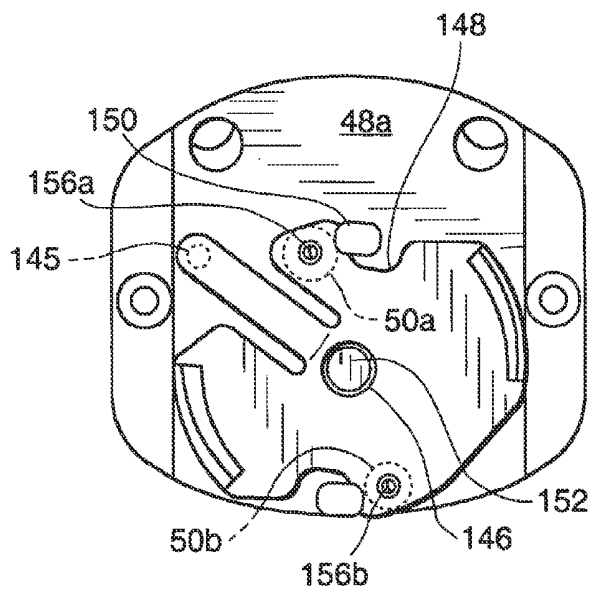


FIG. 30B

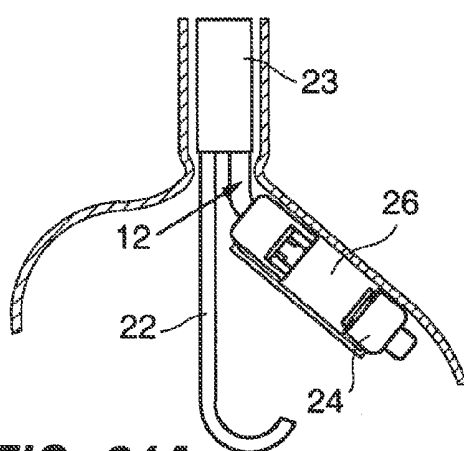


FIG. 31A

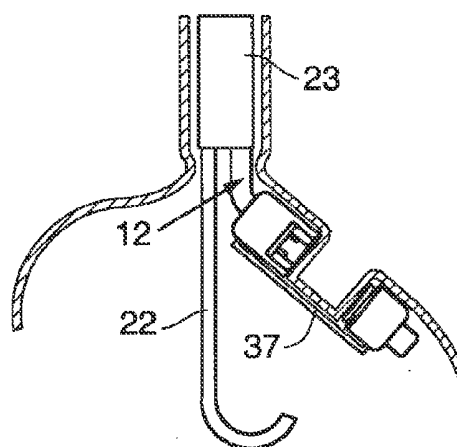


FIG. 31B

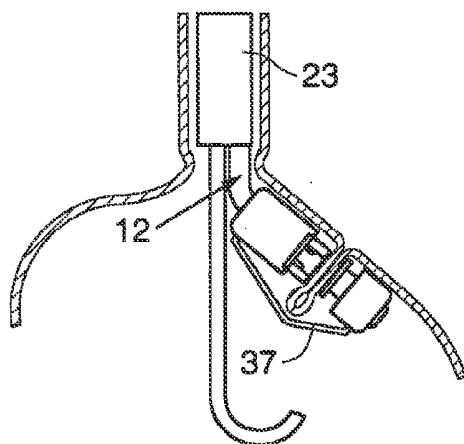


FIG. 31C

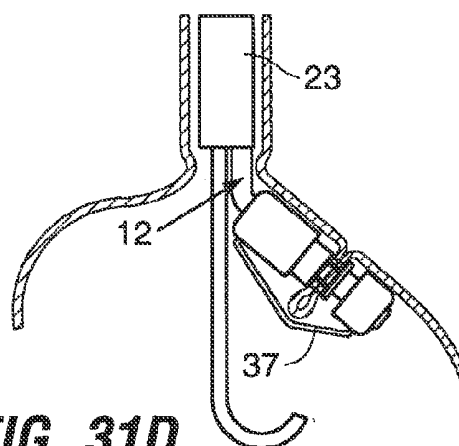


FIG. 31D

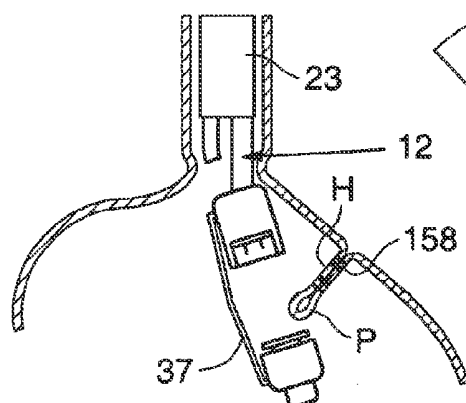


FIG. 31E

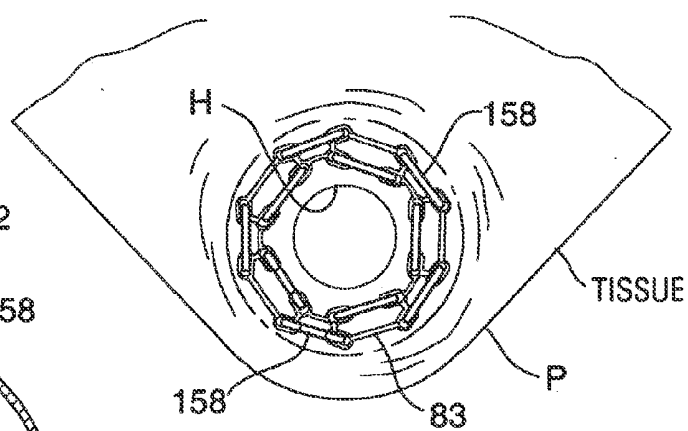


FIG. 33

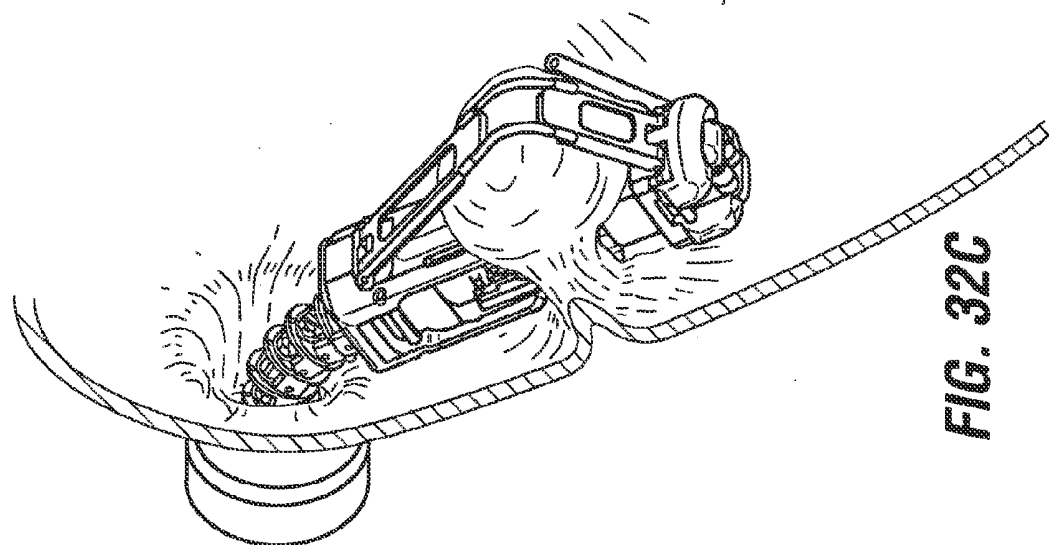


FIG. 32C

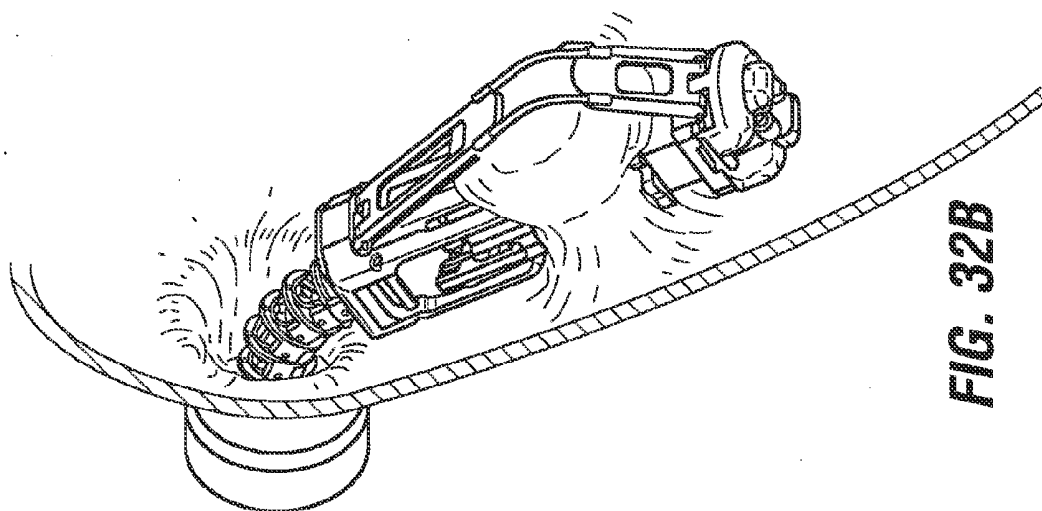


FIG. 32B

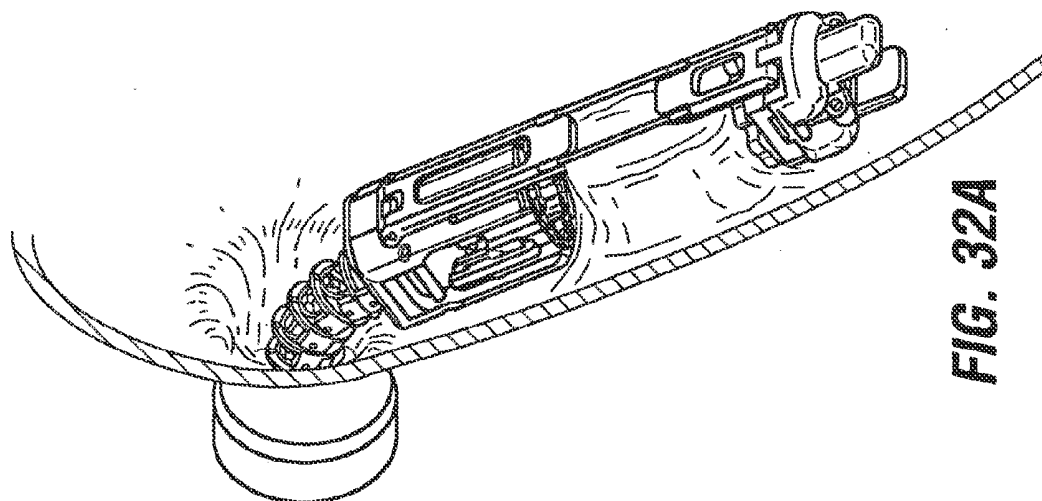
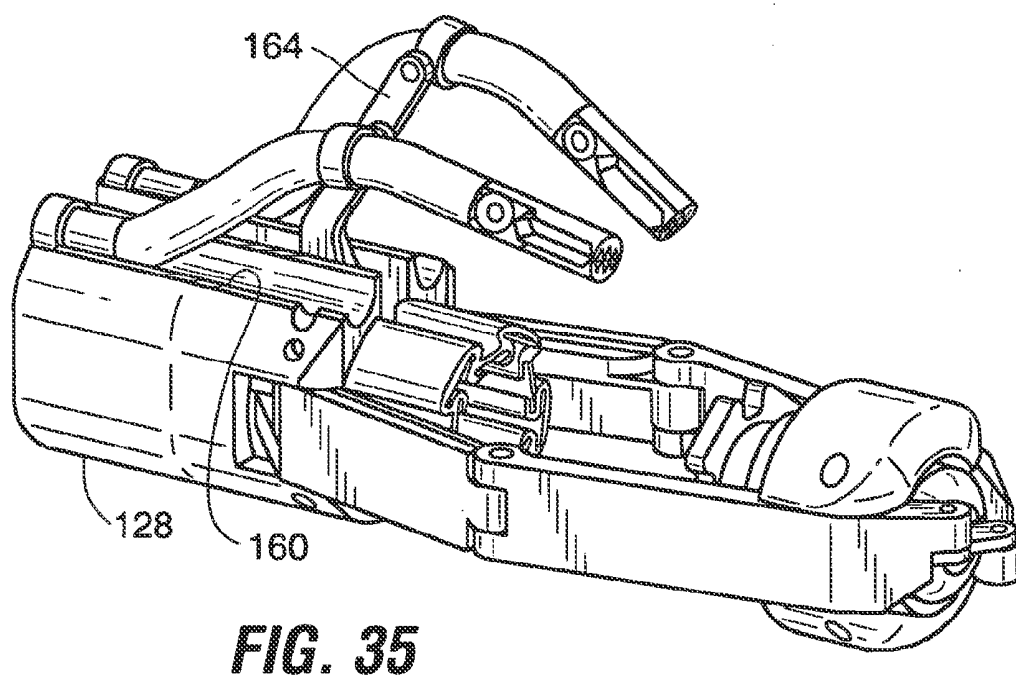
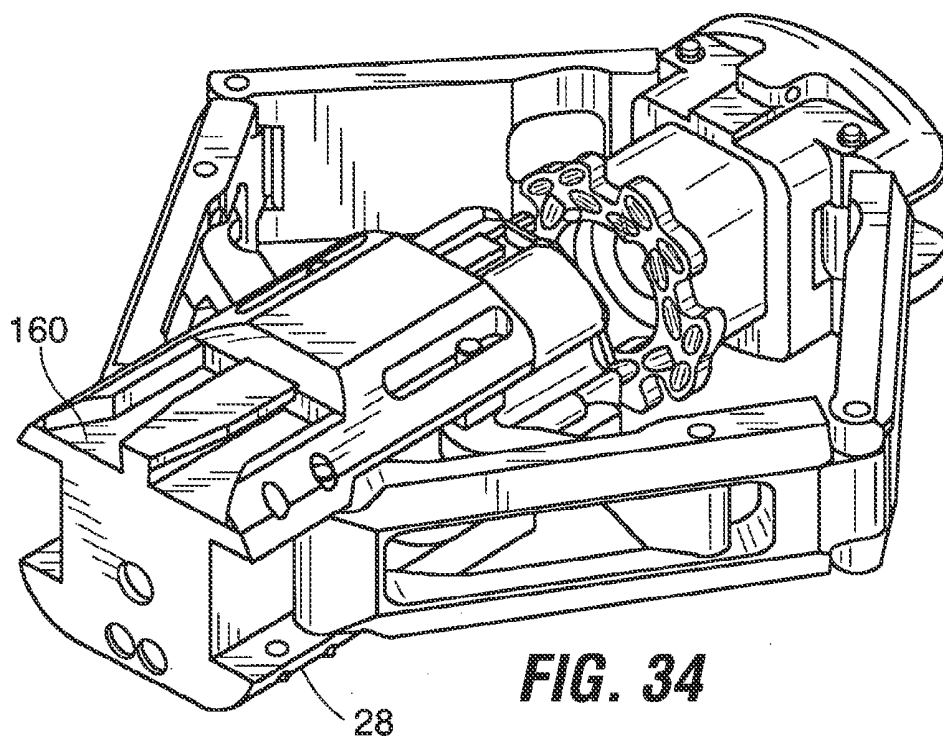


FIG. 32A



ENDOSCOPIC STAPLING DEVICES AND METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 12/050,169, filed Mar. 18, 2008, entitled ENDOSCOPIC STAPLING DEVICES AND METHODS, now pending; this application is also a divisional of U.S. patent application Ser. No. 12/052,997, filed Mar. 21, 2008, now allowed, which is a divisional of U.S. patent application Ser. No. 12/050,169, filed Mar. 18, 2008, now pending; this application is also a divisional of U.S. patent application Ser. No. 12/053,010, filed Mar. 21, 2008, now allowed, which is a divisional of U.S. patent application Ser. No. 12/050,169, filed Mar. 18, 2008, now pending; this application is also a divisional of U.S. patent application Ser. No. 12/053,027, filed Mar. 21, 2008, now allowed, which is a divisional of U.S. patent application Ser. No. 12/050,169, filed Mar. 18, 2008, now pending; this application is also a divisional of U.S. patent application Ser. No. 12/053,066, filed Mar. 21, 2008, now allowed, which is a divisional of U.S. patent application Ser. No. 12/050,169, filed Mar. 18, 2008, now pending; this application is also a divisional of U.S. patent application Ser. No. 12/053,182, filed Mar. 21, 2008, now allowed, which is a divisional of U.S. patent application Ser. No. 12/050,169, filed Mar. 18, 2008, now pending; all of which are incorporated herein by reference in their entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] None

TECHNICAL FIELD

[0003] The present invention relates generally to the field of systems and methods for performing endoscopic surgery, and specifically to systems and methods for endoscopic stapling of tissue within body cavities.

BACKGROUND

[0004] An anatomical view of a human stomach S and associated features is shown in FIG. 1A. The esophagus E delivers food from the mouth to the proximal portion of the stomach S. The z-line or gastro-esophageal junction Z is the irregularly-shaped border between the thin tissue of the esophagus and the thicker tissue of the stomach wall. The gastro-esophageal junction region G is the region encompassing the distal portion of the esophagus E, the z-line, and the proximal portion of the stomach S.

[0005] Stomach S includes a fundus F at its proximal end and an antrum A at its distal end. Antrum A feeds into the pylorus P which attaches to the duodenum D, the proximal region of the small intestine. Within the pylorus P is a sphincter that prevents backflow of food from the duodenum D into the stomach. The middle region of the small intestine, positioned distally of the duodenum D, is the jejunum J.

[0006] FIG. 1B illustrates the tissue layers forming the stomach wall. The outermost layer is the serosal layer or "serosa" S and the innermost layer, lining the stomach interior, is the mucosal layer or "mucosa" MUC. The submucosa SM and the multi-layer muscularis M lie between the mucosa and the serosa.

[0007] There are a number of applications for endoscopic application of fasteners such as staples to tissue within a body cavity. Some of those applications involve forming tissue structures such as plications or folds in tissue of the body cavity.

[0008] Several prior applications, including International Application No. WO 2005/037152 having an international filing date of Oct. 8, 2004 and U.S. application Ser. No. 11/439,461, filed May 23, 2006 (both incorporated herein by reference) describe methods according to which medical implants are coupled to tissue structures formed within the stomach. According to these applications, devices for inducing weight loss (e.g. by restricting and/or obstructing flow of food into the stomach, and/or by occupying a portion of the stomach volume) may be coupled to tissue tunnels or plications formed from stomach tissue.

[0009] For example, U.S. application Ser. No. 11/439,461 describes a restrictive and/or obstructive implant system for inducing weight loss. In one embodiment, flexible loops are coupled to tissue plications formed in the gastroesophageal junction region of the stomach. An implant, such as a flow restrictive and/or obstructive implant, is passed through the loops 2 and thus retained in the stomach.

[0010] In other instances, tissue plications may themselves be sufficient to provide the necessary treatment. For example, the plications may be used to reduce stomach volume or form a flow restriction within the stomach as disclosed in WO 2005/037152 and in Applicants' co-pending application Ser. No. 11/542,457, filed Oct. 3, 2006, U.S. Publication No. 2007-0219571, which is incorporated herein by reference.

[0011] Other types of implants may be coupled to such plications or other tissue structures for a variety of purposes. These implants include, but are not limited to prosthetic valves for the treatment of gastro-esophageal reflux disease, gastric stimulators, pH monitors and drug eluting devices that release drugs, biologics or cells into the stomach or elsewhere in the GI tract. Such drug eluting devices might include those which release leptin (a hormone which creates feelings of satiety), Ghrelin (a hormone which creates feelings of hunger), octreotide (which reduces Ghrelin levels and thus reduces hunger), Insulin, chemotherapeutic agents, natural biologics (e.g. growth factor, cytokines) which aid in post surgery trauma, ulcers, lacerations etc. Still other implants might be of a type which might provide a platform to which specific cell types can adhere, grow and provide biologically-active gene products to the GI tract, and/or a platform for radiation sources that can provide a local source of radiation for therapeutic purposes, or provide a platform whereby diagnostic ligands are immobilized and used to sample the GI tract for evidence of specific normal or pathological conditions, or provide an anchor point for imaging the GI tract via cameras and other image collecting devices.

[0012] The prior applications listed above, address the desirability of forming tissue plications, pockets or tunnels in a way that regions of serosal tissue (i.e. the tissue on the exterior surface of the stomach) are retained in contact with one another. Over time, adhesions formed between the opposed serosal layers create strong bonds that can facilitate retention of the plication/pocket/tissue over extended durations, despite the forces imparted on them by stomach movement and implanted devices.

[0013] Regardless of the application for which a plication is being formed, it is highly desirable to form that plication using steps carried out from within the stomach using instru-

ments passed down the esophagus, rather than using more invasive surgical or laparoscopic methods. The present application describes endoscopic staplers which may be passed transorally into the stomach and used to form serosal-to-serosal plications in a stomach wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1A is a schematic illustration of a human stomach and a portion of the small intestine.
 [0015] FIG. 1B is a cross-sectional perspective view of a portion of a stomach wall, illustrating the layers of tissue forming the wall.
 [0016] FIG. 2 illustrates an endoscopic stapling system.
 [0017] FIGS. 3A-3C are perspective views showing the stapler head of the stapling system of FIG. 2 in three different positions.
 [0018] FIG. 4 is a perspective view of the stapler head, with the membrane removed.
 [0019] FIG. 5 is a perspective view of the proximal end of the staple housing of the stapler head of FIG. 4.
 [0020] FIG. 6 is a perspective view of the distal end of the staple housing of the stapler head of FIG. 4.
 [0021] FIG. 7 is an exploded perspective view showing elements advanceable within the staple housing during compression and stapling operations.
 [0022] FIG. 8 is a plan view of a staple reinforcement device.
 [0023] FIG. 9 is a side elevation view of a staple cartridge.
 [0024] FIG. 10 is a perspective view of the staple housing similar to FIG. 6, but showing some of the elements of FIG. 7 within the housing.
 [0025] FIGS. 11A-11D are a series of schematic representations of the hydraulic chamber and pistons, illustrating operation of an exemplary hydraulic system during tissue compression and stapling.
 [0026] FIG. 11E is similar to FIG. 11D and shows an alternative piston configuration.
 [0027] FIG. 12 is a perspective view of the anvil housing of the stapler head of FIG. 4.
 [0028] FIG. 13 is a perspective view of the anvil support.
 [0029] FIG. 14 is a plan view of the anvil.
 [0030] FIG. 15A is a cross-sectional side view of the cutting device and a first embodiment of a cutting board.
 [0031] FIG. 15B is a cross-sectional side view of the cutting device and a second embodiment of a cutting board.
 [0032] FIG. 16 is a perspective view of the hinged arm assemblies of the stapler head of FIG. 4.
 [0033] FIG. 17 is a top plan view of the stapler head of FIG. 4 in the streamlined position for introduction into the body. Both the membrane and the membrane raiser are not shown for purposes of clarity.
 [0034] FIG. 18 is similar to FIG. 17 and illustrates hidden features of FIG. 17.
 [0035] FIG. 19 is a perspective view of the stapler head in an intermediate, partially expanded, position.
 [0036] FIG. 20 is a plan view similar to FIG. 17 but showing the stapler head in the intermediate position.
 [0037] FIG. 21 is similar to FIG. 20 and illustrates hidden features of FIG. 20.
 [0038] FIG. 22 is a perspective view of the stapler head in a fully expanded, full compression position.
 [0039] FIG. 23 is a plan view similar to FIG. 20 but showing the stapler head in the full compression position.

[0040] FIG. 24 is similar to FIG. 23 and illustrates hidden features of FIG. 24.

[0041] FIGS. 25A-25C are perspective views showing the staple housing, cartridge and a portion of the membrane raiser. These figures illustrate the steps of detaching a staple cartridge from the staple housing.

[0042] FIG. 26 is a perspective view of the stapler of FIG. 2, with the staple head removed.

[0043] FIG. 27A is a plan view of the articulating section of the stapler of FIG. 2, showing the drive fluid lines.

[0044] FIG. 27B shows a drive fluid line having an alternate longitudinally expandable shape.

[0045] FIG. 28 is a cross-sectional side view of the handle of the stapler of FIG. 2.

[0046] FIG. 29 is a perspective view of the handle of the stapler of FIG. 2.

[0047] FIGS. 30A and 30B are plan views of the proximal face of the staple housing, showing a method for attaching the end plate of the stapler handle to the staple housing.

[0048] FIGS. 31A-31E are a series of drawings schematically illustrating use of the system of FIG. 2 to form a plication in a stomach.

[0049] FIGS. 32A-32C are a series of perspective views illustrating use of the stapler of FIG. 2 to acquire, compress, and then staple stomach wall tissue to form a plication in the stomach. The membrane is not shown in these drawings.

[0050] FIG. 33 is a top plan view of a plication formed in body tissue.

[0051] FIGS. 34 and 35 are perspective views of an alternative stapler head equipped to carry additional tools.

DETAILED DESCRIPTION

[0052] The present application describes endoscopic fastener-applying devices which in preferred embodiments may be passed transorally into the stomach and used to plicate stomach tissue.

[0053] In the disclosed embodiments, tissue is drawn inwardly into a vacuum chamber, although tissue may be drawn inwardly using other components (e.g. graspers) that do not involve the use of a vacuum. When a portion of the interior stomach wall is drawn inwardly, sections of serosal tissue on the exterior of the stomach are positioned facing one another. The disclosed fastener applying device allows the opposed sections of tissue to be moved into contact with one another, and delivers fasteners that will hold the tissue sections together until at least such time as serosal bonds form between them. Each of these steps may be performed wholly from the inside of the stomach and thus can eliminate the need for any surgical or laparoscopic intervention. After one or more plications is formed, medical devices (including, but not limited to any of the types listed above) may be coupled to the plication(s) for retention within the stomach.

[0054] The disclosed embodiments include an optional feature that forms a hole or cut in a plication using the fastener-applying device. This hole or cut might be formed so that a portion of a medical implant may be passed through or linked to the hole/cut, or it may be formed so as to provoke a healing response that will contribute to the strength of the resulting tissue bond.

[0055] In the description of the embodiments given below, the fastener-applying devices are described as being staplers, and exemplary methods are given with respect to the formation of plications in stomach tissue. It should be understood, however, that the embodiments described herein include fea-

tures having equal applicability for applying other types of fasteners, and for applying staples or other fasteners for purposes other than formation of plications. The disclosed embodiments and methods will also find use in parts of the body outside the GI system. Additionally, although the disclosed embodiment features circular stapling and cutting of a concentric hole, modifications are conceivable in which linear stapling can be accomplished, as well as circular or linear stapling without cutting.

[0056] FIG. 2 illustrates one embodiment of a system 10 for tissue stapling that is suitable for endoscopic use, as well as surgical or laparoscopic use if desired.

[0057] Generally speaking, system 10 includes a stapler 12 having a stapler head 14 positioned on a distal portion of a shaft 16. A handle 18 on the shaft 16 controls articulation of the stapler head 14 and actuation of the tissue acquisition, tissue compression, and stapling functions of the stapler head 14. Vacuum and fluid sources 20, 25 are fluidly coupled to the handle 18 for use in tissue acquisition, compression and stapling as discussed below. The vacuum source 20 may be the "house vacuum" accessible through a coupling on the wall of the operating room, or an auxiliary suction pump. The stapler may include a switch 21 allowing the user to control airflow between the vacuum source and stapler.

[0058] The fluid source 25 may be a single source of drive fluid (e.g. water, saline, oil, gas) or multiple sources, but in each case the fluid source preferably includes two actuators separately used to control flow into each of two hydraulic lines (one for tissue compression and one for stapling). An endoscope 22 insertable through a lumen in the shaft 16 permits visualization of the plication procedure. The system may optionally include an overtube, such an endoscopic guide tube 23, having a lumen for receiving the stapler 12.

[0059] Referring to FIG. 3A, a covering or membrane 24 encloses the stapler head 14 to form a vacuum chamber within the stapler head 14. The side exposed to the tissue to be plicated remains uncovered by the membrane 24 to allow tissue to be drawn into the chamber during use. For example, the membrane 24 may include a side opening 26 as shown in FIG. 3B. Membrane 24 is preferably formed of silicone, elastomeric material, or any other inelastic or elastic flexible or deformable biocompatible material capable of forming a vacuum chamber that will expand in volume to accommodate tissue drawn into the chamber.

[0060] At least a portion of the membrane is at least partially transparent. In being at least partially transparent, the membrane is formed of a material, or includes sections of material, that will allow the user to see through the membrane well enough to confirm (via endoscopic observation) that an appropriate volume of tissue has been acquired into the stapler head prior to staple application. The opening 26 may be surrounded by a reinforced section 27 formed of material that will strengthen the area around the opening 26. Reinforced section 27 may be formed of a thicker section of the membrane material, and/or a higher durometer material. Alternatively, reinforcing ribs or other structures or elements may be formed into or onto the membrane material, or embedded in the membrane material.

Stapler Head

[0061] The stapler head 14 is designed to have a minimum profile during insertion to the plication site, and to then transform into a much larger profile device having a large internal volume. For example, in one embodiment the vacuum cham-

ber might have an initial internal volume of 0.2 cubic inches, and an expanded volume of 0.6 cubic inches (i.e. the internal chamber volume after subtracting the volume occupied by the stapler head components positioned within the vacuum chamber). This large internal volume allows a large volume of tissue to be drawn into the vacuum chamber and stapled. In this way, the stapler head creates a large plication without requiring invasive techniques for insertion. The unique features of the stapler head allow in situ volumetric expansion of the stapler head using a minimum of motion and force input. [0062] Features of the stapler head are shown in FIGS. 4-10. For clarity, the membrane is not shown in these figures. Referring to FIG. 4, stapler head 14 generally includes a first member comprising a proximal staple housing 28, a second member comprising a distal anvil housing 30, and at least one elongate member but preferably a pair of hinged arm assemblies 32.

[0063] The staple housing and anvil housing are arranged to allow tissue to be compressed between contact surfaces on each of the staple housing and the anvil housing. In the disclosed embodiment, the contact surfaces are on a staple holding portion of the staple housing and an anvil on the anvil housing.

[0064] The arm assemblies 32 extend between the staple housing 28 and anvil housing 30 on opposite sides of the stapler head 14. Proximal and distal pins 34, 36 pivotally couple each arm assembly 32 to the staple housing 28 and the anvil housing 30. An expansion member comprising a membrane raiser 37 also extends between the staple housing 28 and the anvil housing 30. Although the membrane 24 is not shown in FIG. 4, it should be understood that the membrane raiser 37 is positioned opposite the opening 26 (FIG. 3B) in the membrane. In the illustrated embodiment, membrane raiser 37 includes a link 38 pivotally mounted to the staple housing by a pin 42, a corresponding link 40 pivotally mounted to the anvil housing by pin 44, and spring wires 46 coupling the links 38, 40 to one another.

Staple Housing

[0065] Turning to a more detailed discussion of the stapler head components, the staple housing 28 can be seen separated from other components in FIGS. 5 and 6. As shown in FIG. 5, proximal face 48 of the staple housing includes input ports 50a, 50b through which fluid is directed for hydraulic actuation of the tissue compression, stapling, and optional cutting operations of the stapler head. Seals 51 surround the ports 50a, 50b to minimize fluid leakage.

[0066] Vacuum ports 52 are fluidly coupled to a vacuum source 20 (FIG. 2) that is selectively activated to create negative pressure in the vacuum chamber for tissue acquisition. The vacuum ports 52 are connected to the vacuum source 20 by flexible tubing (not shown) in the stapler shaft 16 (FIG. 2). Mounting holes 54 are used to mount the stapler head 14 to the shaft 16.

[0067] The staple housing 28 includes upper and lower sections 58a, 58b above and below open side sections 56. The upper section 58a includes a recess 60 within which the pivot pin 42 for link 38 (FIG. 4) is mounted. As best shown in FIG. 6, bores 62 are positioned in the upper and lower sections 58a, 58b to receive pins 34 (FIG. 4) that serve as the proximal pivot points for arm assemblies 32. Guide slots 64 extend longitudinally through the upper and lower sections 58a, 58b.

[0068] Referring to FIG. 6, a hydraulic chamber 66 is disposed within the staple housing 28. Within the hydraulic

chamber 66 (FIG. 6) is a dedicated hydraulic circuit for driving the tissue compression and stapling functions of the stapler. Chamber 66 is fluidly coupled to the fluid input ports 50a, 50b (FIG. 5). As will be discussed in detail in connection with FIGS. 11A-11D, fluid driven into the hydraulic chamber 66 via input ports 50a, 50b sequentially advances a system of hydraulic pistons (not shown) that act on other components to compress the tissue, and that drive the staples and cutting element through the compressed tissue.

[0069] FIG. 7 illustrates components of the stapler head that are driven by the hydraulic system for compression, stapling, and cutting. For clarity, these components are shown separated from the staple housing and from each other. In this discussion, the components that are driven by the hydraulic system will be described. The hydraulic system itself is described in a later section in connection with FIGS. 1A-11D.

[0070] In particular, FIG. 7 illustrates a drive member which takes the form of a disk 68 in the staple housing. In the assembled housing, disk 68 is positioned such that it will be pushed distally by a hydraulic compression piston (not shown). The drive member is coupled to the arm assemblies 32, anvil housing, and staple housing so that advancing the drive member distally effects tissue compression by bringing the contact surfaces of the staple housing and anvil housing relatively towards one another.

[0071] Disk 68 includes mounting bores 70, a central opening 72, and alignment posts 74. Referring briefly to FIG. 10, in the assembled stapler head, disk 68 is coupled to the stapler housing 28 using pins 84 that extend through the housing's guide slots 64 and through mounting bores 70 in the disk 68.

[0072] A portion of the staple housing 28 contains staples to be fired into the tissue. The staples are contained within a staple holder on the staple housing. The staple holder may have a number of different configurations. For example, it may be an integral portion of the staple housing, or a separate part mounted or attached to the staple housing, and/or it may be moveable relative to the body of the staple housing to effect tissue compression prior to stapling. In any of these examples, the staple holder may be a removeable/replaceable cartridge, and/or it may be refillable by inserting additional staples into it. In other embodiments, the staple holder may be neither replaceable nor refillable.

[0073] In the disclosed embodiment, the staple holder is a removeable staple cartridge 78 that can be replaced with another cartridge after staple firing. In this embodiment, the staple cartridge is moveable relative to the body of the staple housing to compress the tissue prior to staple firing.

[0074] Referring again to FIG. 7, staple cartridge 78 is positionable within the staple housing, distal to the disk 68, such that distal advancement of the disk by the compression piston pushes the cartridge distally to compress tissue disposed between the cartridge and anvil. Grooves 79 on the exterior of the cartridge slide over corresponding ones of the alignment posts 74 during insertion of the cartridge into the stapler head. FIG. 10 shows the alignment posts prior to loading of a cartridge into the staple housing. As shown, the alignment posts 74 may have tapered ends to facilitate loading of the cartridge over the posts.

[0075] Again referring to FIG. 7, cartridge 78 includes a number of staple locations 80, each housing a staple. The staple cartridge is equipped with bosses 81 to retain a staple line reinforcement device 83 of the type shown in FIG. 8 and disclosed in detail in commonly-owned U.S. application Ser. No. 11/542,457, entitled ENDOSCOPIC PLICATION

DEVICES AND METHODS, filed Oct. 3, 2006, and published Sep. 20, 2007 as US 20070219571. To summarize briefly, this type of reinforcement device 83 may be a ring or other element positionable against the distal face of the staple cartridge. When the ring is placed on the cartridge, openings 85 in the ring align with prongs of some of the staples in the cartridge. When staples are driven from the cartridge, these prongs pass through associated ones of the openings 85 and capture the ring 83 against the adjacent body tissue.

[0076] Referring to FIGS. 7 and 9, a number of undercut bosses 81 on the anvil-facing side of the cartridge may be used to lock the reinforcement device 83 in place on the face of the staple cartridge. Other positive shapes, such as mushrooms, hooks, and tilted bosses could be used to accomplish the same end. Negative shapes, such as pockets or grooves formed into the surface of the cartridge, may also be employed to engage corresponding features on the reinforcement device 83. As another alternative, the reinforcement device may be held in place on the cartridge using adhesives.

[0077] A cutter element 86 extends through the central opening 72 (FIG. 7) of the disk 68. The cutter element is shown as a tubular punch having a sharpened wall and a lumen 87, but may be provided in alternative forms. A staple pusher 76 is mounted to the cutter element, distally of the disk as can be seen in the assembled view of FIG. 10. Staple pusher 76 includes pusher elements 82 proportioned to slide into the cartridge's staple locations 80 as the staple pusher 76 is advanced into the staple cartridge 78, thus driving the staples from the cartridge. A hydraulically-driven staple piston (not shown in FIG. 7) in the hydraulic chamber 66 is coupled to the cutter element 86 such that advancement of the stapler piston advances the staple pusher 76 and cutter element 86 in a distal direction.

Fluid Drive System

[0078] The fluid drive system used to actuate compression, stapling and cutting may be configured in various ways. The following paragraphs describe one exemplary configuration for the fluid drive system, which in this embodiment is a hydraulic system. FIGS. 1A and 11B schematically show the fluid flow in the hydraulic chamber 66 of the staple housing 28 during both compression and stapling stages of actuation. Referring to FIG. 11A, compression piston 106 is disposed within hydraulic chamber 66. Disk 68 (also shown in FIGS. 7 and 10) is positioned in contact with or slightly distal to piston 106. Compression piston 106 is generally cup-shaped, having a rear wall 108 and a side wall 110 enclosing an interior 111. O-ring seals 112 are spaced-apart on a proximal portion of the side wall 110. Channels 114 are formed through the side wall 110, between the o-ring seals 112.

[0079] A second piston, referred to as the staple piston 116, is positioned in the interior 111 of compression piston 106, against the rear wall 108. Although not shown in FIGS. 1A-11D, cutting element 86 (FIG. 7), with the staple pusher 76 thereon, is positioned in contact with or slightly distal to the staple piston 116. An o-ring seal 118 surrounds a portion of the staple piston 116 that is distal to the channels 114 in the compression piston.

[0080] A first fluid channel 120 extends from fluid port 50a in the stapler housing 28 to a proximal section of the hydraulic chamber 66. A second fluid channel 122 extends from fluid port 50b in the stapler housing to a more distal section of the hydraulic chamber 66. Fluid flow from port 50a and fluid channel 120 against the compression piston cylinder is shown

in FIG. 1A. Fluid pressure within the hydraulic chamber 66 advances the compression piston 106, with the stapler piston 116 within it, in a distal direction. FIG. 11B shows the compression piston 106 approaching the end of its travel. Once the compression piston reaches the end of its travel as shown in FIG. 11C, channel 114 in the compression piston 106 aligns with channel 122 in the housing, allowing fluid introduced through fluid port 50b to enter the interior of the compression piston 106 via channel 122. The fluid entering the interior of the compression piston drives the staple piston distally as shown in FIG. 11D. In an alternative embodiment shown in FIG. 11E, a third piston 117 is provided for separately driving the cutting element 86. In this embodiment, fluid introduced into a third drive fluid port 50c causes advancement of the third piston 117. The pistons 106, 116 and 117 and associated fluid paths may be arranged so that fluid cannot enter the interior of the stapler piston to advance the cutting piston 117 until compression piston 106 has traveled to the tissue-compression position and stapler piston 116 has in turn traveled to the stapling position.

[0081] The anvil housing (identified by numeral 30 in FIG. 4) will next be described with reference to FIG. 12. The anvil housing 30 includes mounting bores 88 for receiving pivot pins 36 at the distal end of the hinged arm assemblies 32. The upper section of the anvil housing 30 includes a section 94 through which the pivot pin 44 for link 40 (FIG. 4) is mounted.

[0082] A central bore 90 extends longitudinally through the anvil housing 30. An anvil support 92 is longitudinally slidable within the bore. Both the bore 90 and the anvil support 92 are preferably formed to have non-circular cross-sections (such as the illustrated rectangular cross-section) with flat bearing surfaces to prevent rotation of the piston within the bore.

[0083] FIG. 13 shows the anvil support 92 separated from the anvil housing 30. The distal portion of the anvil support 92 is split into upper and lower plates 95a, b. Plate 95a has a bore 93 axially aligned with a similar bore in plate 95b. The proximal portion of the anvil support 92 carries the anvil 96. As shown in FIG. 14, anvil 96 includes a plurality of indentations 98 positioned such when staples are driven from the staple cartridge, each staple leg engages one of the indentations, which causes the staple leg to fold. A central opening 97 extends through the anvil 96 and is contiguous with a lumen in the anvil support 92.

[0084] The anvil 96 and the staple cartridge 78 (FIG. 7) are the two parts of the stapler head which exert force on the tissue to be stapled. As shown in FIGS. 9 and 14, the preferred anvil and cartridge are designed to use a minimal amount of material surrounding the indentations 98 of the anvil 96 and the staple locations 80 of the cartridge 78—so that the amount of anvil/cartridge surface area contacting the tissue is as small as possible. When subjected to a constant force, a smaller footprint will damage less tissue than would a larger footprint, since a smaller area of tissue is squeezed between the anvil and cartridge. However, the tissue that does get squeezed experiences more pressure from the given force because the force is distributed over a smaller area. In other words, the minimized footprint creates more pressure on the tissue with less force. This is advantageous from a mechanical standpoint because the stapler head need not supply or withstand as much force as would be needed with a larger-footprint cartridge and anvil.

[0085] Referring to FIG. 7, in the illustrated embodiments, the staple cartridge 78 has an outer wall that tracks the contours of the staples housed within it, thus forming a number of pedals 73 surrounding the outer staple positions or slots 80a, with the grooves 79 disposed between the pedals, adjacent to the inner staple positions 80b. Rather than providing each staple position to be fully surrounded by cartridge material, the staple positions 80a, 80b preferably each include a back wall 71a and a retaining element attached to the wall and positioned to retain a staple between the retaining element and the back wall. In FIG. 7, the retaining element comprises a pair of wings 71b that curve inwardly from the back wall 71 to define a slot that is sufficiently bounded to retain a staple within the staple position, but that is preferably not bounded around its full circumference. The anvil has a similar pedal arrangement, as shown in FIG. 13.

[0086] Referring again to FIG. 13, a plate 99 is positioned on the anvil 96 such that the distally-advancing cutting element 86 will advance into contact with the plate 99 during tissue cutting. In one embodiment, the plate 99 may be seated within the opening 97 in the anvil. The plate 99, which will also be referred to as the “cutting board”, has a hole 101 in it which relieves the pressure of the captured tissue and prevents hydraulic locking, a condition in which the punch and plate create a closed volume. If it is desired to move the cutting element 86 after contact is made, pressure will increase inside this closed volume and it will resist further motion. This may prevent or adversely affect tissue cutting.

[0087] The cutting board is preferably designed so as to not serve as a hard stop against advancement of the cutting element 86. If the cutting element 86 is stopped by the cutting board, the stapling piston will also be stopped and incomplete staple formation may result. Therefore, it is preferred that the cutting element 86 is allowed to penetrate or displace the cutting board during and after the tissue is cut.

[0088] FIGS. 15A and 15B illustrate the cutting element 86 advanced into contact with different embodiments of cutting boards. In the FIG. 15A embodiment, the material of cutting board 99a is a relatively soft material, such as an elastomeric silicone, which is cut by the advancing cutting element as shown. This material allows the sharp distal end of the cutting element to move into the cutting board during the final stage of staple formation. In the FIG. 15B embodiment, the cutting board 99b can be made of a harder material positioned with a compressible object such as an elastomeric spring 99c behind it. In the figure, this spring is an o-ring. Advancement of the cutting element 86 against the cutting board 99b causes the cutting board to be displaced distally against the spring 99c. The advancing cutting element 86 experiences increasing resistance as the o-ring is compressed. Other spring shapes and materials, such as coiled wire, spring washers and leaf springs can be used to achieve the same result. The chamfer 99d on the surface of the cutting board 99b may help to align the cutting element 86 as it is forced into contact with the cutting board.

Arm Assemblies

[0089] Following is a discussion of the features of the arm assemblies 32. FIG. 16 shows the arm assemblies 32 separated from the other elements of the stapler head. In general, each arm assembly has a first arm section pivotally coupled to the staple housing and a second arm section pivotally coupled between the first arm section and the anvil housing. While not

present in the illustrated embodiment, additional arm sections may be positioned between the first and second arm sections. [0090] Each arm assembly includes a proximal arm 100 and a distal arm 102 joined to one another to form a hinge 104. Each of the proximal arms 100 has a longitudinal cutout 108 and a spreader arm 110 pivotally mounted within the cutout 108. The distal end of each spreader arm 110 includes a bore 112. Pin 84 is positioned within the bore 112. As disclosed in connection with FIG. 10, this pin 84 extends through the disk 68 and has ends that ride within the slots 64 (FIG. 6) on the lower and upper sections of the stapler housing. Longitudinal movement of the disk 68 within the stapler housing will thus advance the pins 84 within their corresponding slots 64, causing the spreader arms 110 to pivot relative to the pins 84 and to thus drive the arm assemblies 32 outwardly. Additional specifics concerning movement of the arm assemblies 32 is set forth in the section entitled Stapler Head Operation.

[0091] Distal arms 102 of the arm assemblies include pins 36 which, as discussed, are pivotally mounted to the anvil housing 30 (FIG. 4). A pair of drive links 114 are provided, each of which has a first end pivotally attached to a corresponding one of the distal arms 102 and a second end pivotally coupled to a common pin 116. In the assembled stapler head, pin 116 is positioned in the bores 93 of the upper and lower plates 95a, 95b of the anvil support (see plates 95a, b in FIG. 12). As detailed in the Stapler Head Operation section below, when the spreader arms 110 drive the arm assemblies 32 outwardly, drive links 114 act on the pin 116 to push the anvil support in a proximal direction, causing the anvil to advance proximally towards the staple cartridge.

Stapler Head Operation

[0092] The following discussion centers on the manner in which the arm assemblies function to expand the vacuum chamber and to compress tissue that has been drawn into the chamber using suction. As an initial step preceding chamber expansion, the stapler head is positioned with the opening 26 in the membrane 24 in contact with tissue at the location at which plication creation is desired. Vacuum source 20 (FIG. 2) is activated to apply vacuum to the inside of the vacuum chamber defined by the membrane. Tissue in contact with the opening 26 (FIG. 3B) will be drawn into the vacuum chamber between the staple housing 28 and the anvil housing 30. After the tissue is drawn in, the stapler profile is changed, expanding the volume of the chamber within the membrane.

[0093] The streamlined position of the stapler head 28 prior to expansion is shown in FIGS. 4, 17 and 18. In particular, the hinged arm assemblies 32 and membrane raisers 37 are in generally straight orientations. The proximal arms 100 serve as the drive arms for chamber expansion and tissue compression. Motion of these arms is initiated when water under pressure is forced into the hydraulic circuit of the staple housing. Referring to FIG. 19, the fluid pressure advances disk 68 (by action of the compression piston 106, not shown in FIG. 19). Disk 68 in turn pushes the staple cartridge 78 toward the anvil 96 as shown in FIGS. 19-21, causing the staple cartridge 78 to extend further from the staple housing 28.

[0094] Both the disk 68 and the arm spreaders 110 are coupled to the pins 84. For this reason, the longitudinal movement of the disk 68 within the stapler housing 28 will carry the pins 84 distally within their corresponding slots 64. The arm spreaders 110 will consequently pivot relative to the pins 84, driving the proximal arms 100 outwardly. Outward move-

ment of proximal arms 100 at hinge 104 causes the distal arms 102 to also pivot outwardly at hinge 104, forming an angle between the proximal and distal arms 100, 102. Naturally, formation of the angle between the arms 100, 102 shortens the effective length between the remote ends of the arms, causing the distal pins 36 of the distal arms 102 to carry the anvil housing 30 towards the staple cartridge. The pivoting movement of the distal arms 102 further causes drive links 114 to act on pin 116 to push the anvil support in a proximal direction. This moves the anvil support relative to the anvil housing in a proximal direction at the same time the anvil housing is also moving proximally.

[0095] In essence, one motion, that of the hydraulically driven compression piston, creates at least three motions, illustrated by arrows A1, A2 and A3 in FIGS. 19-21. These three motions include: the staple cartridge 78 moving relative to the staple housing in a direction towards the anvil 96 (arrow A1), the anvil housing 30 moving toward the staple housing 28 (arrow A2) and the anvil 96 itself moving relative to the anvil housing 30 in a direction towards the cartridge (arrow A3). This compound motion of the anvil toward the staple cartridge enables a small displacement of the compression piston to quickly compress tissue in the grip of stapler. The multiplication of motion also enhances force transmission between the two housings by keeping the angle at hinge 104, between the proximal (driven) arm and the distal (drive) arm, as large as possible.

[0096] The relative motion of the two housings 28, 30 toward each other also drives upward links 38, 40 and their interconnecting spring wires 46 on the top of the stapler head 14. Together, the links and spring wires raise the top of the membrane, creating more volume to accommodate expansion of the tissue during compression.

[0097] Compression of the tissue is halted when the pins 84 traveling in slots 64 in the staple housing 28 reach the limit of travel, as shown in FIGS. 22-24. Thus, the slots and associated components are dimensioned to set the desired separation distance between the tissue contact surfaces on the stapler side and the anvil side of the stapler head. Exemplary separation distances for use in stomach wall plications might include approximately 0.06-0.07 inches (e.g. for use with staples having legs of 5.5 mm length) or 0.109 inches for 6.5 mm leg length staples. Application of additional pressure into the hydraulic circuit will not compress the tissue any further.

[0098] Moreover, because of the piston arrangement, the stapling function is effectively locked out until tissue compression is complete. With this arrangement, fluid introduced via the fluid port 50b (FIG. 11A) into the staple fluid channel 122 prior to completion of tissue compression will leak until the two o-rings 112 of the compression piston 106 are straddling the inlet 114. This design prevents premature staple firing.

[0099] At the fully compressed position, the arm spreaders 110 are nearly perpendicular to the longitudinal centerline of the stapler head. Once tissue is compressed between cartridge 78 and anvil 96, the tissue is ready for stapling.

[0100] Stapling is initiated by introducing hydraulic fluid through port 50b (FIG. 5). The staple piston advances, pushing cutting element 86 (FIGS. 7 and 10) towards the anvil 96. Because the staple pusher 76 is mounted to the cutter 86, this action carries the staple pusher 76 through the cartridge 78 where it simultaneously pushes all staples through the tissue. Staple piston travel is limited by internal stops, and is preset to yield optimal staple formation.

[0101] During compression, as the angle at the hinge **104** of arm assemblies **32** reaches its minimum, the force required to resist separation of the staple and anvil housings increases. These forces increase further when the forces of staple crushing are exerted on the anvil by the staple piston. To compensate, the arm spreaders **110** serve as displacement struts to channel at least a portion of these forces into the disk **68**. These forces, if not reacted by the pusher disk, would pull in the arms **100**, **102** and potentially release the compression on the tissue, causing incomplete staple formation or tissue cutting. In this way, a truss-like structure is created for force displacement.

[0102] When staples have been formed, staple pressure is released and a spring (not shown) returns the staple pusher **72** to its base position. Releasing fluid pressure will allow the deflected spring wires **46** on membrane raiser **37** to return the staple head to its minimum profile configuration and release the plication from the stapler. Once outside the patient, the used staple cartridge can be ejected and a new one installed.

[0103] FIGS. 25A-25C illustrate one method for retaining a removable staple cartridge **78** within the staple housing. The cartridge is spring-loaded into the staple housing and retained by two latches **170** (one visible), each pivotable relative to a fulcrum **172**. As shown, the fulcrum **172** may be coupled to the disk **68** by pin **84**. Each latch **170** includes a catch **174** which engages a corresponding catch **176** on the cartridge. The latch **170** is preferably spring biased to urge the catch **174** inwardly towards the cartridge.

[0104] Depressing the proximal end **175** of each latch **170** as shown by arrow P in FIG. 25B pivots the latch against this bias, causing ejection of the staple cartridge. A new staple cartridge may then be positioned with its grooves **79** aligned with alignment posts **74** as shown in FIG. 25C and then pushed towards the staple housing. As the new cartridge slides into position, catch **174** rides over the tapered proximal portion **178** of the catch **176**. Once catch **174** passes over the distal end **180** of the catch **176**, it drops inwardly towards the cartridge due to its spring bias, thus engaging the cartridge. When the cartridge is properly seated, a click will be felt or heard as the latches engage the new cartridge.

Stapler Shaft and Handle

[0105] Referring again to FIG. 2, the stapler shaft **16** connecting the handle **18** and the stapler head **14** is flexible enough to conform to the curvature of the upper digestive tract, yet maintains the ability to transmit enough torque to rotate the stapler head. The shaft is formed with sufficient stiffness to allow it to be pushed down esophageal guide tube **23**. Suitable materials include

[0106] FIG. 26 shows a distal portion of the shaft **16**, with the stapler head removed from the shaft. As shown, shaft **16** includes an endoscope lumen **124** through which an endoscope is advanced to allow visualization of a stapling operation. Side lumens **126** may also be provided for receiving other instruments useful during the procedure.

[0107] An articulating section **128** is positioned at the distal end of the shaft **16**, between the shaft **16** and the stapler head **14** so as to allow the stapler head to be articulated relative to the shaft. Tubing coupled to the vacuum source and the source of hydraulic fluid extends from the handle and through the shaft **16** and the articulating section **128**.

[0108] FIG. 27A shows one configuration that may be used for the hydraulic fluid lines **130**. During use, the hydraulic fluid lines are subjected to significant deflection and elonga-

tion in the articulating section of the stapler. They are also subjected at times to fluid pressure which may be in excess of 1000 psi. Typically, hydraulic lines in industrial applications are flexible and have a working loop of extra tubing that accommodates length changes during use. The illustrated configuration for the hydraulic lines is a lower profile solution particularly suitable for an endoscopic device having space constraints. A preferred hydraulic line is a tube **130** having a portion that is shaped into a longitudinally expandable shape so that it can accommodate effective length changes during bending. The longitudinally expandable portion of the tube is preferably disposed within the articulating section **128** of the stapler **12**. In a preferred design, the longitudinally expandable shape is a coil shape as shown in FIG. 27A. In alternate embodiments, the tube **130** may be formed into other longitudinally expandable shapes, such as regular or irregular undulating shapes (FIG. 27B).

[0109] The preferred material for the tubes **130** is stainless steel hypotube, although other materials may instead be used. In the preferred stapler configuration, two drive fluid lines are provided, one for actuating tissue compression, and the other for staple application (and cutting when used). In the present embodiment, the tubes are coiled together as shown in FIG. 27A. In alternate embodiments, two or more coiled tubes may be nested one inside the other. As the articulating section bends, it forces the coiled tubes **130** to bend and to change length in response to bending. The coiled tubes behave just as coiled wires would during these motions and are thus able to change length, deflect, and follow the contour of the articulating section without compromising flow through the lumens of the tubes or imparting undue stress to the connections at either end of the hydraulic system.

[0110] The longitudinally expandable shapes for the fluid lines may be suitable for use in allowing delivery of fluid to the operative ends of other types of articulating medical devices, such as catheters or endoscopic devices for delivering therapeutic agents or irrigation fluids past an articulating or bendable section of the device.

[0111] Referring again to FIG. 26, articulating section **128** is comprised of a spine formed of a plurality of links **132** strung over a pair of pull cables **134** (only one shown in FIG. 26). In one embodiment, engagement of the pull cables allows the stapler head **14** to be articulated in two directions through a range of motion of approximately 90 degrees in one direction (see FIG. 3B) to 175 degrees in the opposite direction (see FIG. 3C). Each pull cable is anchored at or near the stapler head, such as at the distalmost link **132** of the stapler housing **28**.

[0112] The more proximal portions of the pull cables **134** extend the length of the shaft **16** and terminate in the handle **18**. Referring to FIG. 28, the handle **18** includes a rotating knob **136** that may be selectively rotated in a clockwise or counterclockwise to articulate the stapler head up or down. Rotation in one direction applies tension to one of the pull cables to cause the stapler head to bend downwardly, whereas rotation in the opposite direction puts tension on the other cable, causing the head to bend upwardly.

[0113] In a preferred handle configuration, the knob **136** includes an internal threaded bore **138**. Knob **136** is partially restrained within the handle **18** so that it remains fixed within the handle but can rotate freely. A carriage **140** having a threaded exterior surface is positioned within the threaded bore **128** of the knob. The threads within the bore **138** are

engaged with the threads on the carriage **140** so that rotation of the knob causes the carriage **140** to translate, but not rotate, within the handle.

[0114] Each of the two pull cables, identified in FIG. **28** as cables **134a** and **134b**, is terminated on a different member in the handle. Cable **134a** is mounted on the sliding carriage and cable **134b** is mounted to a stationary part of the handle **18**. Each cable extends through a corresponding sheath. Cable **134a** extends through a sheath **135a** having a proximal end fixed to a stationary part of the handle **18**. Cable **134b** extends through a sheath **135b** having a proximal end mounted to the sliding carriage.

[0115] The cables **134a, b** and sheaths **135a, b** are arranged such that translation of the carriage in one direction will cause deflection of the stapler head in one direction, and translation of the carriage on the other direction will deflect the stapler head in another direction.

[0116] Referring to FIG. **28**, if knob **136** is rotated to causes the carriage **140** to translate to the left of the page, cable **134a** will be tensioned and cable **134b** will slacken, causing the stapler head to articulate in a first direction (e.g. upwardly). Rotation of the knob **136** in the opposite direction will advance the carriage to the right of the page, releasing tension on cable **134a** and pushing sheath **135b** over the cable **134b** towards the distal end of the staple head, causing articulation in the second direction (e.g. downwardly) as the sheath **135b** is advanced against a distal portion of the shaft **16**. The proximal portion of sheath **135b** is provided with sufficient working length prevent it from being placed under tension when the carriage moves distally. The positioning of the knob is advantageous in that the hand movement required for stapler articulation is always the same, regardless of the rotational orientation of the stapler. Also, the use of the threaded knob can prevent unintentional relaxation of the deflection angle, even if the knob is provided without a lock to retain its rotational position.

[0117] Referring to FIGS. **28** and **29**, the endoscope lumen **124** extends along the center axis of the stapler. The positioning of the lumen and the coaxial relationship of the articulation knob in relative to the endoscope **124** allows the endoscope and stapler to be rotated independently without one interfering with one another. Thus, if the user chooses to change the rotational orientation of the stapler head **14** within the body, s/he may rotate the handle **18** and shaft **16** while maintaining the rotational position of the endoscope.

[0118] For cost efficiency, the stapler **12** may be designed to permit the stapler head **14** to be discarded while allowing the shaft **16** and handle **18** to be sterilized and re-used. One mechanism for removably coupling the stapler head to the shaft **16** is illustrated, although others are readily conceivable (e.g. a slip coupling type arrangement). Referring to FIG. **26**, an end plate **142** is mounted to the distalmost one of the links **132**. Each of the end plate **142** and the corresponding rear surface of the stapler head are provided with latch features that allow the end plate and stapler head to be engaged to one another.

[0119] End plate **142** includes a cantilevered pin **144** having a peg **145** (which may be a spring pin), a central opening **146**, and a pair of u-shaped catches **148** along its edges. Hydraulic feed holes **156a, b** are formed through the end plate **142**. The hydraulic tubes that deliver hydraulic fluid to the stapler head (see tubes **130** of FIG. **27**) are preferably welded to the end plate to allow fluid from the tubes to be directed through the feed holes **156a, b**.

[0120] FIGS. **30A** and **30B** show the rear surface **48a** of the staple housing, which has been somewhat modified relative to FIG. **5**. In this variation of the rear surface **48a**, the hydraulic input ports **50a, 50b** are repositioned as shown. Additionally, the rear surface **48a** has been modified to include a pair of catches in the form of undercut bosses **150**, plus an aligning pin **152**, and a hole **154**.

[0121] FIGS. **30A** and **30B** show the end plate **142** positioned against the rear surface **48a** of the staple housing. The other features of the articulating section **128** are not shown in FIGS. **30A** and **30B** for clarity. To attach the stapler head to the shaft **16**, the plate **142**, attached to the handle assembly, is pressed against the rear surface **48a** of the staple housing as shown in FIG. **30A**. As the plate is pushed, it is rotated in a clockwise direction, causing the peg **145** (FIG. **26**) of the cantilevered pin **144** to engage hole **154** in the rear surface of the staple housing. When this latch is engaged, hydraulic feed holes **156a, b** of the end plate **142** are lined up with the hydraulic inlets **50a, 50b** on the staple head as shown in FIG. **30B**. At the same time, portions of the end plate surrounding u-shaped catches **148** slide beneath the undercut bosses **152**. Pressing the plate compresses the face-sealing o-rings surrounding the hydraulic input ports **50a, 50b**. Compression on the o-rings is maintained by engagement of the catches and the undercut bosses overhanging the end plate. To remove the stapler head from the housing, the stapler housing is twisted in a counterclockwise direction to disengage the end plate **142** from the rear surface **48a**. The stapler shaft and handle may then be sterilized in preparation for mounting of a fresh stapler head.

Exemplary Procedure

[0122] One example of a method for using the system **10** will next be described in the context of formation of plications in stomach wall tissue.

[0123] As an initial step (FIG. **2**), endoscopic guide tube **23** is advanced into the stomach via the mouth and esophagus. The endoscope **22** is inserted into the endoscope channel in the stapler handle (not shown) and advanced down the lumen of the stapler handle. The stapler/endoscope are simultaneously passed through the endoscopic guide tube towards the stomach. Once the stapler and endoscope reach the gastroesophageal junction region of the stomach, the position of the stapler is maintained while the endoscope is advance further into the stomach.

[0124] The stapler head **14** is advanced to the desired depth and location in the stomach. Using the articulation controls on the stapler handle, the angular orientation of the stapler head is adjusted to allow positioning of the stapler head **12** at the pre-identified target tissue as shown in FIG. **3A**. The opening **26** in the membrane **24** is positioned against the target tissue. The endoscope **22** is placed in a retroflexed position as shown.

[0125] The vacuum source **20** (FIG. **2**) is coupled to the vacuum port on the handle external to the body, and vacuum pressure is applied to draw tissue through the opening **26** and into the vacuum chamber defined by membrane **24** as shown in FIGS. **31B** and **32A**. Acquisition of the target tissue will be readily identified endoscopically through the wall of transparent membrane **24** on the stapler head.

[0126] The fluid source (is shown) is coupled to the handle. Once it has been visually confirmed that a sufficient amount of tissue has been acquired, fluid is introduced to cause compression of the tissue and expansion of the arm assemblies **32** and membrane raiser **37** as shown in FIGS. **32B** and **31C**. As

can be seen, the expansion of the arm assemblies and the membrane allows a large volume of tissue to be acquired into the vacuum chamber and displaced further into the chamber during tissue compression.

[0127] Once the tissue has been compressed, additional hydraulic fluid is introduced to cause stapling and cutting of the tissue as shown in FIGS. 31D and 32C, forming a plication P. The compression and stapling hydraulic sources are then deactivated to release fluid pressure within the hydraulic circuit. With the hydraulic pressure relieved, the spring wires of the membrane raiser 37 help to restore the stapler head 14 to its original streamlined configuration, allowing the stapler head to be withdrawn from the tissue as shown in FIG. 31E. The stapler head may be articulated relative to the shaft to assist in moving the stapler head away from the plication P.

[0128] In a preferred plication configuration shown in FIG. 33 the staples 158 are arranged in two concentric rings of five staples, with the staple reinforcement device 83 retained by the staples and distributing forces around the staple pattern as shown. The plication P includes a hole H formed by the cutting element, through which various implants or anchors for various implants can be placed.

[0129] If multiple plications are needed, the stapler 12 is briefly withdrawn from the endoscopic guide tube and the staple cartridge is replaced in the manner described in connection with FIGS. 25A-25C. The procedure is repeated until all desired plications have been formed.

[0130] The system may be packaged with instructions for use instructing the user to use the various disclosed features to perform a stapling procedure using methods disclosed herein.

Alternate Embodiments

[0131] The basic architecture of the stapler disclosed above can be used as a foundation for other stapling tools. FIGS. 34-35 show a modified stapler in which the membrane and membrane raiser have been removed, and in which the staple housing 28 has been modified for the attachment of tools. As shown in FIG. 34, the staple housing 28 includes a pair of grooves 160 proportioned to receive tools 162. Tools 162 may be seated in these grooves 160 and mounted to the staple housing as shown in FIG. 35. This attachment will provide for a stable base from which to actuate the tools. The tools may be self-articulating, or the staple housing 28 may be equipped with devices 164 for moving the tools between streamlined positions for insertion of the assembly into a body cavity, and a deployed position such as that shown in FIG. 35. Tools similar to those in FIG. 35 might be used for tissue acquisition, by reaching between the cartridge and anvil and used to engage tissue and pull the tissue into position between the cartridge and anvil so that it may be stapled, or otherwise affected by various features added to or in place of the anvil and cartridge. Procedures which may benefit from adaptation of the stapler include, but are not limited to gastroplasty, stoma adjustment, polypectomy, lead placement, bleeding control, perforation or hole closure, biopsy and tumor removal.

[0132] The disclosed systems provide convenient embodiments for carrying out the disclosed compression and stapling functions. However, there are many other widely varying instruments or systems may alternatively be used within the scope of the present invention. Moreover, features of the disclosed embodiments may be combined with one another and with other features in varying ways to produce additional embodiments. Thus, the embodiments described herein

should be treated as representative examples of systems useful for forming endoscopic tissue plications, and should not be used to limit the scope of the claimed invention.

[0133] Any and all patents, patent applications and printed publications referred to above, including those relied upon for purposes of priority, are incorporated herein by reference.

We claim:

1. A medical instrument for applying a fastener to tissue, comprising:

a head including

a first member carrying at least one fastener;

a second member; and

a drive assembly including a drive member moveable on the first member from a first position to a second position, the drive assembly operatively coupled to the first and second members such that movement of the drive member from the first position to the second position causes the second member to move in a direction towards the first member and causes at least a portion of the first member to move in a direction towards the second member.

2. The medical instrument of claim 1, wherein the first member has a first tissue contact area and the second member has a second tissue contact area opposed to the first contact area.

3. The medical instrument of claim 1, wherein:

the head further includes:

a fastener holder, the fastener holder positioned on the first member; and

wherein

the drive assembly is operatively coupled to the first member, fastener holder and second member such that movement of the drive member from the first position to the second position causes movement of the fastener holder relative to the first member in a direction towards the second member, and causes relative movement of the first member and second member towards one another.

4. The medical instrument of claim 1, wherein the drive assembly includes at least one elongate member having a first section pivotally coupled to the first member and a second section pivotally coupled to the first section and the second member, the first and second sections pivotable to move the elongate member between a streamlined position and an expanded position; and

wherein the drive member and elongate member are arranged such that movement of the drive member from the first position to the second position pivots the first section relative to the first member, moving the elongate member to the expanded position and thereby causing relative movement of the first and second members towards one another.

5. The medical instrument of claim 4, wherein the drive assembly further includes a drive arm pivotally coupled to the drive member and the elongate member.

6. The medical instrument of claim 4, wherein the drive assembly includes a plurality of elongate members extending between the first and second members, the plurality of elongate members pivotable between streamlined and expanded positions.

7. The medical instrument of claim 1, wherein:

the head further includes:

a support, the second member positioned on the support; and wherein

the drive assembly is operatively coupled to the support, first member and second member such that movement of the drive member from the first position to the second position causes movement of the second member relative to the support in a direction towards the first member, and causes relative movement of the first member and support towards one another.

8. The medical instrument of claim 7, wherein support includes a non-circular opening and wherein the second member is slidable within the opening and includes a non-circular cross-section.

9. The medical instrument of claim wherein:

the head further includes:

a fastener holder positioned on the first member; and

a support, the second member positioned on the support; and wherein

the drive assembly is operatively coupled to the first member, support, fastener holder and second member such that movement of the drive member from the first position to the second position causes movement of the second member relative to the support in a direction towards the first member, causes movement of the fastener holder relative to the first member in a direction towards the support, and causes relative movement of the first member and support towards one another.

10. The medical instrument of claim 7, wherein:

the drive assembly includes at least one elongate member having a first section coupled to the first member and a second section pivotally coupled to the first section and the support, the first and second sections pivotable to move the elongate member between a streamlined position and an expanded position; and

wherein the drive member and elongate member are arranged such that movement of the drive member from the first position to the second position pivots the first section relative to the first member to move the elongate member to the expanded position.

11. The medical instrument of claim 10, wherein the drive assembly includes a pivot arm having a first end pivotally coupled to the drive member and a second end pivotally coupled to the first section of the elongate member

12. The medical instrument of claim 11, wherein:

the second member is slidably positioned on the support; and

the second section of the elongate member is positioned such that moving the elongate member to the expanded position causes a portion of the second section to push the second member relative to the support in a direction towards the first member.

13. The medical instrument of claim 10, wherein:

the head includes a pivotable arm having a first end coupled to the drive member and a second end coupled to the elongate member, the arm positioned such that movement of the drive member from the first position to the second position causes the second end of the arm to pivot the first section of the elongate member relative to the first member, moving the elongate member to the expanded position.

14. The medical instrument of claim 1, wherein:

the drive member comprises a piston moveable from the first position to the second position.

15. The medical instrument of claim 14, wherein the head includes a chamber, and wherein the piston is moveable from

the first position to the second position in response to application of fluid pressure in the chamber.

16. The medical instrument of claim 14, wherein the piston is a first piston and wherein head further includes:

a fastener driver advanceable at least partially through the first member to drive fasteners from the first member;

a second piston within the chamber, the second piston moveable between a first position to a second position, the second piston operatively associated with the fastener driver such that movement of the second piston from the first position to the second position advances the fastener driver through the first member.

17. The medical instrument of claim 16 wherein the second piston is coupled to the first piston such that movement of the first piston to the second position moves the second piston relative to the chamber.

18. The medical instrument of claim 17, wherein the second piston is positioned within the first piston.

19. The medical instrument of claim 1, further including:

a shaft having a distal portion and a proximal portion, wherein the head is mounted to the distal portion.

20. The medical instrument of claim 19, further including a latch having a first latch member on the shaft and a second latch member on the head, the first and second latch members engageable to detachably mount the head to the shaft.

21. The medical instrument of claim 1, further including a fastener cartridge removably coupled to the first member, the fastener cartridge carrying the at least one fastener.

22. The medical instrument of claim 3, wherein the fastener holder comprises a fastener cartridge removably coupled to the first member, the fastener cartridge carrying the at least one fastener.

23. The medical instrument of claim 1, wherein the fastener is a staple, wherein the first member comprises a staple holder, and wherein the second member comprises an anvil.

24. The medical instrument of claim 1, wherein the head includes a cutting element coupled to the drive assembly.

25. The medical instrument of claim 11, wherein the head includes a cutting element positioned such that advancement of the second piston advances the cutting element through the first member and into contact with a portion of the second member.

26. A method of applying a fastener to tissue, the method comprising the steps of:

positioning a workpiece between a first member and a second member;

advancing a drive member to cause at least a portion of the first member to move towards the second member and to cause at least a portion of the second member to move towards the first member; and

firing a fastener from the first member into the workpiece.

27. The method according to claim 26, wherein the drive member is a piston, and wherein advancing the piston moves at least a portion of the first member towards the second member and moves the second member towards the first member.

28. The method according to claim 26, wherein:

the method further includes providing the first member to include a fastener holder; and

advancing the drive member causes movement of the fastener holder relative to the first member in a direction towards the second member.

29. The method according to claim 26, wherein: the method further includes providing a support, the second member positioned on the support; and advancing the drive member causes movement of the second member relative to the support in a direction towards the first member.
30. The method according to claim 28, wherein: the method further includes providing a support, the second member positioned on the support; and advancing the drive member causes movement of the second member relative to the support in a direction towards the fastener holder, and causes movement of the fastener holder relative to the first member in a direction towards the second member.
31. The method according to claim 30, wherein: advancing the drive member further causes movement of the support relative to the first member.
32. The method of claim 26, wherein the method is for applying a fastener to body tissue, and wherein positioning a workpiece between the first member and second member includes positioning body tissue between the first and second members.
33. The method of claim 32, wherein positioning body tissue between the first and second members includes drawing tissue between the first and second members using suction.
34. The method of claim 32, wherein positioning body tissue between the first and second members includes engaging tissue using an instrument and drawing the engaged tissue between the first and second members.
35. The method according to claim 32 wherein the method is for applying a staple to body tissue, and wherein: positioning body tissue between the first and second members includes positioning body tissue between a staple housing having a staple holder, and an anvil; firing a fastener includes firing a staple from the staple holder through the tissue and into contact with the anvil.
36. The method according to claim 35, wherein advancing the drive member causes movement of the staple holder relative to the staple housing in a direction towards the anvil.
37. The method according to claim 35, wherein the anvil is mounted to an anvil support, and wherein advancing the drive member causes movement of the anvil relative to the anvil support.
38. The method according to claim 36, wherein the anvil is mounted to an anvil support, and wherein advancing the drive member causes movement of the anvil relative to the anvil support.
39. The method according to claim 38, wherein advancing the drive member further causes movement of the anvil support relative to the staple housing.
40. The method according to claim 35, wherein the method further includes compressing the body tissue between the staple housing and anvil.
41. The method according to claim 40, wherein the method further includes advancing a cutting element through the compressed body tissue.
42. The method according to claim 41, wherein: advancing the drive member includes advancing a first piston within a chamber in the staple housing to cause compression of the tissue between the staple housing and anvil; firing the staple includes advancing a second piston within the chamber to advance a staple driver at least partially through the staple holder.
43. The method according to claim 42, wherein advancing the second piston advances the cutting element through the compressed body tissue.
44. A medical instrument, comprising:
a head including a first member carrying at least one fastener, and a second member;
a fastener driver advanceable at least partially through the first member;
a drive chamber including a pair of pistons, the pair of pistons including:
a first piston coupled to the first member and moveable to an advanced position to relatively advance at least a portion of the first member towards the second member, and
a second piston coupled to the fastener driver and moveable from a first position to a second position relative to the first piston when the first piston.
45. The medical instrument of claim 44, wherein the second piston is moveable from the first to the second position when the first piston is in the advanced position.
46. The medical instrument according to claim 45, wherein the second piston is operable to move to the second position only when the first piston is in the advanced position.
47. The medical instrument of claim 44, wherein the second piston is coupled to the first piston such that movement of the first piston to the advanced position moves the second piston relative to the chamber.
48. The medical instrument of claim 47, wherein the second piston is positioned within the first piston.
49. The medical instrument of claim 44, further including a cutting element coupled to one of the first and second pistons.
50. The medical instrument of claim 44, further including a cutting element and a third piston advanceable within the chamber to advance the cutting element relative to the head.
51. The medical instrument of claim 44, further including a first fluid port fluidly coupled to the chamber, the first fluid port positioned such that fluid introduced through the first fluid port into the chamber moves the first piston to the advanced position.
52. The medical instrument of claim 51, wherein:
the first piston includes a side wall, an interior, and an inlet extending through the sidewall into the interior;
the second piston is positioned within the interior of the first piston;
the medical instrument further includes a second fluid port fluidly coupled to the chamber, the second fluid port positioned such that when the first piston is in the advanced position, fluid introduced into the second fluid port flows through the second fluid port and into the interior of the first piston through the inlet, to move the second piston relative to the first piston.
53. The medical instrument of claim 44 wherein the first member comprises a staple housing carrying at least one staple and the second member comprises an anvil, and wherein the driver is a staple driver advanceable at least partially through the staple housing to drive staples into tissue.
54. The medical instrument of claim 44, wherein: the medical instrument further includes a drive assembly comprising:

- a drive member positioned such that movement of the first piston advances the drive member relative to the head, and
- at least one elongate member having a first section pivotally coupled to the first member and a second section pivotally coupled to the first section and the second member, the drive member coupled to the elongate member such that advancement of the drive member pivots the first and second sections to an expanded position to thereby move the second member towards the first member.
- 55.** A method of applying a fastener to tissue, comprising: positioning tissue between first and second members carried by a fastener applying head; compressing the tissue by advancing a first piston to an advanced position within a chamber, said first piston moving at least one of the first and second members towards the other of the first and second members; and fastening the compressed tissue by advancing a second piston within the chamber relative to the first piston, said second piston moving a fastener driver at least partially through the first member.
- 56.** The method of claim **55** wherein advancing the first piston advances the second piston relative to the chamber.
- 57.** The method of claim **55**, wherein compressing the tissue includes introducing fluid into the chamber.
- 58.** The method of claim **55**, wherein fastening the compressed tissue includes introducing fluid into the chamber.
- 59.** The method of claim **58**, wherein: the method provides the second piston to be positioned within the first position; and wherein compressing the tissue includes introducing fluid into the chamber; and fastening the compressed tissue includes introducing fluid into the first piston to advance the second piston within the first piston.
- 60.** The method of claim **58**, wherein: the method provides first and second fluid ports in the chamber, and a fluid inlet in the first piston; compressing the tissue includes introducing fluid through the first fluid port into the chamber to advance the first piston to the advanced position within the chamber, wherein when the first piston is in the advanced position the inlet in the first piston is fluidly coupled with the second fluid port; and fastening the tissue includes introducing fluid into the second fluid port, said fluid passing through the inlet into the first piston to advance the second piston within the first piston.
- 61.** The method of claim **55**, further including advancing a cutting element through the tissue.
- 62.** The method of claim **61**, wherein advancing the second piston advances the cutting element.
- 63.** The method of claim **61**, wherein advancing the cutting element includes advancing a third piston within the chamber.
- 64.** A method of fastening tissue, comprising the steps of: positioning tissue between first and second members; compressing the tissue between the first and second members by moving at least one of the first and second members until the first and second members are in a compression position separated by a predetermined distance; with the first and second members in the compression position, advancing a fastener driver to drive a fastener from at least one of the first and second members into the compressed tissue; and preventing advancement of the fastener driver to drive the fastener when the first and second members are separated by a distance other than the predetermined distance.
- 65.** A medical instrument for applying fasteners to tissue comprising: a head comprising: a first member carrying at least one fastener; a second member, the first and second members having a first relative position and a second relative position in which the first and second members are spaced more closely than when in the first relative position; a drive member moveable on the head to cause relative movement of the first and second members from the first relative position to the second relative position; and a fastener driver moveable to drive a fastener from the first member towards the second member, the fastener driver inoperable to drive the fastener except when the first and second members are in the second relative position.
- 66.** The medical instrument of claim **65**, wherein the head further includes: a drive chamber including a pair of pistons, the pair of pistons including: a first piston coupled to the first member and moveable to an advanced position to relatively advance at least a portion of the first member towards the second member, and a second piston coupled to the fastener driver and moveable from a first position to a second position relative to the first piston when the first piston.
- 67.** The medical instrument of claim **66**, wherein the second piston is moveable from the first to the second position when the first piston is in the advanced position.
- 68.** The medical instrument according to claim **67**, wherein the second piston is operable to move to the second position only when the first piston is in the advanced position.
- 69.** The medical instrument of claim **66**, wherein the second piston is coupled to the first piston such that movement of the first piston to the advanced position moves the second piston relative to the chamber.
- 70.** The medical instrument of claim **69**, wherein the second piston is positioned within the first piston.
- 71.** The medical instrument of claim **68**, further including a first fluid port fluidly coupled to the chamber, the first fluid port positioned such that fluid introduced through the first fluid port into the chamber moves the first piston to the advanced position.
- 72.** The medical instrument of claim **71**, wherein: the first piston includes a side wall, an interior, and an inlet extending through the sidewall into the interior; the second piston is positioned within the interior of the first piston; the medical instrument further includes a second fluid port fluidly coupled to the chamber, the second fluid port positioned such that when the first piston is in the advanced position, fluid introduced into the second fluid port flows through the second fluid port and into the interior of the first piston through the inlet, to move the second piston relative to the first piston.

73. A medical instrument for applying fasteners to tissue comprising:

- a head having a stop and further comprising:
 - a first member carrying at least one fastener;
- a second member, the first and second members having a first relative position and a second relative position in which the first and second members are spaced more closely than when in the first relative position;
- a drive member moveable on the head to cause relative movement of the first and second members from the first relative position to the second relative position, the drive member including a feature positioned to move into contact with the stop when the first and second members reach the relative apart position, such that the stop prevents further movement of the drive member; and
- a fastener driver moveable to drive a fastener from the first member towards the second member.

74. The medical instrument of claim **73**, wherein the fastener driver is inoperable to drive the fastener except when the first and second members are in the second relative position.

75. The medical instrument of claim **73**, wherein: the head includes a slot and the stop is an end of the slot; the feature includes a pin slidable within the slot during movement of the drive member, wherein the slot is proportioned such that the pin abuts an end of the slot when the first and second members reach the second relative position to prevent further movement of the drive member.

76. The medical instrument of claim **73**, wherein: the head includes a chamber, and wherein the drive member comprises a piston moveable within the chamber.

77. The medical instrument of claim **73** wherein the head includes a fluid inlet port fluidly coupled to the chamber.

78. The medical instrument of claim **73**, wherein the first member is coupled to the drive member such that movement of the drive member advances at least a portion of the first member towards the second member.

79. The medical instrument of claim **73**, wherein the second member is coupled to the drive member such that movement of the drive member advances at least a portion of the second member towards the first member.

80. A method of fastening tissue, comprising: positioning first and second members of a tissue fastening head in a tissue acquisition position; positioning tissue between the first and second members; compressing the tissue, wherein compressing the tissue includes advancing a drive member to drive at least one of the first and second members towards the other of the first and second members until a portion of the drive member abuts a stop on the head; and after compressing the tissue, driving at least one fastener from the first member into the tissue.

81. The method of claim **80**, wherein driving the fastener includes advancing a fastener driver to drive the fastener from the first member, and wherein the fastener driver is inoperable to drive the fastener until the drive member abuts the stop.

82. The method according to claim **80**, wherein the method provides the head to include a slot and further provides the drive member to include a pin positioned in the slot, and wherein compressing the tissue includes advancing the drive member until the pin contacts an end of the slot.

83. The method according to claim **80**, wherein compressing the tissue includes:

advancing a first piston within a chamber, the piston moving the drive member into contact with the stop.

84. The method according to claim **83**, wherein driving the fastener includes advancing a second piston relative to the first piston to advance a fastener driver at least partially through the first member.

85. The method according to claim **84**, wherein the method includes preventing advancement of the second piston relative to the first piston until the drive member abuts the stop.

86. The method according to claim **80**, further including the step of advancing a cutter at least partially through the compressed tissue.

87. The method according to claim **83**, wherein advancing the second piston advances a cutting element to form a cut in the tissue.

88. A medical instrument for applying a fastener to tissue, comprising:

- a head including:
 - a first member carrying at least one fastener;
 - a second member, the first and second members relatively moveable towards one another into a tissue compressing position; and
 - a firing element advanceable to drive the fastener from the first member towards the second member using a driving force, the driving force sufficient to produce separating forces against the first and second members; and

a force displacement strut positioned to displace a portion of the separating forces to resist displacement of the first and second members from the tissue compressing position by the driving force.

89. The medical instrument according to claim **88**, wherein the force displacement strut has a longitudinal axis transverse to a direction of the separating forces.

90. The medical instrument according to claim **88**, wherein the head includes;

an arm assembly having a first section pivotally coupled to the first contact member and a second section pivotally coupled to the first section and the second member; and wherein the force displacement strut extends between the arm assembly and either the first member or the second member.

91. The medical instrument according to claim **90**, wherein the force displacement strut extends between the first section and the first member.

92. The medical instrument according to claim **88**, wherein:

the first member includes a fastener holder moveable relative to the first member towards the second member; the head includes an arm assembly having a first section pivotally coupled to the first member and a second section pivotally coupled to the first section and the second member; and the force displacement strut extends between the first section and a portion of the fastener holder.

93. The medical instrument according to claim **92**, wherein:

the fastener holder includes a drive member moveable on the first member from a first position to a second position to move the fastener holder towards the second member; and the force displacement strut has a first end pivotally coupled to the first section and a second end pivotally coupled to the drive member.

94. The medical instrument according to claim **93**, wherein the force displacement strut is pivotable from a first orientation to a second orientation in response to movement of the drive member from the first position to the second position.

95. The medical instrument according to claim **94**, wherein the arm assembly is pivotable away from the head from a first position in which the first member and second member housing are separated by a first distance, and a second position in which the first member and second member are separated by a second, smaller distance.

96. The medical instrument according to claim **95**, wherein the force displacement strut is positioned such that movement of the force displacement strut to the second orientation moves the arm assembly to the second position.

97. The medical instrument according to claim **88**, wherein the at least one fastener is carried by a fastener holder, the fastener holder comprising a cartridge removably coupled to the first member.

98. The medical instrument according to claim **88**, wherein the medical instrument is a medical stapler, wherein the first member comprises a staple housing including a staple holder carrying at least one staple, and wherein the second member comprises an anvil support including an anvil.

99. The medical instrument according to claim **98** wherein the head includes an arm assembly having a first section pivotally coupled to the staple housing, and a second section pivotally coupled to the first section and the anvil support; and the force displacement strut extends between the first section and the staple housing.

100. The medical instrument according to claim **99**, wherein the staple holder includes a drive member moveable on the staple housing from a first position to a second position to move the staple holder relative to the staple housing towards the anvil; and

the force displacement strut has a first end pivotally coupled to the first section and a second end pivotally coupled to the drive member.

101. A method of applying a fastener to a workpiece, the method comprising:

positioning a workpiece to be fastened between a first member and a second member;

moving the first and second members relatively towards one another into a compression position to compress the workpiece between them, the first and second members in the compression position separated by a gap having a width;

driving at least one fastener from the first member into the workpiece, wherein driving the fastener into the workpiece generates separating forces against the first and second members; and

displacing at least a portion of the separating forces along a displacement strut to thereby maintain the width of the gap.

102. The method of claim **101**, wherein:

the method includes providing a head including the first and second members and at least one arm extending between the first and second members, the arm including a first section pivotally coupled to the first member and a second section pivotally coupled to the first section and the second member, the force displacement strut extending between the arm and the first or second member;

positioning the first member and second member in the compression position includes causing the arm to pivot to form an angle between the first and second members; and

the separating forces including angular forces oriented to increase the angle; and

displacing the separating forces includes displacing the angular forces along the displacement strut so as to substantially maintain the angle.

103. The method according to claim **102**, wherein:

providing the head includes providing a fastener holder on the first member, the fastener holder carrying the at least one fastener and being coupled to a drive member, the force displacement strut having a first end pivotally coupled to the arm and a second end pivotally coupled to the drive member; and

positioning the first member and second member includes advancing the drive member to move the fastener holder relative to the first member in a direction towards the second member, wherein advancing the drive member pivots the force displacement strut to a laterally extending position.

104. The method according to claim **103**, wherein pivoting the force displacement strut to the laterally extending position causes the arm to pivot at the hinge to form the angle.

105. The method according to claim **102**, wherein the method provides the at least one fastener to be carried by a fastener cartridge removably attached to the first member.

106. The method according to claim **101** wherein the method is a method for applying a fastener to tissue, and wherein positioning a workpiece includes positioning tissue to be fastened between the first and second members.

107. The method according to claim **101**, wherein the method is a method for applying a staple to tissue, and wherein:

positioning the workpiece between the first and second members includes positioning the workpiece between a staple housing and an anvil;

moving the first and second members into the compression position includes moving the anvil and staple housing relatively towards one another.

108. The method according to claim **107**, wherein driving the at least one fastener includes advancing a staple driver at least partially through a staple holder carrying at least one staple.

109. A medical instrument for use in fastening tissue, comprising:

a head including:

a covering defining a vacuum chamber, the covering having an opening positionable in contact with tissue to be fastened such that application of suction to the vacuum chamber draws the tissue into the vacuum chamber;

first and second members at least partially disposed within the vacuum chamber, the first and second members moveable relative to one another into a compression position to compress tissue drawn into the vacuum chamber;

a fastener driver; and

an expansion member extendable from the head to expand the vacuum chamber, the expansion member comprising an elongate member having a first section and a second section, the second section more flexible than the first section.

110. The medical instrument of claim **109**, wherein the expansion member includes a third section less flexible than the second section, wherein the first section of the expansion member is coupled to the first member, wherein the second section of the expansion member is coupled to the second member, and wherein the third section is positioned between the first and second sections.

111. The medical instrument of claim **109**, wherein the second section is a spring member.

112. The medical instrument of claim **111**, wherein the expansion member is coupled to the first and second members such that relative movement of the first and second members into the compression position moves the expansion member from an elongated position to an expanded position.

113. The medical instrument of claim **112**, wherein the spring member has a natural bias tending to move the expansion member from the expanded position to the elongated position.

114. The medical instrument according to claim **109**, wherein the medical instrument is a stapler, wherein the first member is a staple housing carrying at least one staple, and wherein the second member is an anvil.

115. A method of tissue fastening, the method comprising: providing a head having first and second members, a covering positioned on the first and second members, and an expansion member positioned in contact with the covering, the expansion member comprising an elongate member extending between the first and second members, the elongate member including a first section and a second section, the second section more flexible than the first section;

applying suction to the vacuum chamber to draw tissue into the vacuum chamber and between the first and second members;

moving at least one of the first and second members towards the other of the first and said members, wherein moving at least one of the first and second members causes expansion of the expansion member to increase the volume within the vacuum chamber; and

driving at least one fastener from the first member into the tissue.

116. The method of claim **115**, wherein moving at least one of the first and second members towards the other of the first and said members compresses tissue between the first and second members, and wherein driving the fastener includes driving the fastener through the compressed tissue.

117. The method of claim **116**, wherein the method provides the second section of the expansion member to include a spring member having a natural bias, and wherein the method includes, after driving the at least one fastener, separating the first and second members to release the compressed tissue, the natural bias of the spring member at least partially returning the expansion member to a relatively straightened position.

118. The method of claim **115**, wherein the medical instrument further includes:

at least one elongate member having a first section pivotally coupled to the first member and a second section pivotally coupled to the first section and the second member, the first and second sections pivotable between a streamlined position and an expanded position to move at least one of the first and second members into the compression position.

119. A tissue fastening system comprising:

a shaft;

a head positioned on the shaft, the head including first and second members, and a flexible covering at least partially enclosing the head to define a vacuum chamber, wherein the flexible covering is at least partially transparent and includes an opening positionable in contact with tissue to be fastened; and

a vacuum port coupled to the vacuum chamber such that application of vacuum pressure to the vacuum port draws tissue through the opening into the vacuum chamber.

120. The fastening system of claim **119**, further including an endoscope positionable in proximity to the vacuum chamber, the covering having a wall that is sufficiently transparent to permit observation of acquired tissue through the wall using the endoscope.

121. The fastening system of claim **119**, wherein the covering is formed of silicone.

122. The fastening system of claim **119**, wherein the covering includes a reinforced section surrounding the opening.

123. The fastening system of claim **119**, wherein the covering has a wall and wherein the reinforced section includes a plurality of ribs positioned on the wall.

124. The fastening system of claim **5**, wherein the wall and the ribs are formed of silicone.

125. The fastening system of claim **119**, wherein the first member comprises a staple holder and the second member comprises an anvil, at least one of the first and second members moveable towards the other to compress acquired tissue between them.

126. A tissue fastening method, comprising:

providing a fastening instrument including a vacuum chamber having a wall; applying suction to draw tissue into the vacuum chamber via an opening in the wall; observing the tissue through an at least partially transparent surface of the wall; and advancing at least one fastener into the tissue.

127. The method according to claim **126**, wherein observing the tissue includes positioning an endoscope in proximity to the wall and observing the tissue through the wall using the endoscope.

128. The method according to claim **126**, wherein the method includes compressing the tissue and applying the fastener to the compressed tissue.

129. The method according to claim **128**, wherein the method is a stapling method, wherein compressing the tissue includes compressing the tissue between a first member comprising a staple housing and a second member comprising an anvil, and wherein advancing the fastener includes driving a staple from the staple housing through the compressed tissue.

130. A fluid drive system, comprising:

a chamber; and

a fluid line fluidly coupled to the chamber, the fluid line comprising tubing having a lumen, at least portion of the tubing comprising a deflectable portion having a longitudinally expandable shape; and

a piston in the chamber, the piston advanceable within the chamber in response to flow of fluid from the fluid line into the chamber.

131. The fluid drive system according to claim **130**, wherein the longitudinally expandable shape is a coil shape.

132. The fluid drive system according to claim **130**, wherein the longitudinally expandable shape is an undulating shape.

133. The fluid drive system of claim **131**, further including a second fluid line fluidly coupled to the chamber, the second fluid line including a second coil wound together with the first coil.

134. The fluid drive system of claim **130**, wherein the deflectable portion is formed of an inelastic material.

135. The fluid drive system of claim **134**, wherein the inelastic material comprises stainless steel.

136. The fluid drive system according to claim **130**, further including a fluid source fluidly coupled to the fluid line.

137. A fluid-actuated endoscopic tissue fastening instrument, comprising:

- an elongate shaft having a flexible distal portion and a proximal portion;
- a head mounted to the distal portion, the head carrying at least one fastener and including a chamber; and
- a fluid line fluidly coupled to the chamber, the fluid line comprising tubing having a lumen, at least portion of the tubing comprising a deflectable portion having a longitudinally expandable shape; and
- a piston in the chamber, the piston advanceable within the chamber in response to flow of fluid from the fluid line into the chamber to advance the at least one fastener from the head.

138. The tissue fastening instrument according to claim **137**, wherein the fluid line includes a proximal section extending through the proximal portion of the elongate shaft, and a distal section extending through the distal portion of the elongate shaft, wherein at least a portion of the proximal section is substantially straight, and wherein at least a portion of the distal section comprises the longitudinally expandable shape.

139. The tissue fastening instrument according to claim **137**, further including a pull cable extending through the elongate shaft to the distal portion, and an handle operable to withdraw the pull wire to deflect the distal portion.

140. The tissue fastening instrument according to claim **139**, wherein the longitudinally expandable portion is deflectable with the distal portion in response to withdrawal of the pull wire.

141. The tissue fastening instrument according to claim **137**, wherein the head includes a first member carrying the fastener, and a second member spaced apart from the first member, wherein at least one of the first and second members is coupled to the piston such that advancement of the piston moves the first and second members relatively towards one another.

142. The tissue fastening instrument head according to claim **137**, wherein:

- the head includes a staple holder carrying at least one staple; and
- the head includes a staple driver coupled to the piston such that advancement of the piston advances the staple driver to drive the staple from the staple holder.

143. The tissue fastening instrument of claim **137**, further including a second fluid line fluidly coupled to the chamber, the second fluid line including a second deflectable portion having a longitudinally expandable shape.

144. The tissue fastening instrument according to claim **137**, wherein the longitudinally expandable shape is a coil shape.

145. The tissue fastening instrument according to claim **137**, wherein the longitudinally expandable shape is an undulating shape.

146. The tissue fastening instrument of claim **143**, wherein the first and second longitudinally expandable shapes are coil shapes.

147. The tissue fastening instrument of claim **137** wherein the deflectable portion is formed of an inelastic material.

148. The fluid drive system of claim **147**, wherein the inelastic material comprises stainless steel.

149. The fluid drive system of claim **148**, wherein the deflectable section comprises a stainless steel coil.

150. The fluid drive system according to claim **137**, further including a fluid source fluidly coupled to the fluid line.

151. A medical device, comprising:

- an elongate shaft comprising a flexible distal portion and a fluid line, the fluid line comprising tubing having a lumen, at least portion of the tubing comprising a deflectable portion formed into a longitudinally expandable shape; and
- a fluid port fluidly coupled to the fluid line.

152. The tissue fastening instrument of claim **151** wherein the deflectable portion is formed of an inelastic material.

153. The fluid drive system of claim **152**, wherein the inelastic material comprises stainless steel.

154. The fluid drive system according to claim **151**, wherein the longitudinally expandable shape is a coil shape.

155. The fluid drive system according to claim **151**, wherein the longitudinally expandable shape is an undulating shape.

156. The medical device of claim **151**, wherein the fluid line includes a proximal section extending through the proximal portion of the elongate shaft, and a distal section extending through the distal portion of the elongate shaft, wherein the proximal section is substantially straight, and wherein at least a portion of the distal section comprises the longitudinally expandable shape.

157. The stapler according to claim **151**, further including a pull cable extending through the elongate shaft to the distal portion, and a handle operable to withdraw the pull wire to deflect the distal portion.

158. The stapler according to claim **157**, wherein the deflectable portion of the fluid line is deflectable with the distal portion in response to withdrawal of the pull wire.

159. A method for delivering fluid to an operative end of a flexible medical device, comprising:

- providing an elongate shaft having a distal end and a fluid line extending through the shaft, the fluid line comprising tubing including a deflectable section in which the tubing is formed into a longitudinally expandable shape; and
- passing fluid through the fluid line to the distal end of the elongate shaft.

160. The method of claim **159**, wherein the method includes:

- deflecting the distal end of the elongate shaft, causing a portion of deflectable section to elongate, and wherein introducing fluid into the fluid line includes introducing fluid into the fluid line with the elongate shaft in the deflected position.

161. The method of claim **159**, wherein the method is further for stapling tissue, and wherein the method further comprises:

providing the elongate shaft to include a staple head mounted to the distal end, the staple head including a chamber fluidly coupled to the fluid line and a piston in the chamber, the staple head further includes an anvil and a staple holder, one of the staple holder and anvil coupled to the piston;

positioning tissue between the anvil and holder; and wherein the step of introducing fluid into the fluid line causes the fluid to pass through the deflectable portion into the chamber and to advance the piston, causing relative movement of the cartridge towards the anvil to compress the tissue; and

driving staples from the cartridge into the compressed tissue.

162. The method of claim **161**, wherein driving staples from the cartridge into the tissue includes introducing additional fluid into the chamber.

163. The method of claim **159**, wherein the method is further for stapling tissue, and wherein the method further comprises:

providing the elongate shaft to include a staple head mounted to the distal end, the staple head including a chamber fluidly coupled to the fluid line and a piston in the chamber, the staple head further includes an anvil, a cartridge, and a stapler driver coupled to the piston;

compressing tissue between the anvil and cartridge; and wherein the step of introducing fluid into the fluid line causes the fluid to pass through the deflectable portion into the chamber and to advance the piston, causing staples to be driven from the cartridge into the compressed tissue.

164. A medical instrument for applying tissue fasteners, comprising:

a shaft having a distal end;

a head having a proximal end;

a first face on a first one of the distal end or the proximal end;

a second face on the other one of the distal end or the proximal end;

a latch having a first feature on the first face and a second feature on the second face, the first and second features engageable with one another to removably couple the stapler head to the shaft.

165. The medical instrument according to claim **164**, further including:

a fluid line in the shaft; and

a fluid port in the head, wherein the fluid line and fluid port are fluidly coupled to one another when the stapler head is coupled to the shaft.

166. The medical instrument of claim **164**, wherein: the medical instrument further includes an alignment pin on the first face and an opening on the second face, the alignment pin insertable into the hole; and wherein the first and second faces are rotatable relative to the alignment pin to a latched position in which the first and second features engage with one another.

167. The medical instrument of claim **166**, wherein the first feature is a boss having an undercut, and the second feature is a member rotatable into an engaged position beneath the undercut.

168. The medical instrument of claim **166**, wherein the first feature is a second pin and the second feature is an opening positioned such that relative rotation of the first and second faces causes the pin to engage with the opening.

169. The medical instrument of claim **166**, wherein the first plate includes a first drive fluid throughhole and the second plate includes a second drive fluid throughhole, and wherein the first and second throughholes are positioned such that rotation of the first and second plates to the latched position moves the first and second throughholes in alignment with one another.

170. The medical instrument of claim **169**, wherein the first plate is on the distal end of the elongate shaft, and wherein the medical instrument further includes a drive fluid line extending through the shaft, the drive fluid line positioned on the first plate to direct drive fluid into the first drive fluid throughhole.

171. The medical instrument of claim **164**, wherein the distal end of the shaft includes an articulating section.

172. The medical instrument of claim **171**, wherein the articulating segment includes an elongate spine formed of a plurality of spine segments threaded over at least one cable, and wherein the first plate is coupled to a distalmost one of the spine segments.

173. The medical instrument of claim **164**, wherein:

the head is a stapler head having a staple holder; and

the head includes a piston in the chamber, and a staple driver coupled to the piston such that directing fluid from the fluid line into the chamber advances the staple driver at least partially through the staple holder.

174. A method for coupling a shaft having a distal end to a fastener-applying head having a proximal end, comprising:

providing a first face on a first one of the distal end or the proximal end and a second face on the other one of the distal end or the proximal end;

engaging a latch having a first feature on the first face and a second feature on the second face, engaging the latch including engaging the first and second features to removably couple the fastener-applying head to the shaft.

175. The method of claim **174**, wherein engaging the latch further includes:

inserting an alignment pin on the first face into a hole in the second face; and

after inserting the alignment pin, rotating the first and second faces relative to the alignment pin to the first and second features to engage with one another

176. The method of claim **175**, wherein the method provides the first feature to be a boss having an undercut, and further provides the second feature to be a member, and wherein rotating the first and second faces rotates the member into an engaged position beneath the undercut.

177. The medical instrument of claim **174**, wherein the method provides the first feature to be a second pin and further provides the second feature to be an opening, and wherein rotating the first and second faces causes the pin to engage with the opening.

178. The medical instrument of claim **174**, wherein rotation of the first and second plates to the latched position moves a first drive fluid throughhole in the first plate into alignment with a second drive fluid throughhole in the second plate.

179. The medical instrument of claim **178**, wherein the first plate is on the distal end of the elongate shaft, and wherein the medical instrument further includes a drive fluid line extending through the shaft, the drive fluid line positioned on the first plate to direct drive fluid into the first drive fluid throughhole.

180. A tissue fastening device, comprising:
 a fastener head positioned on an elongate shaft;
 a fastener cartridge carrying at least one fastener, the cartridge attachable to the head by a latch having a first portion on the fastener head and a second portion on the cartridge, the first and second portions positioned such that advancing the cartridge into contact with the fastener head causes engagement of the first and second portions.

181. The tissue fastening device of claim **180** wherein:
 the first portion of the latch includes a spring biased member having first and second ends and a first catch on the second end, and the second portion of the latch includes a second catch engageable with the first catch.

182. The tissue fastening device of claim **180** wherein the spring biased member is pivotable relative to a fulcrum between a first position in which the first end extends inwardly relative to the second end, and a second position in which the first end extends outwardly relative to the second end.

183. The tissue fastening device of claim **182** wherein the spring biased member is spring biased in the first position.

184. The tissue fastening assembly of claim **183**, wherein the second end of the spring biased member is manually depressible to pivot the member from the first position to the second position.

185. The tissue fastening assembly of claim **181**, wherein the spring biased member is mounted to the fastener head and the second catch is positioned on the cartridge.

186. The tissue fastening assembly of claim **180**, wherein the fastener head includes at least one alignment pin and wherein the cartridge includes a receptacle for receiving the alignment pin.

187. The tissue fastening assembly of claim **186** wherein the alignment pin includes a tapered end.

188. The tissue fastening assembly of claim **186**, wherein the receptacle includes a slot in an exterior surface of the cartridge.

189. The tissue fastening assembly of claim **186**, wherein the receptacle includes a bore formed in the cartridge.

190. The tissue fastening assembly of claim **186**, wherein the fastener head includes a plurality of alignment pins, and wherein the cartridge includes a plurality of receptacles positioned to receive the alignment pins.

191. A method of loading a fastener cartridge onto a tissue fastening device, the method comprising: providing a cartridge carrying at least one tissue fastener and a tissue fastening instrument having an elongate shaft and an instrument head on the elongate shaft;
 advancing the cartridge into contact with the instrument head, causing a first engaging portion on the instrument to engage a second engaging portion on an exterior surface of the cartridge.

192. The method of claim **191**, wherein at least one of the first and second engaging portions comprises a pivotable spring latch, and the other of the first and second engaging portions includes a catch, and wherein advancing the cartridge into contact with the instrument includes pivoting a first end of the spring latch outwardly and then pivoting the first end of the spring latch inwardly to engage the catch.

193. The method of claim **192** wherein pivoting the spring latch outwardly includes advancing the first end of the spring latch into contact with the catch to cause the first end of the spring latch to pivot outwardly.

194. The method of claim **192**, wherein pivoting the spring latch outwardly includes manually depressing a second end of the spring latch.

195. The method according to claim **191**, wherein causing the first engaging portion to engage the second engaging portion includes advancing an alignment pin on the fastener head into a receptacle on an exterior surface of the cartridge.

196. The method of claim **192**, wherein the method further includes advancing an alignment pin on the fastener head into a receptacle on the cartridge.

197. The method of claim **196** wherein the receptacle is a slot in the exterior surface of the cartridge.

198. The method of claim **196**, wherein the receptacle is a bore in the cartridge.

199. An articulating medical device, comprising:

an elongate shaft having a flexible distal portion and a proximal portion;

a handle on the proximal portion;

a knob rotatably mounted on the handle, the knob rotatable relative to the handle, the knob including a threaded bore;

a first cable extending from the handle through the elongate shaft and having a distal end coupled to the distal portion of the elongate shaft;

a second cable extending from the handle through the elongate shaft and having a distal end coupled to the distal portion of the elongate shaft;

wherein the knob is rotatable from a first position to a second position to apply tension to the first cable and to thereby cause deflection of the catheter in a first direction, and wherein the knob is further rotatable from the second position to the first position to apply tension to the second cable and to thereby cause deflection of the catheter in a second direction.

200. The medical device of claim **199**, wherein:

the handle includes a threaded bore;

the medical device includes a carriage disposed within the threaded bore, the carriage having a threaded exterior engaged with the threaded bore; and

the first cable includes a proximal end coupled to the carriage;

a second cable includes a proximal end coupled to the handle; and

wherein the knob is rotatable from a first position to a second position to effect translation of the carriage in a proximal direction to effect translation of the carriage in a distal direction.

201. The medical device of claim **200**, further including:

a sliding member having a proximal portion coupled to the carriage and a distal portion coupled to the second cable; and

wherein the knob is rotatable from a first position to a second position to effect translation of the carriage in a proximal direction, thereby applying tension to the first cable and causing deflection of the shaft in a first direction, and wherein the knob is further rotatable from the second position to the first position to effect translation of the carriage and the proximal portion of the sliding member in a distal direction, thereby applying tension to the first cable and causing deflection of the shaft in a second direction.

202. The medical device of claim **201**, further including a first tube positioned such that the first cable extends through the first tube, the first tube including a first end mounted to the handle.

203. The medical device of claim **202**, wherein the first end of the first tube is attached to the handle such that the first end remains in a longitudinally fixed position during translation of the carriage.

204. The medical device of claim **201**, wherein the sliding member comprises a second tube and wherein the second cable extends through the second tube.

205. The medical device of claim **204**, wherein the second cable is mounted to the handle such that the proximal end of the second cable remains in a longitudinally fixed position during translation of the carriage.

206. The medical device of claim **201**, further including an instrument lumen extending longitudinally through the carriage and elongate shaft.

207. The medical device of claim **199** wherein the flexible distal portion of the elongate shaft includes an elongate spine formed of a plurality of spine segments threaded over the first and second cables.

208. The medical device of claim **199**, wherein fluid line extends through the shaft.

209. The medical device of claim **199** wherein the fluid line includes a section formed of tubing formed into a longitudinally expandable shape.

210. The medical device of claim **209** wherein the longitudinally expandable shape is a coil.

211. The medical device of claim **209** wherein the longitudinally expandable shape is an undulating shape.

212. A method of articulating a medical device, the method comprising:

providing an elongate shaft having a flexible distal portion, a proximal portion including a handle, and first and second cables extending between the handle and the flexible distal portion;

axially rotating a knob on the handle in a first direction to apply tension to the first cable, causing the first distal portion to deflect in a first direction; and

axially rotating the knob in a second direction opposite to the first direction to apply tension to the second cable, causing the distal portion to deflect in a second direction.

213. The method according to claim **212**, wherein the method provides the handle to include a carriage engaged to the knob by threads, wherein the cable has a proximal end coupled to the carriage, and wherein axially rotating the knob in the first direction causes translation of the carriage and the proximal end of the first cable in a first direction.

214. The method according to claim **213** wherein axially rotating the knob in the second direction causes translation of the carriage in a second direction opposite to the first direction.

215. The method according to claim **214** wherein:

the method provides the medical device to include a sliding member having a first end attached to the carriage and a second end attached to the second cable, and further provides the second cable to have a proximal end attached to the handle; and

translating the carriage in the second direction causes translation of the sliding member in the second direction, said translation of the sliding member applying tension to the second cable.

216. The method according to claim **212**, wherein the knob remains longitudinally fixed relative to the handle during axial rotation of the knob.

217. The method according to claim **213**, wherein the carriage remains rotationally fixed relative to the handle during translation.

218. The method according to claim **212**, wherein the method further includes passing an instrument through an instrument port extending longitudinally through the handle and elongate member; and wherein the axially and rotational position of the instrument port is unaffected by rotation of the knob.

219. A staple holder for housing medical staples, the staple holder comprising: a body including a plurality of pedal sections, each pedal section including a slot containing a staple.

220. The staple holder of claim **219**, wherein the pedal section includes an outer wall portion and a retaining element coupled to the outer wall portion to define the slot.

221. The staple holder of claim **220** wherein the retaining element includes a pair of wings, each wing extending from an opposite end of the outer wall portion.

222. The staple holder of claim **219**, wherein the plurality of pedal sections extend radially from the body.

223. The staple holder of claim **222**, wherein the pedal sections define an outer ring of staple slots, and wherein the body includes an inner ring of inner staple slots concentrically arranged with the outer ring.

224. The staple holder of claim **223**, further including longitudinal wall sections disposed between the pedal sections, and second retaining elements extending inwardly from the longitudinal wall sections to define the inner staple slots.

225. The staple holder of claim **224**, wherein the second retaining elements each include a pair of wings, each wing extending from an opposite end of the longitudinal wall section.

226. A staple anvil, comprising:

a body including a plurality of pedal sections extending radially from the body, each pedal section including a pair of staple-folding recesses.

227. The staple anvil according to claim **226**, wherein the staple folding recesses define an outer ring of staple folding recesses, and wherein the staple anvil further includes an inner ring of staple folding recesses concentrically arranged with the outer ring.

228. A stapler, including:

staple holder comprising a body including a plurality of pedal sections, each pedal section including a slot containing a staple; and

an anvil, comprising a body including a plurality of pedal sections extending radially from the body, each pedal section including a pair of staple-folding recesses; and a staple driver advanceable at least partially through the staple holder.

229. The stapler of claim **228**, wherein the pedal sections of the staple holder are aligned such that advancement of a staple from a slot in a first pedal section of the staple holder will advance the staple into contact with staple-folding recesses of a corresponding pedal sections of the anvil.

230. The stapler of claim **229**, wherein the pedal sections define an outer ring of staple slots, and wherein the body includes an inner ring of inner staple slots concentrically arranged with the outer ring.

231. The stapler of claim **230**, wherein the staple folding recesses define an outer ring of staple folding recesses, and

wherein the staple anvil further includes an inner ring of staple folding recesses concentrically arranged with the outer.

232. A medical cutting device, comprising:

a cutting element having a distal tip; and

a cutting board having a face, the distal tip and face spaced-apart by a first distance to define a tissue receiving area, the cutting element advanceable in a distal direction into contact with the face to cause cutting of tissue in the receiving area, the face adaptable to permit advancement of the distal tip by an amount greater than the first distance.

233. The medical cutting device of claim **232**, wherein the first distance is a fixed distance, and wherein the face cutting board is formed of a material capable of penetration by the cutting element.

234. The medical cutting device of claim **232**, wherein the cutting board is mounted to a housing, the cutting board deflectable relative to the housing such that movement of the cutting element into contact with the cutting board deflects the cutting board in the distal direction.

235. The medical cutting device of claim **234**, further including a spring element positioned between the cutting board and the housing such that movement of the cutting element into contact with the cutting board causes the cutting board to compress the spring element.

236. The medical cutting device of claim **235**, wherein the spring element is an elastomeric element.

237. The medical cutting device of claim **232** wherein the cutting element is a tubular cutting element.

238. The medical cutting device of claim **237**, wherein the cutting board includes a central opening.

239. The medical cutting device of claim **232**, wherein the medical cutting device is a medical stapling and cutting device, and wherein the device further includes:

a head including:

a first member, a staple holder carrying at least one fastening positioned on the first member, a staple driver advanceable through the staple holder, wherein the cutting element is positioned on the first member; and

a second member and an anvil positioned on the first member, wherein the cutting board is positioned on the second member.

240. The device of claim **239**, wherein the cutting element is coupled to the fastener driver, such that advancement of the staple driver advances the cutting element through the tissue receiving area.

241. A method of cutting tissue, comprising:

providing a cutting device comprising a tissue cutting element, a cutting board having a face spaced from the cutting device by a first distance to define a tissue receiving area between the cutting element and the cutting board;

positioning tissue in the tissue receiving area;

advancing the cutting element through the tissue and into contact with the cutting board, and causing the cutting board to permit advancement of the distal tip by an amount greater than the first distance.

242. The method of claim **241**, wherein the first distance is a fixed distance, and wherein causing the cutting board to permit advancement includes causing the cutting element to penetrate the cutting board.

243. The method of claim **241**, wherein causing the cutting board to permit advancement includes causing the cutting board to deflect.

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专利名称(译)	内窥镜缝合装置和方法		
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当前申请(专利权)人(译)	BAROSENSE INC.		
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摘要(译)

本文描述了内窥镜缝合器和用于将一个或多个紧固件施加到身体组织的方法。在一个实施例中，紧固件施加装置（优选地是订书机）通过从胃内部接合组织并将其向内拉入而经口部通入胃中以使胃组织复杂化。在所公开的实施例中，组织被吸入组织室，使得浆膜组织的部分彼此面对地定位。所公开的订书机允许相对的组织部分移动到与另一个组织接触，并且优选地递送钉以维持组织切片之间的接触，至少直到形成浆膜结合。这些步骤中的每一个可以完全从胃内部进行，因此可以消除对任何手术或腹腔镜介入的需要。在形成一个或多个褶皱之后，医疗装置可以可选地连接到褶皱以保持在内胃。

