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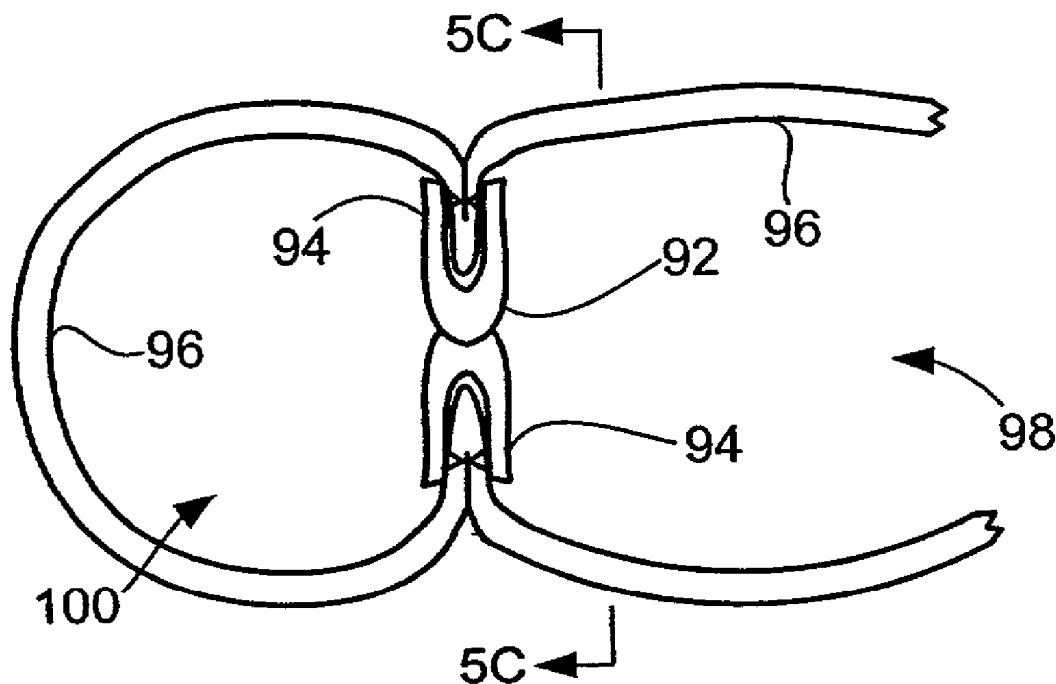
(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2002/0183768 A1****Deem et al.**(43) **Pub. Date: Dec. 5, 2002**(54) **OBESITY TREATMENT TOOLS AND METHODS**(52) **U.S. Cl. .... 606/151**

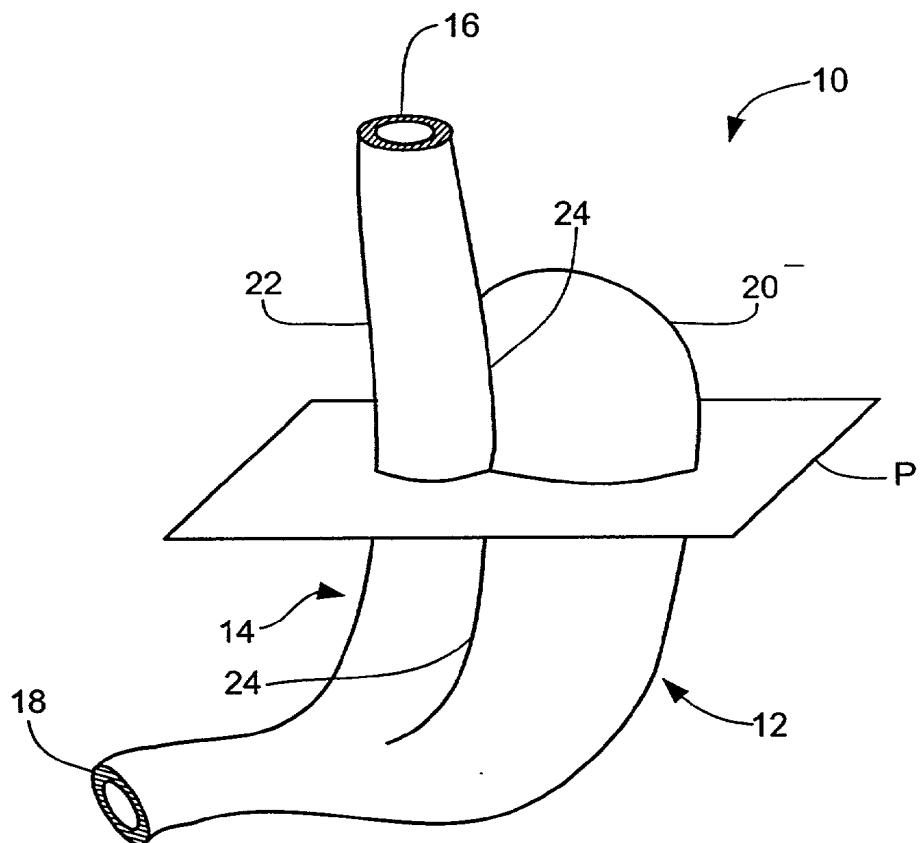
(76) Inventors: **Mark E. Deem**, Mountain View, CA (US); **Douglas S. Sutton**, Pacifica, CA (US); **Hanson S. Gifford**, Woodside, CA (US); **Bernard H. Andreas**, Redwood City, CA (US); **Ronald G. French**, Santa Clara, CA (US)

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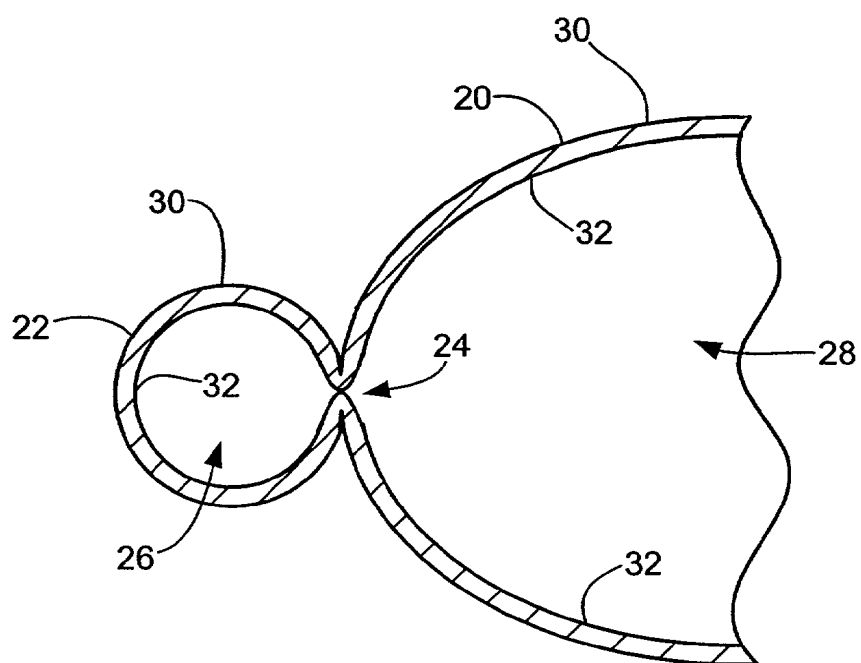
(21) Appl. No.: **09/871,297**(22) Filed: **May 30, 2001****Publication Classification**(51) **Int. Cl.<sup>7</sup> ..... A61B 17/08**(57) **ABSTRACT**

Various obesity treatment tools and methods are described herein, as well as treatments for other gastric-related diseases, e.g., GERD. Treatment includes reducing the size of the stomach pouch to limit the caloric intake as well as to provide an earlier feeling of satiety. This may be done by creating a smaller gastric pouch within the stomach directly from the interior of the stomach itself. The smaller pouches may be made through the use of individual anchoring devices, rotating probes, or volume reduction devices. A pyloroplasty procedure may also be performed to render the pyloric sphincter incompetent. A gastric bypass procedure may additionally be performed using atraumatic magnetic anastomoses devices so that sugars and fats are passed directly to the bowel while bypassing the stomach. Many of these procedures may be done in a variety of combinations. Treatment may create enforced behavioral modifications by discouraging the ingestion of high-caloric foods.

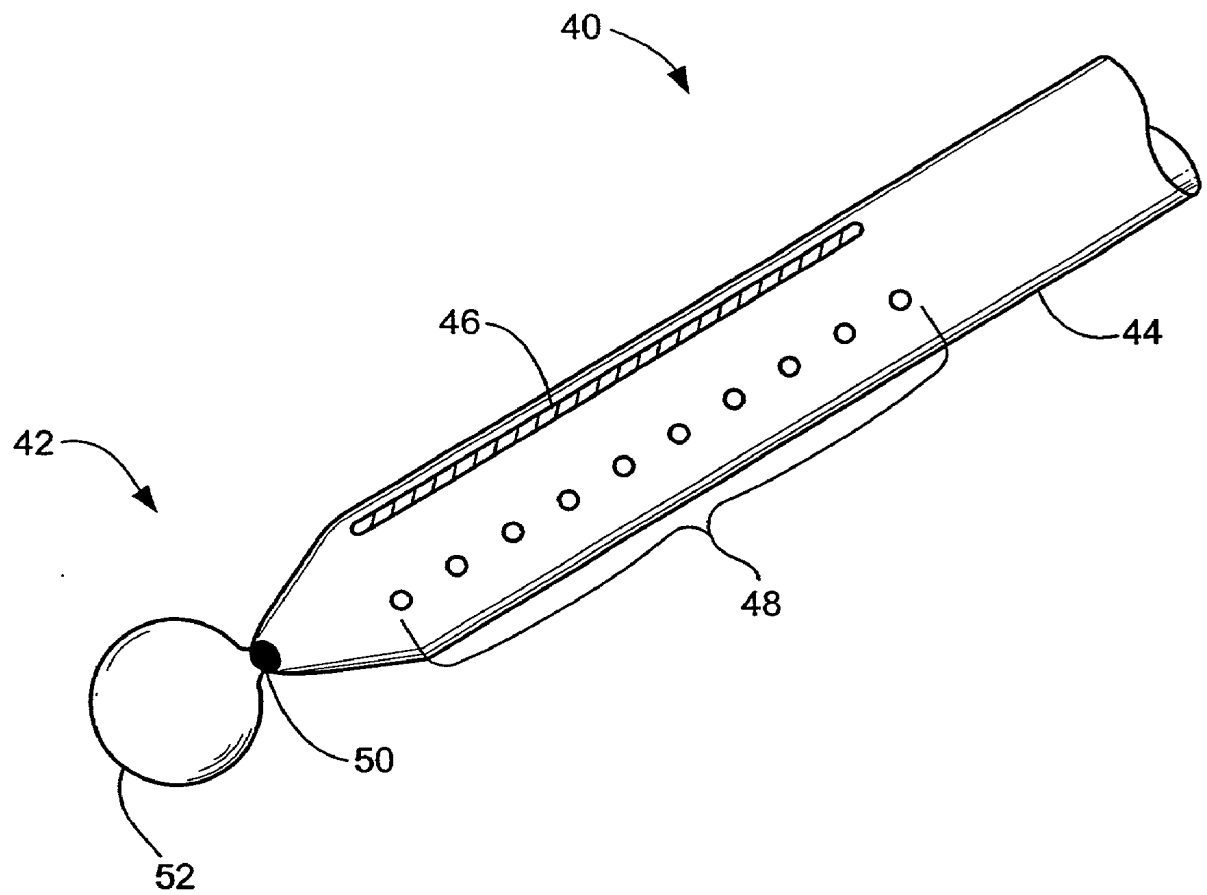




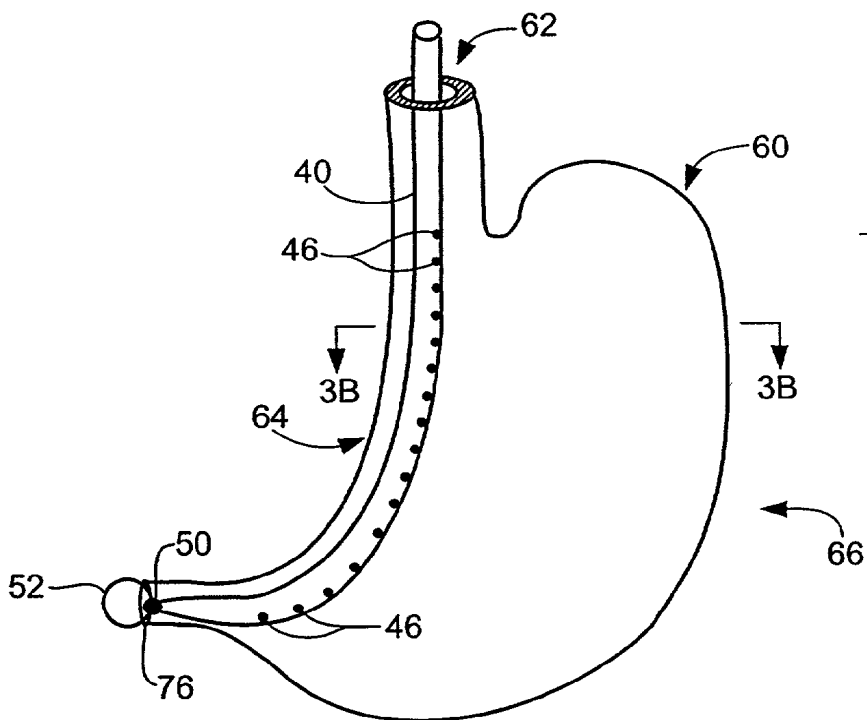
**FIG. 1A**



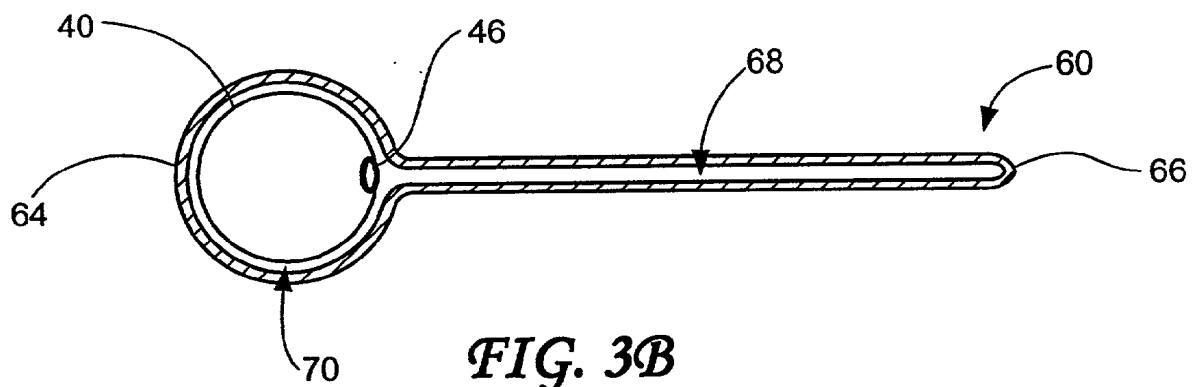
**FIG. 1B**



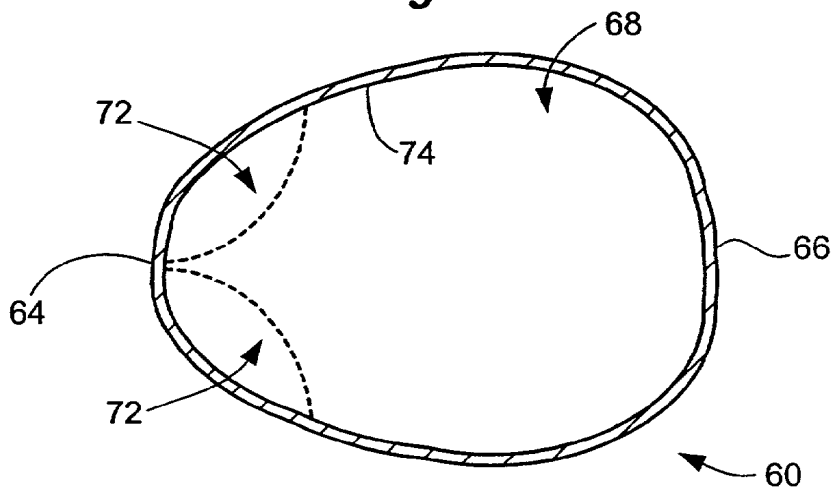
**FIG. 2**



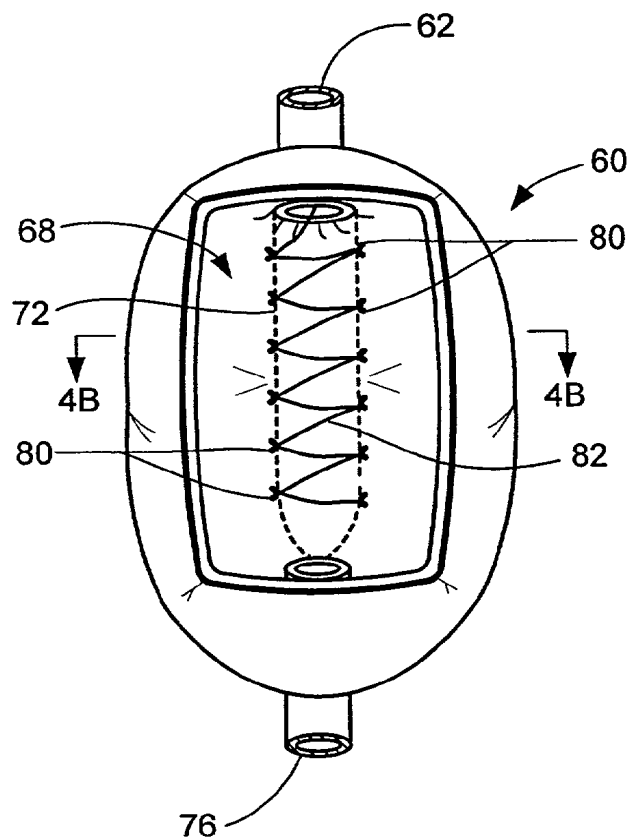
**FIG. 3A**



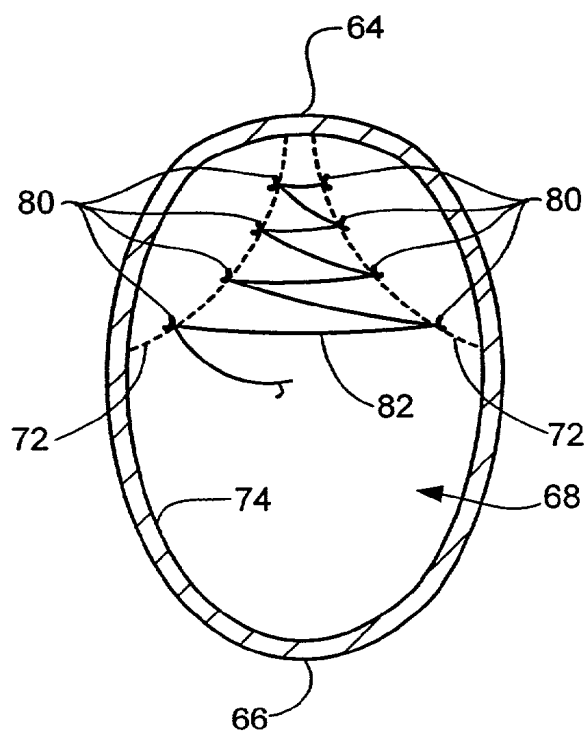
**FIG. 3B**



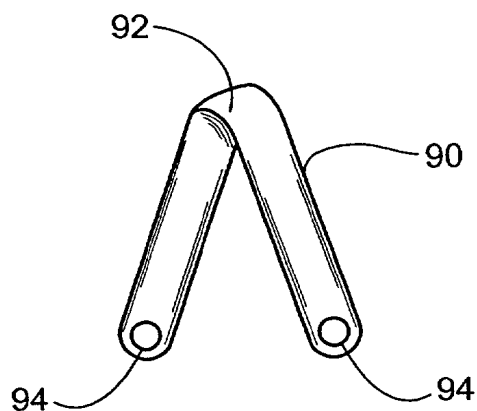
**FIG. 3C**



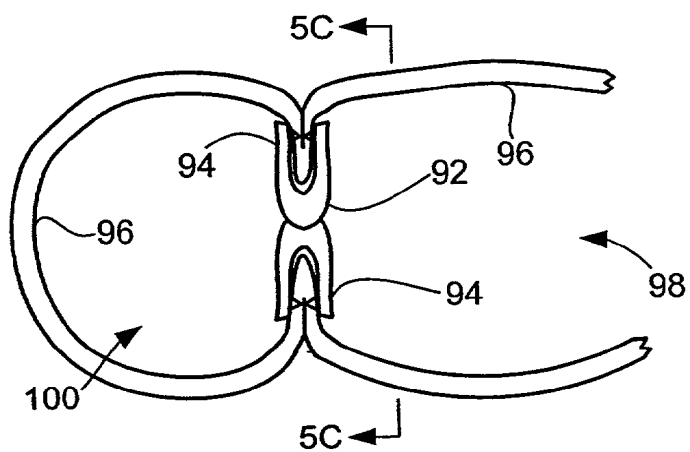
**FIG. 4A**



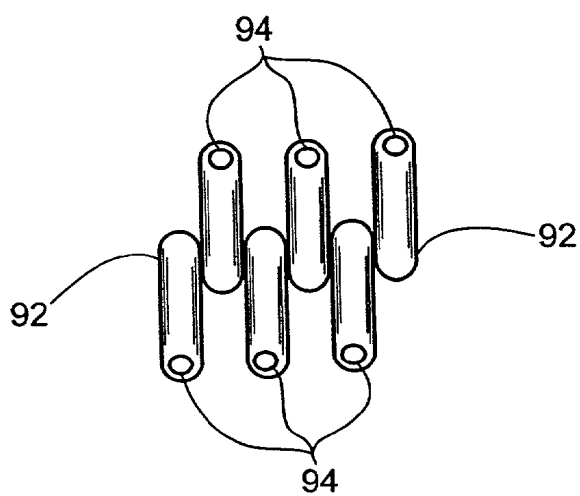
**FIG. 4B**



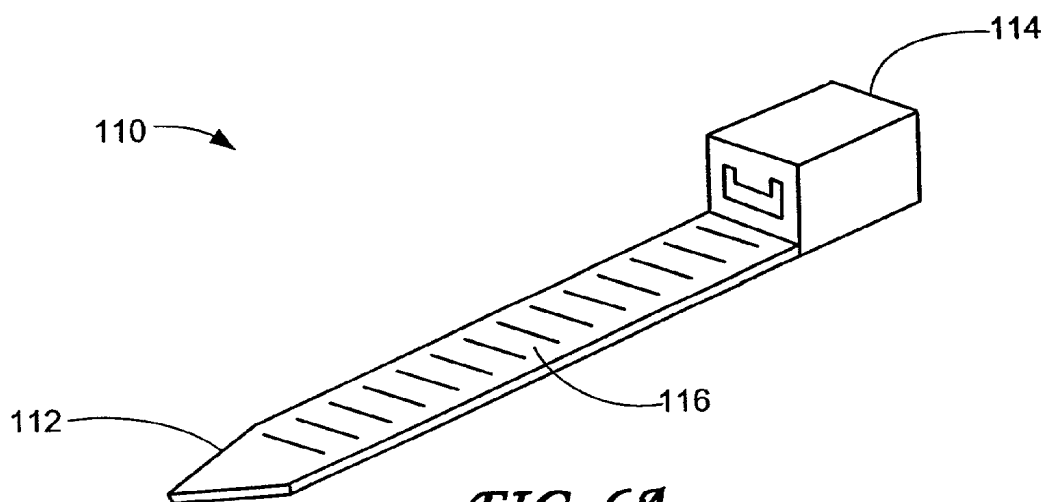
**FIG. 5A**



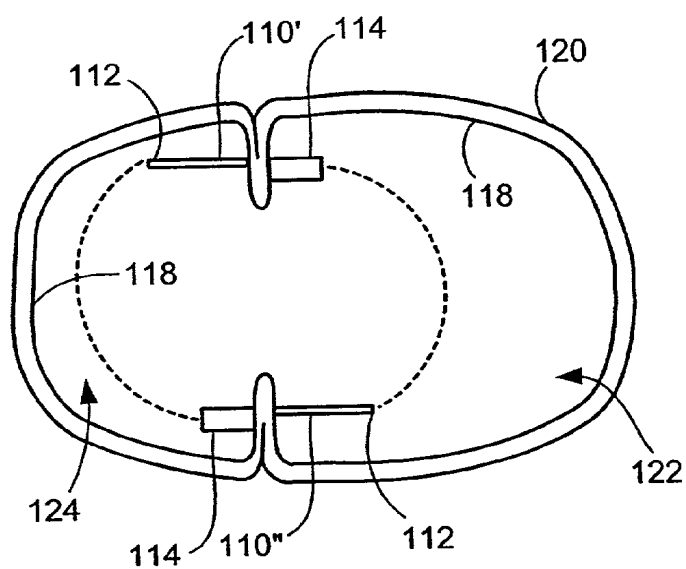
**FIG. 5B**



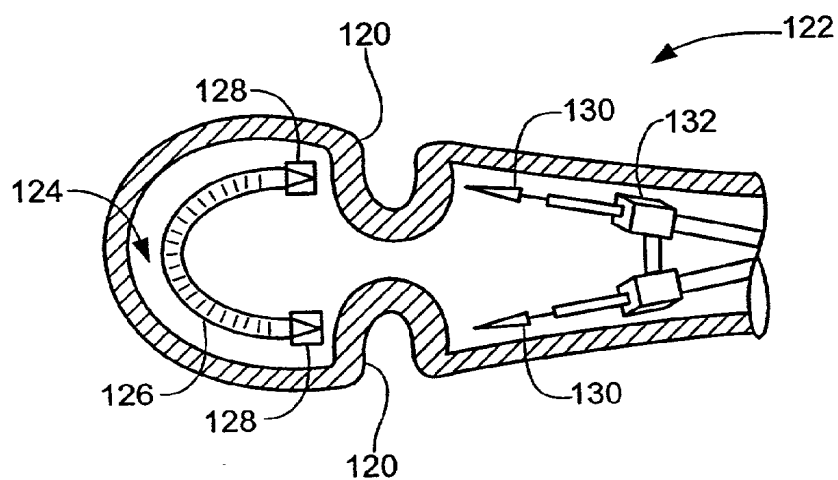
**FIG. 5C**



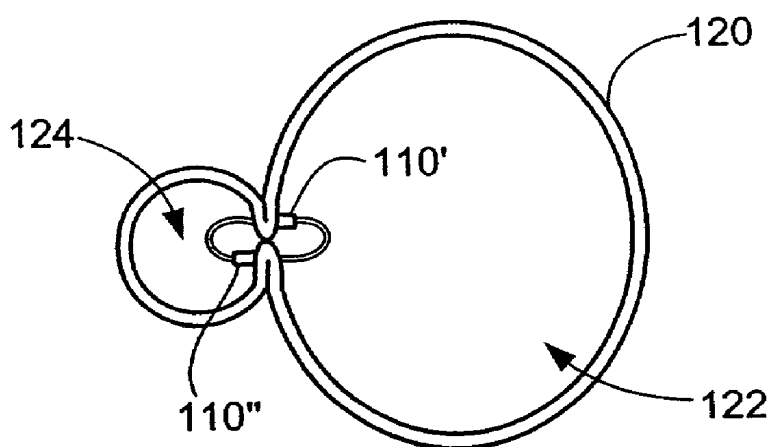
**FIG. 6A**



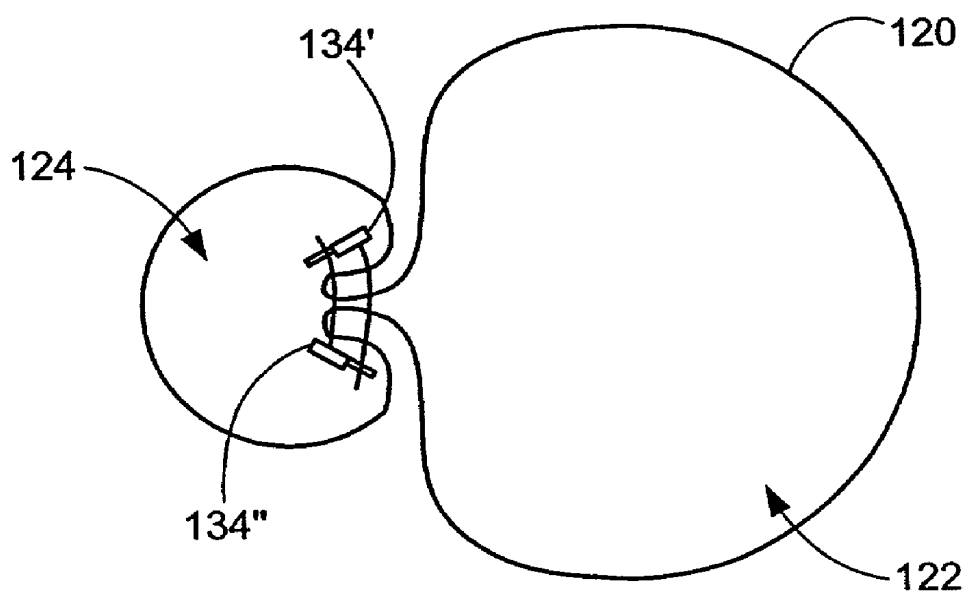
**FIG. 6B**



**FIG. 6C**

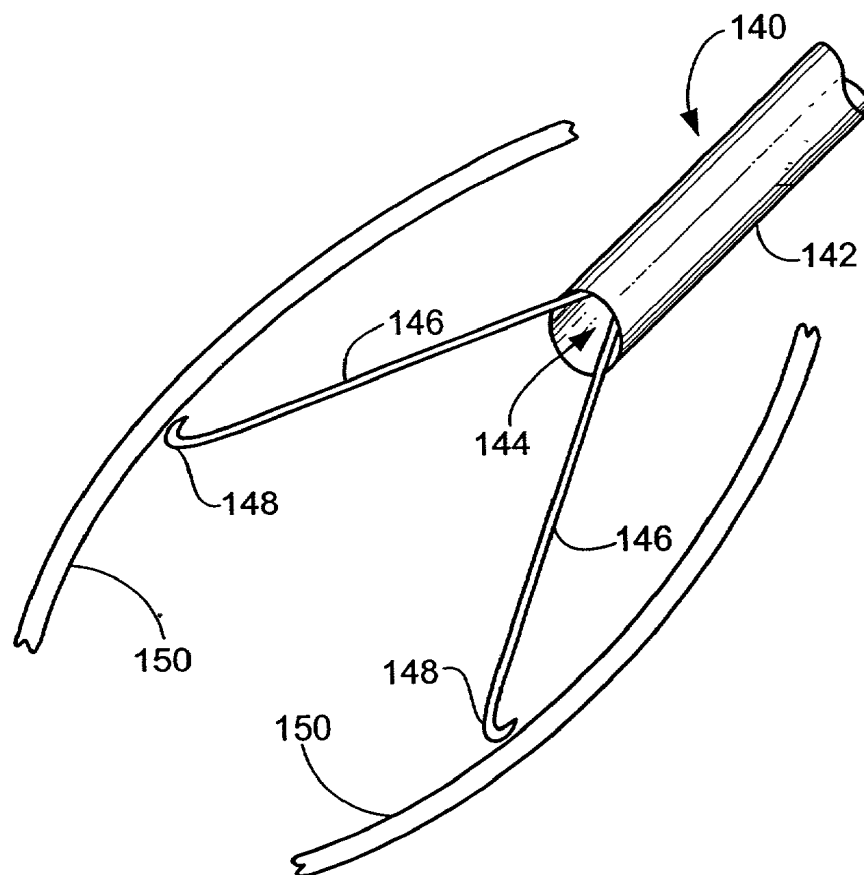


**FIG. 6D**

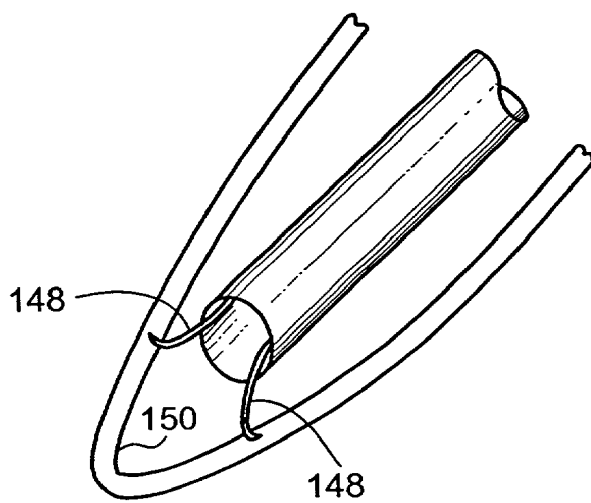


**FIG. 6E**

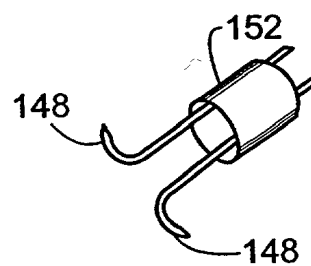




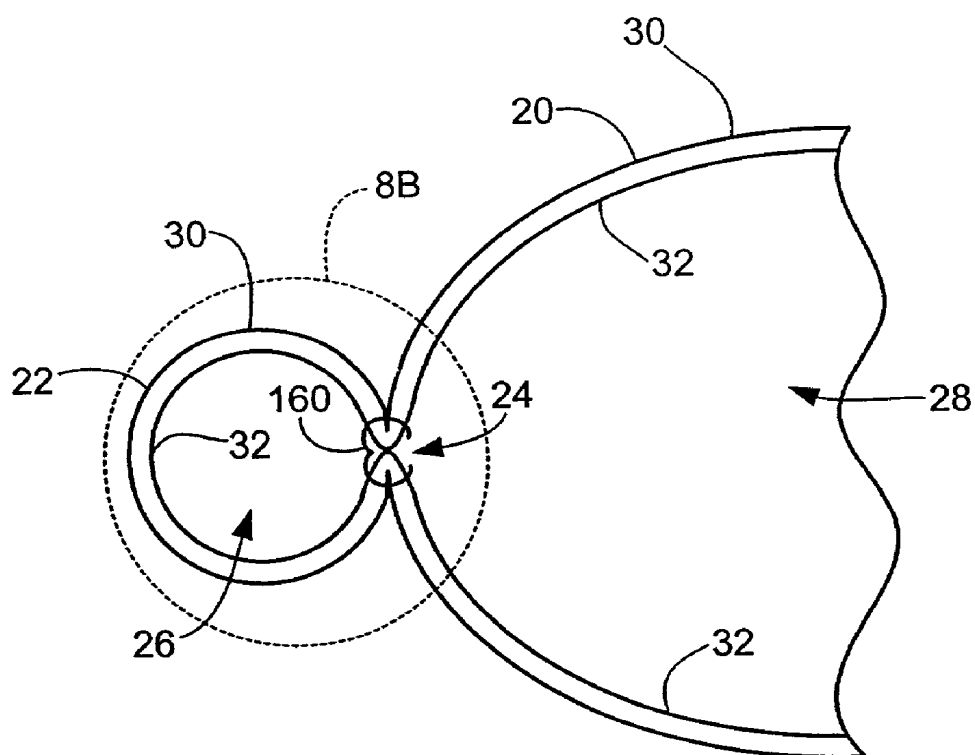
**FIG. 7A**



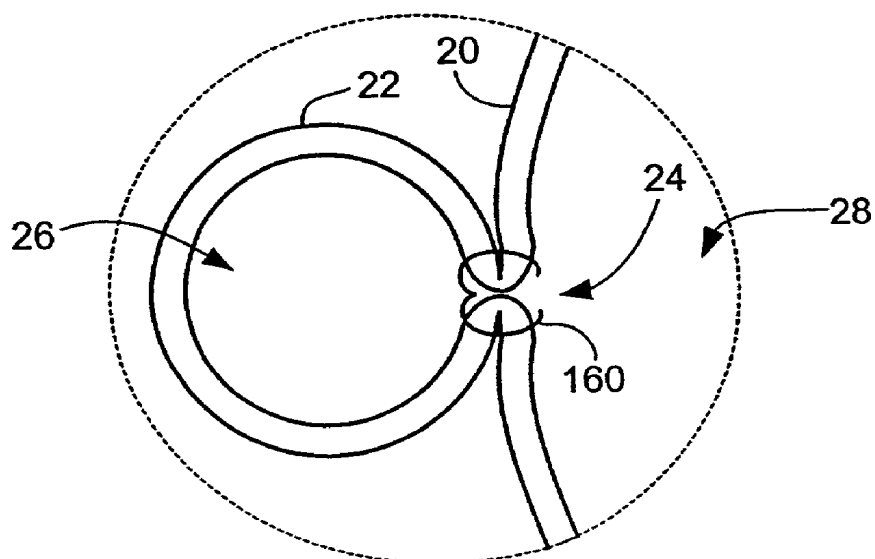
**FIG. 7B**



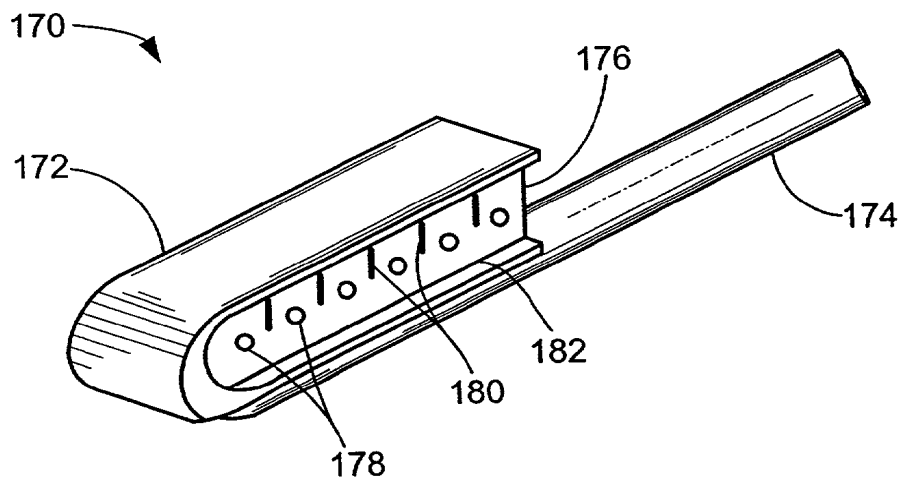
**FIG. 7C**



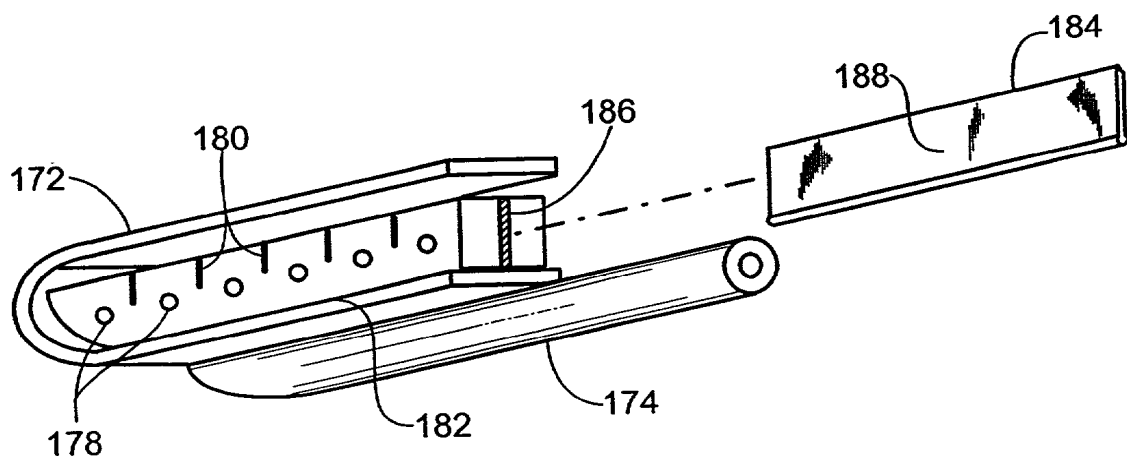
**FIG. 8A**



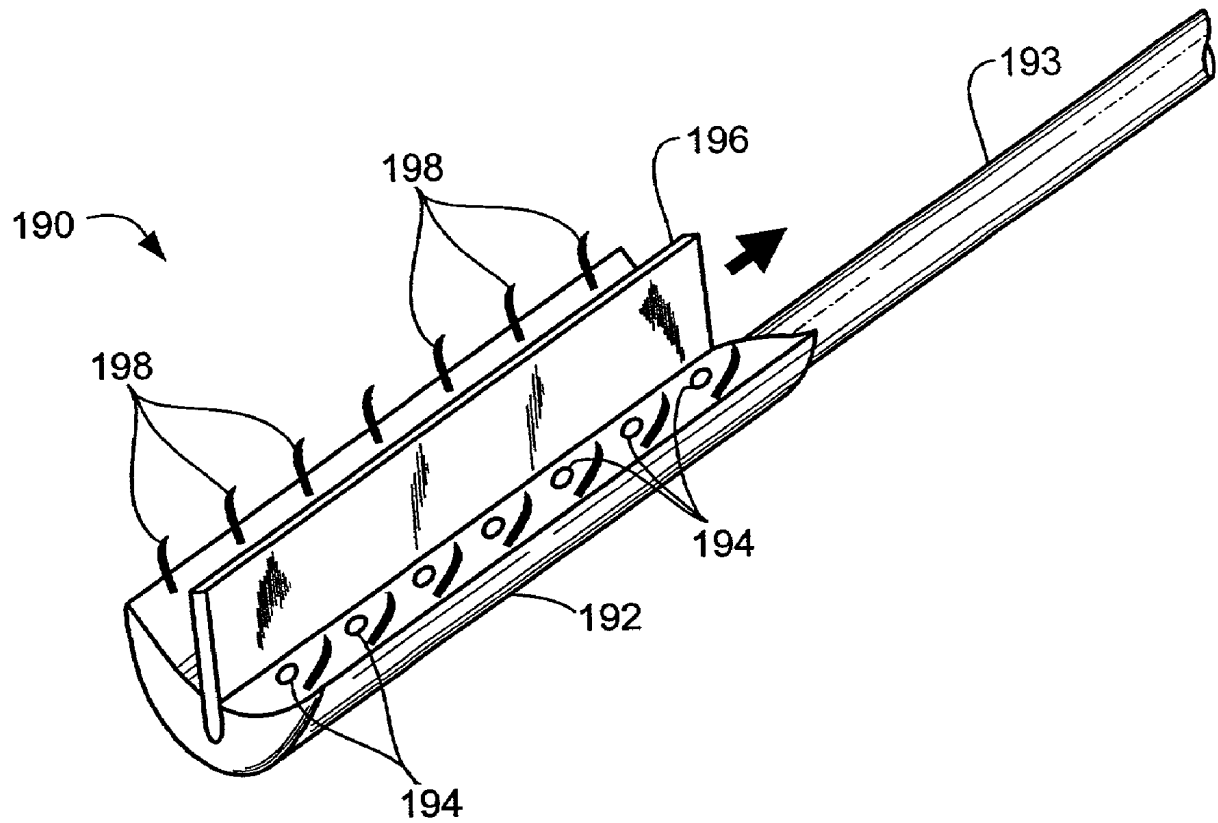
**FIG. 8B**



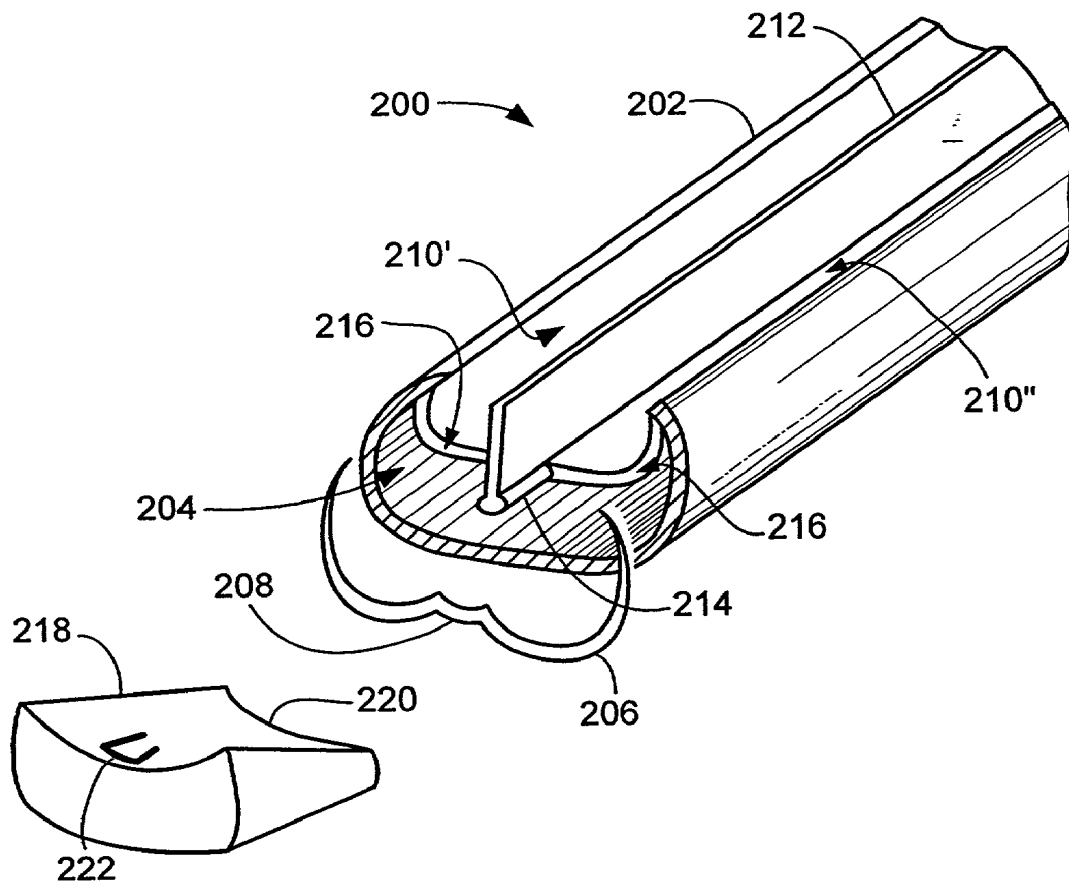
**FIG. 9A**



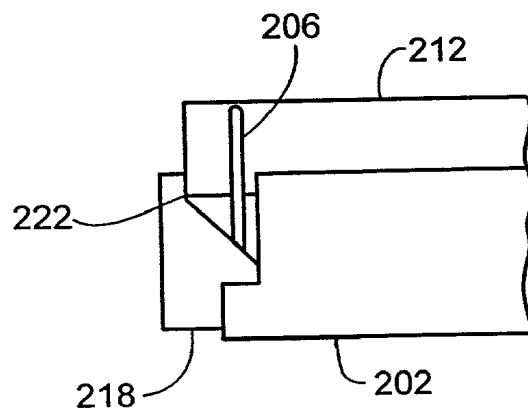
**FIG. 9B**



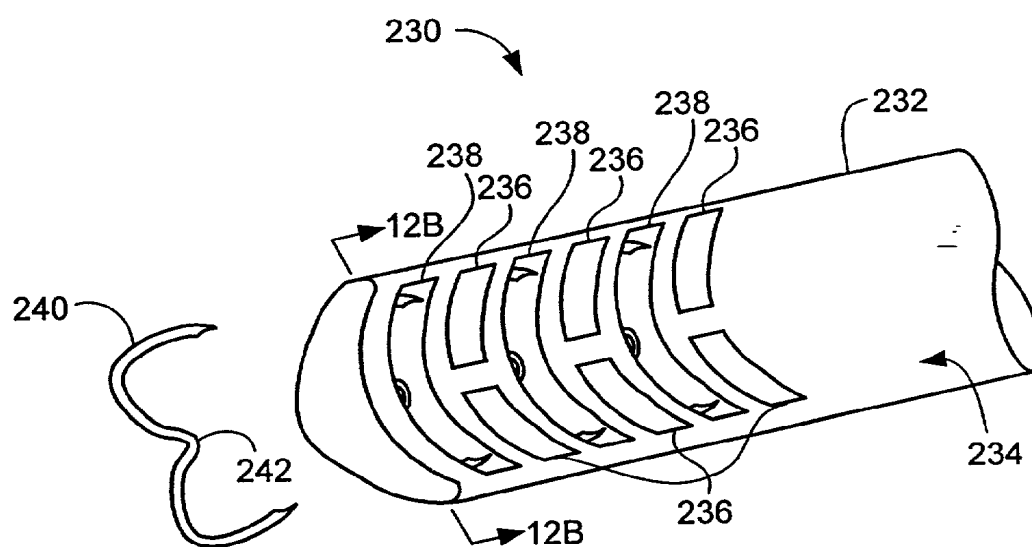
**FIG. 10**



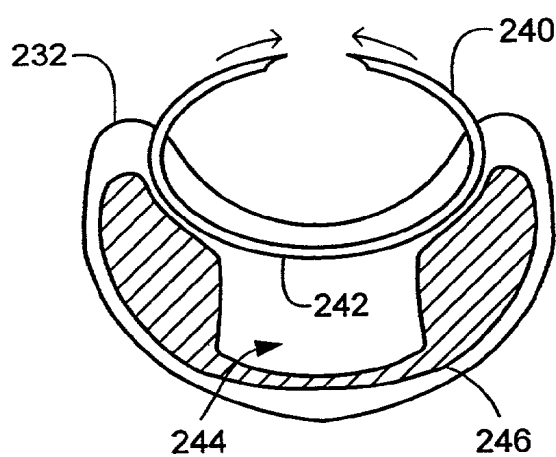
**FIG. 11A**



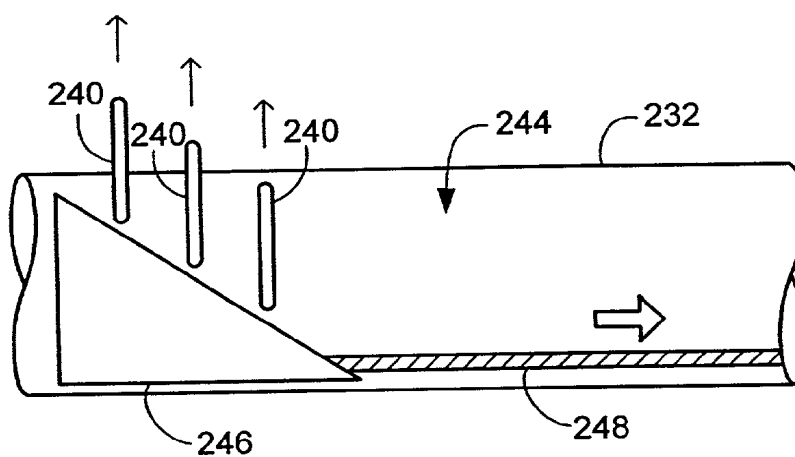
**FIG. 11B**



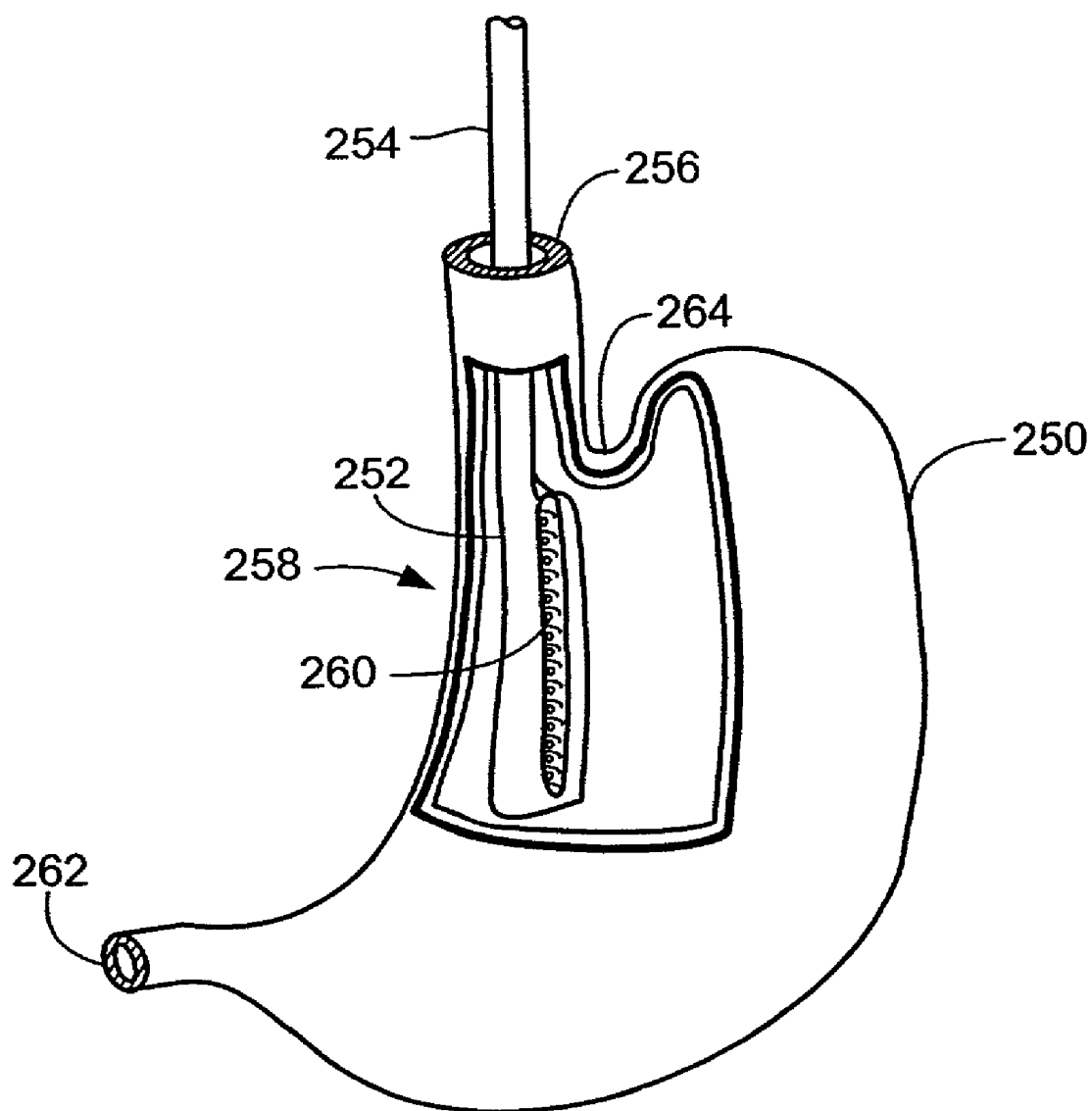
**FIG. 12A**



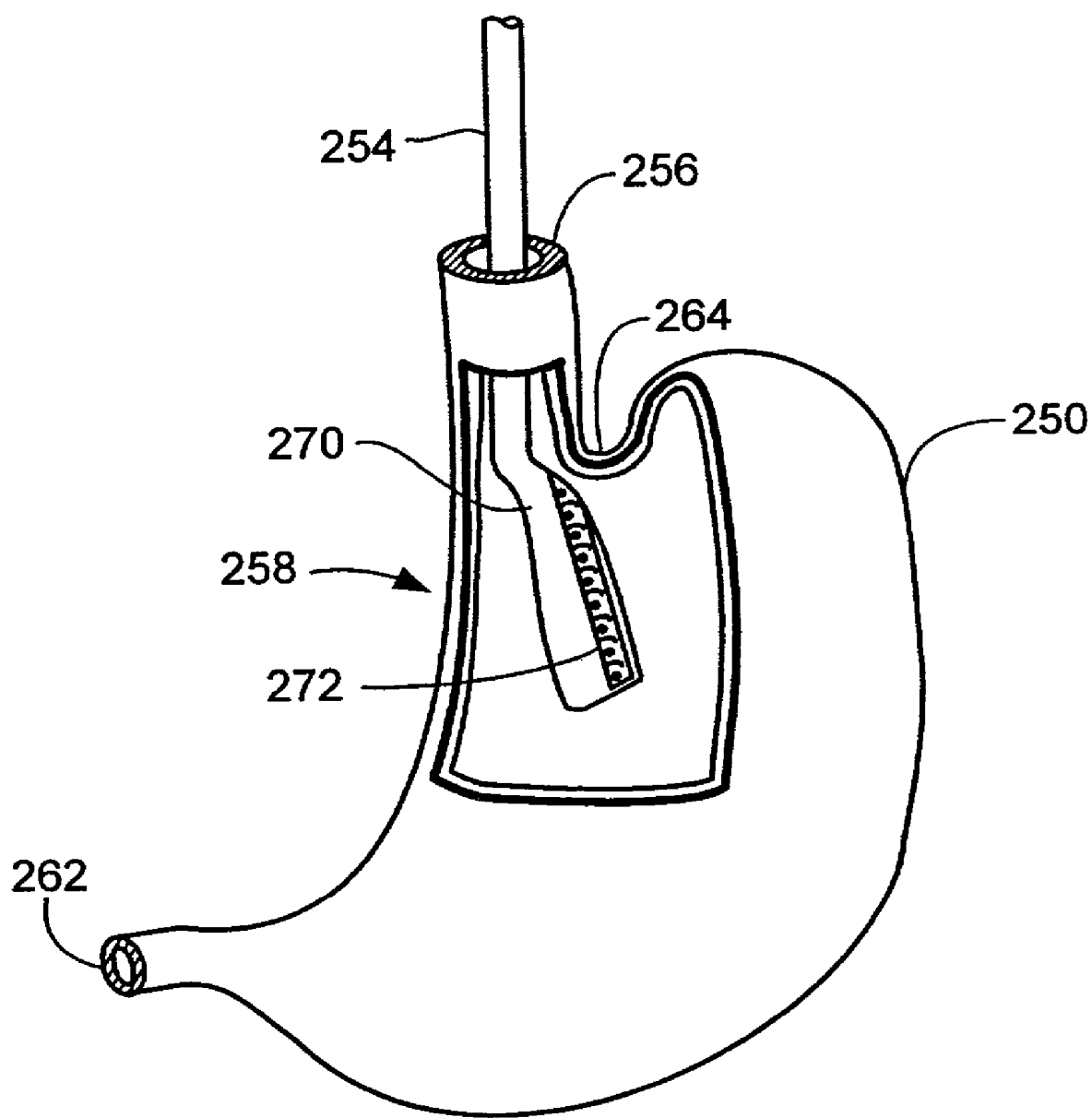
**FIG. 12B**



**FIG. 12C**

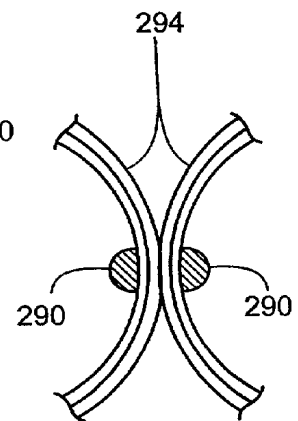
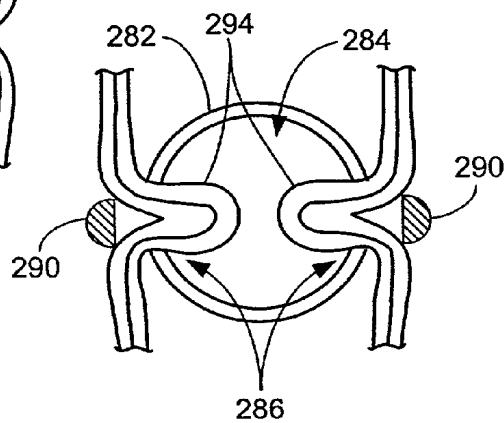
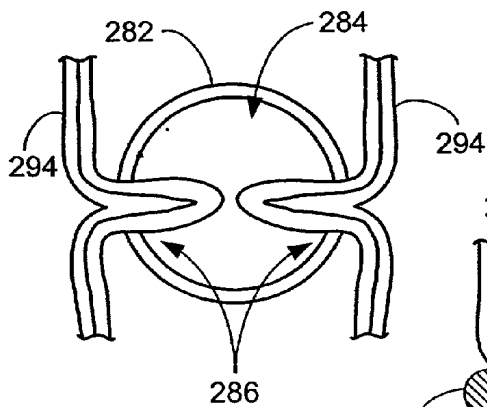
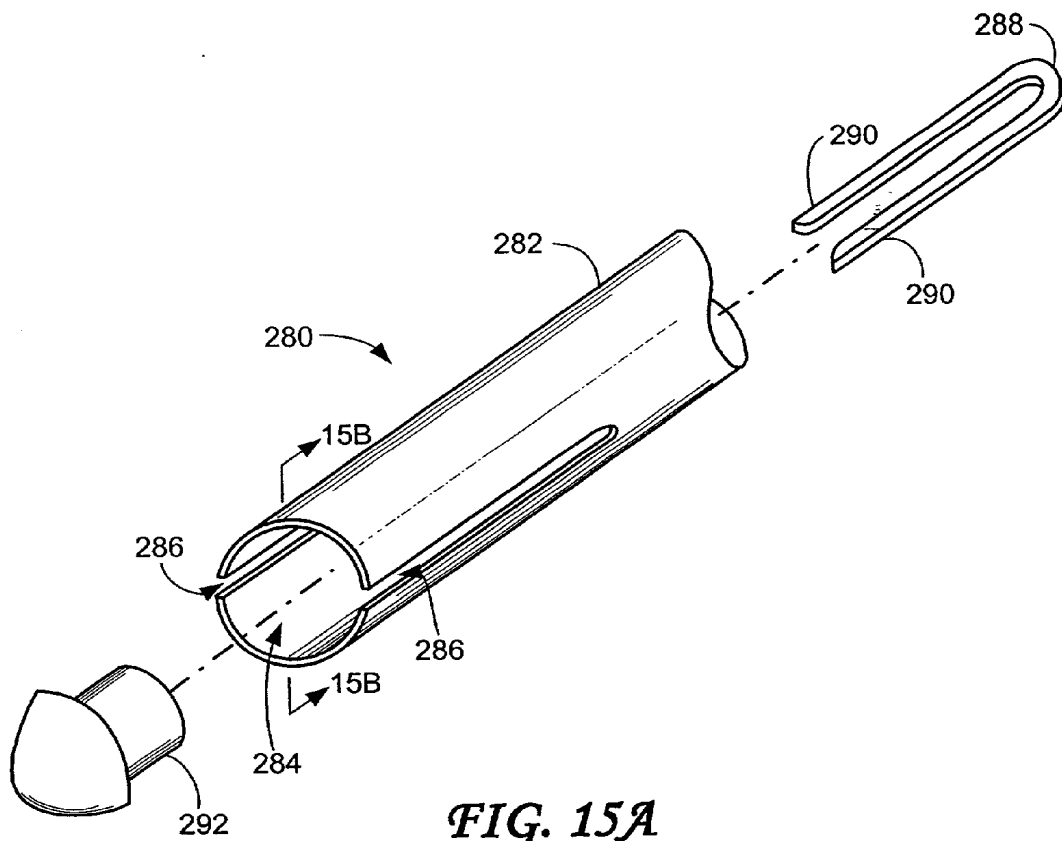


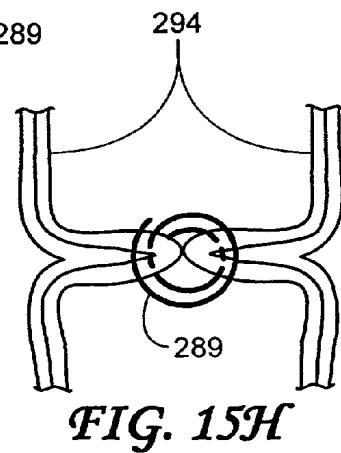
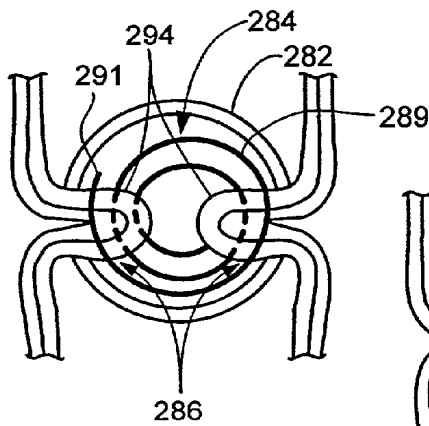
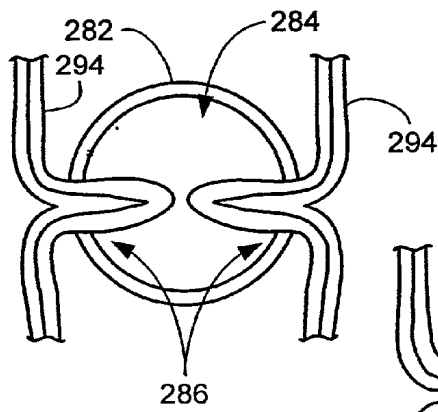
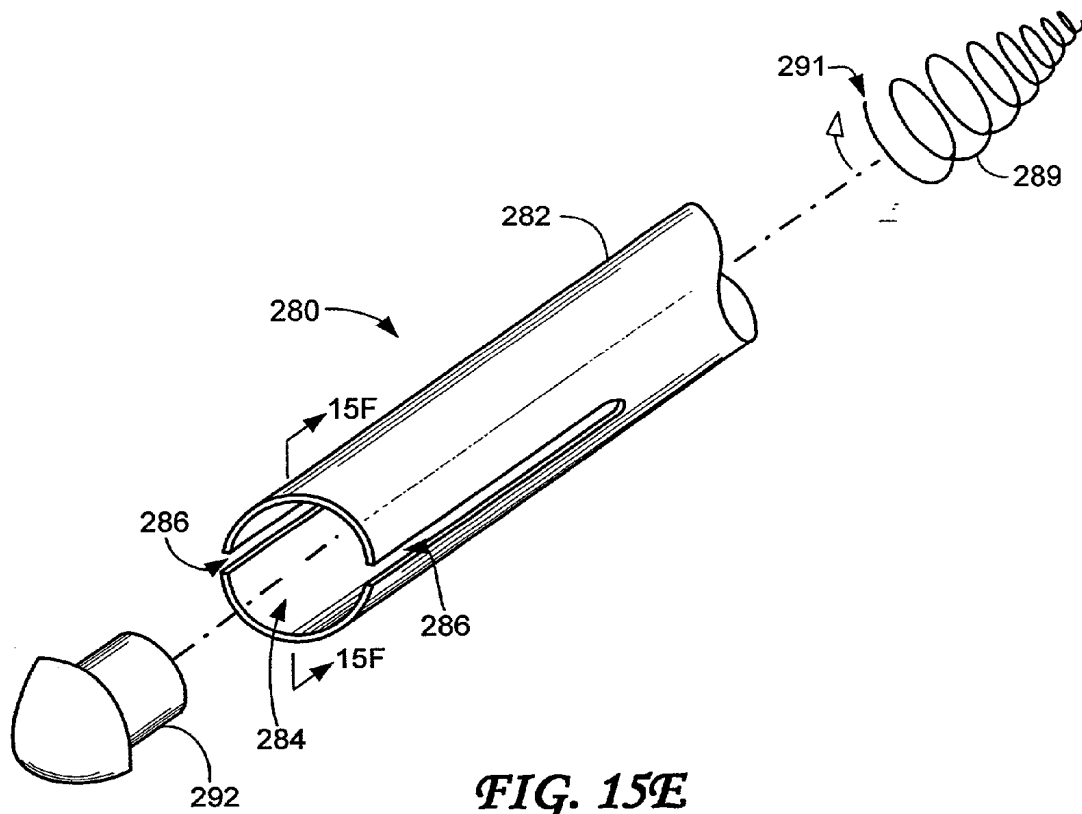
**FIG. 13**

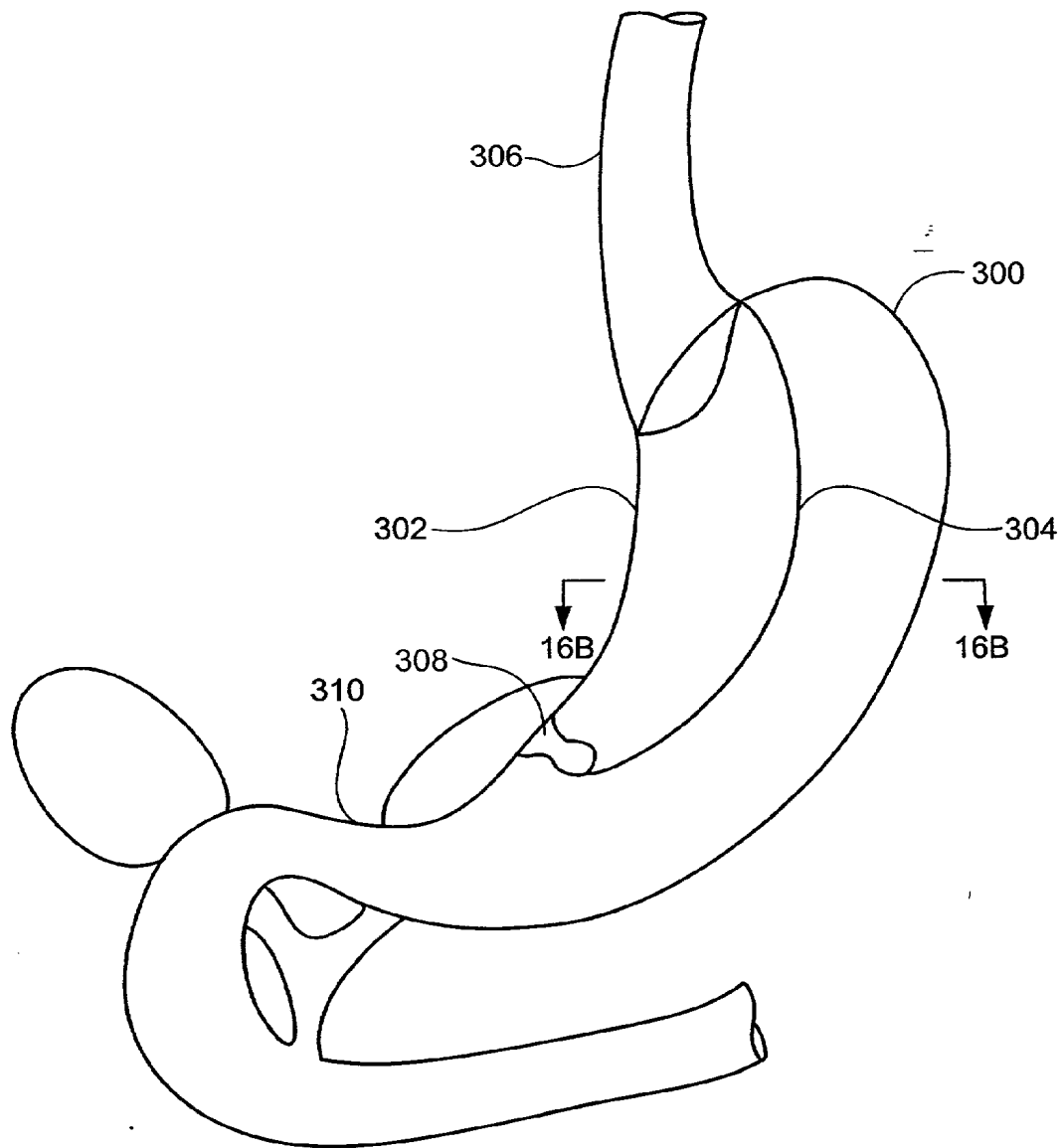


**FIG. 14**

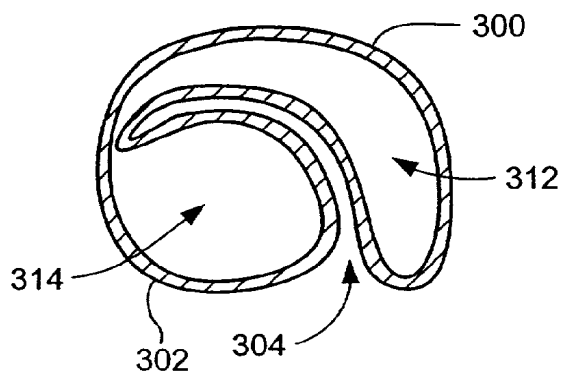




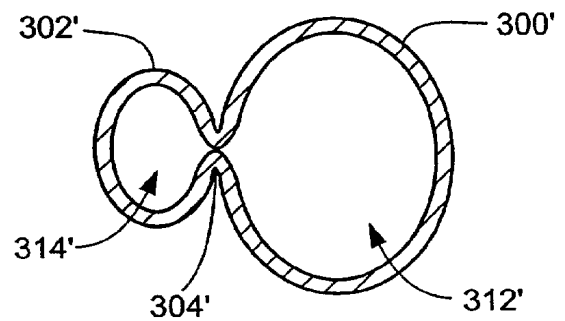




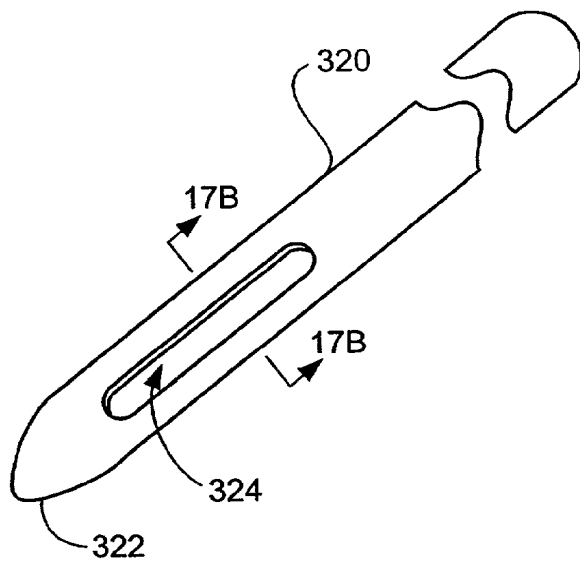
**FIG. 16A**



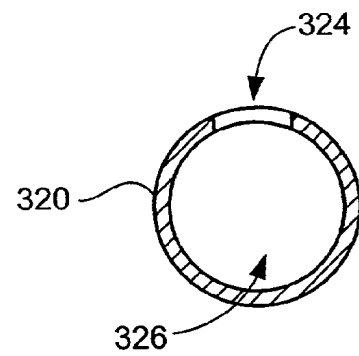
**FIG. 16B**



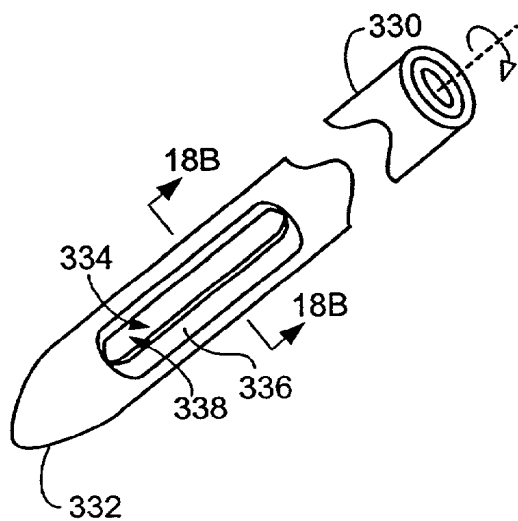
**FIG. 16C**



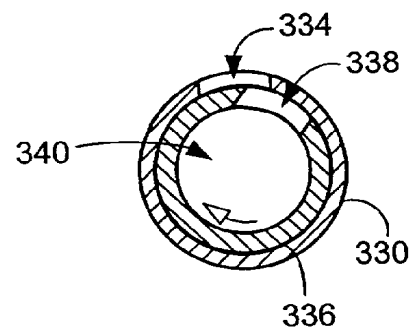
**FIG. 17A**



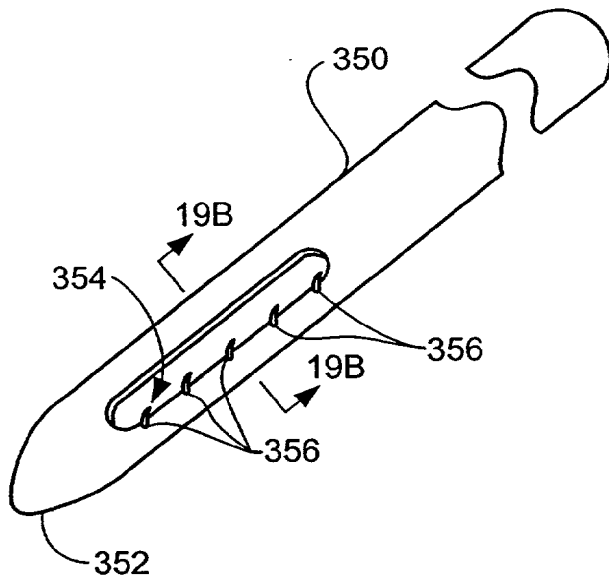
**FIG. 17B**



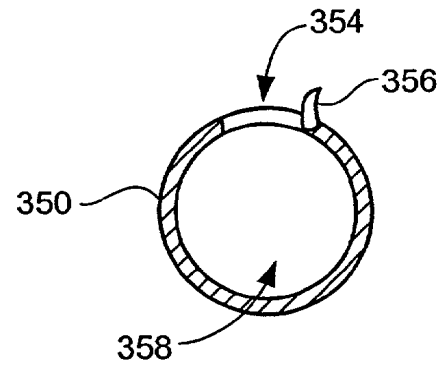
**FIG. 18A**



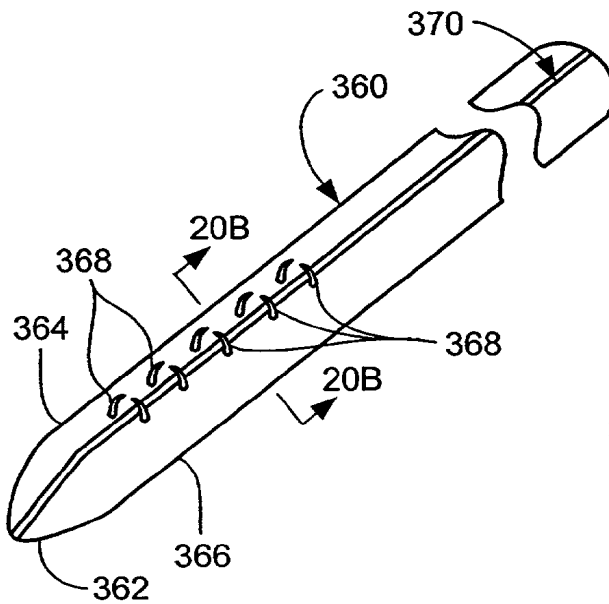
**FIG. 18B**



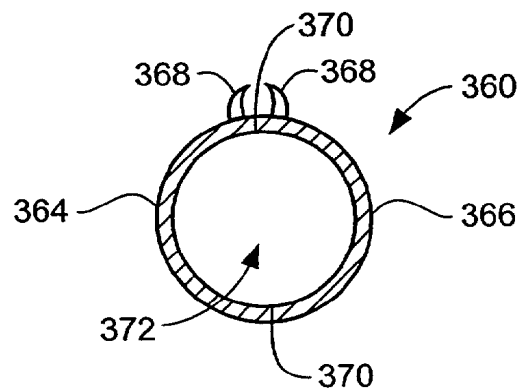
**FIG. 19A**



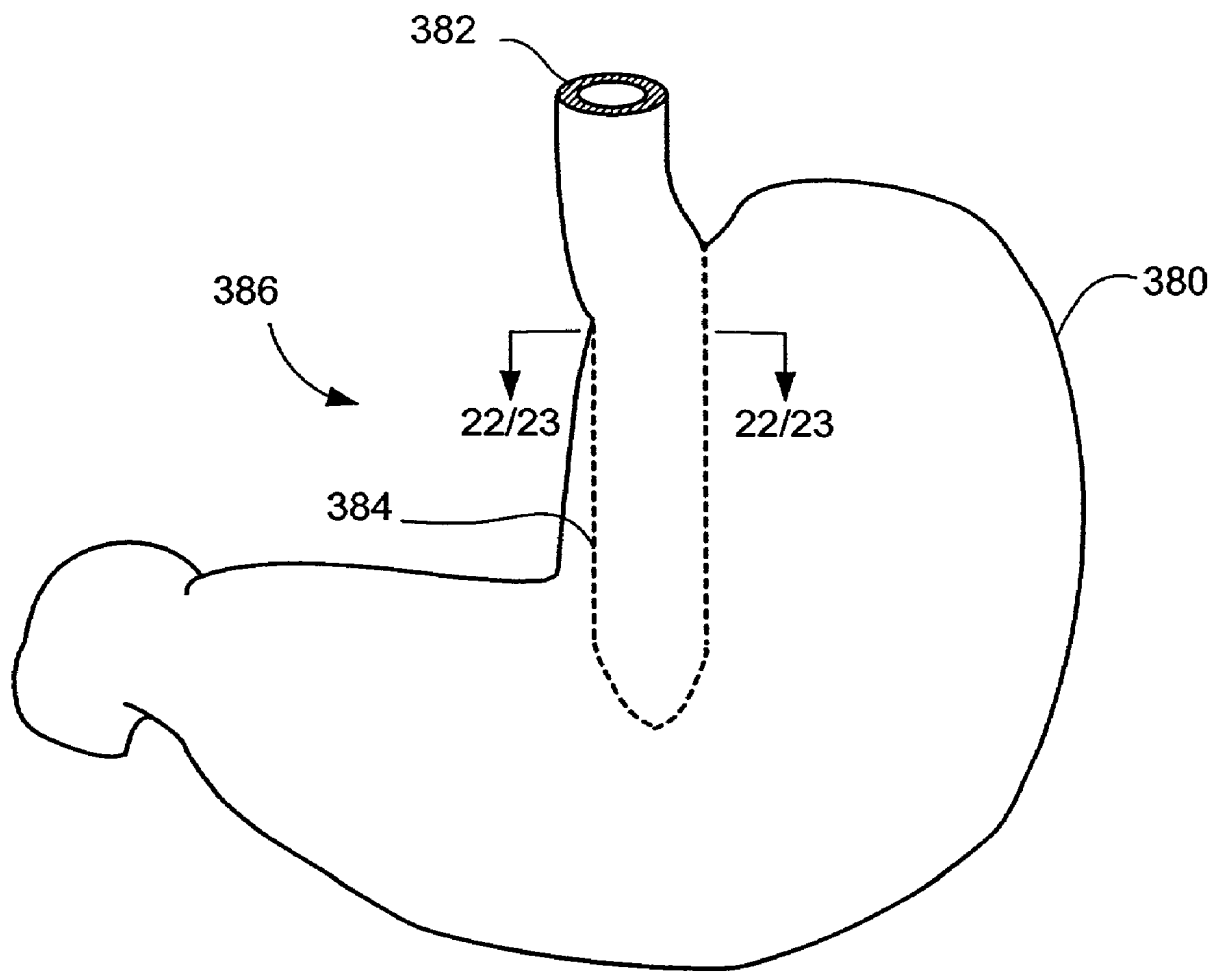
**FIG. 19B**



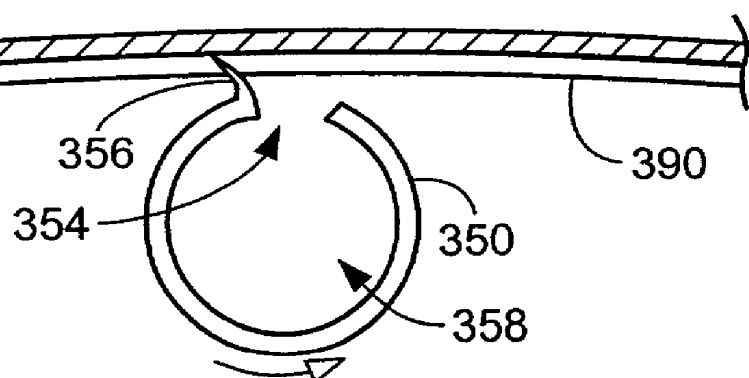
**FIG. 20A**



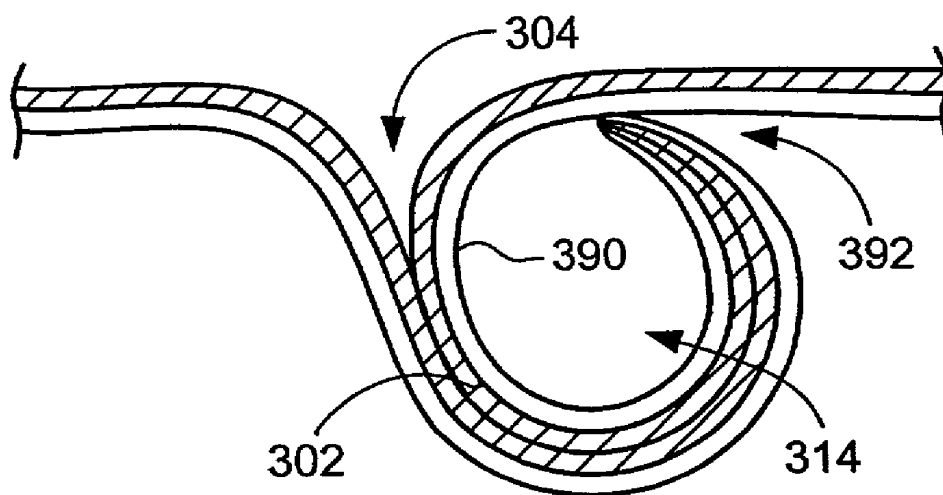
**FIG. 20B**



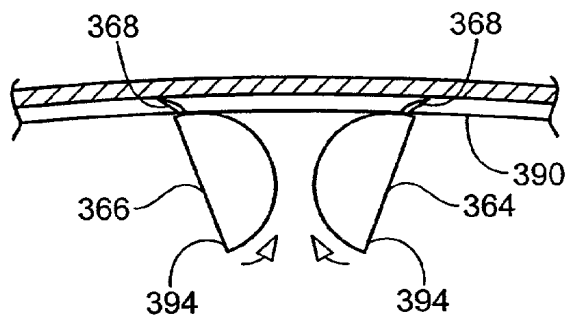
**FIG. 21**



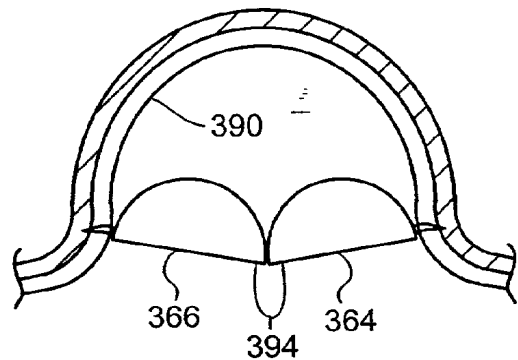
**FIG. 22A**



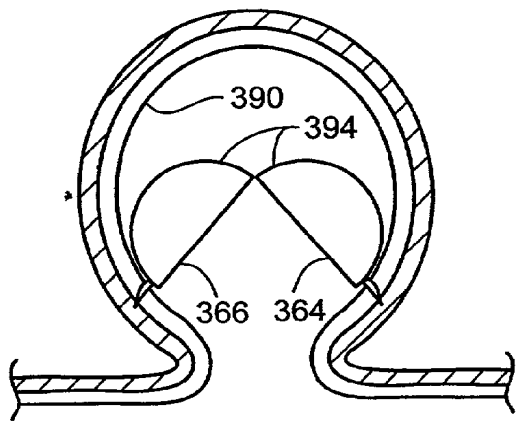
**FIG. 22B**



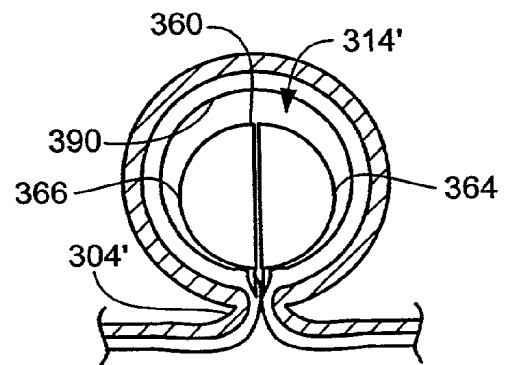
**FIG. 23A**



**FIG. 23B**



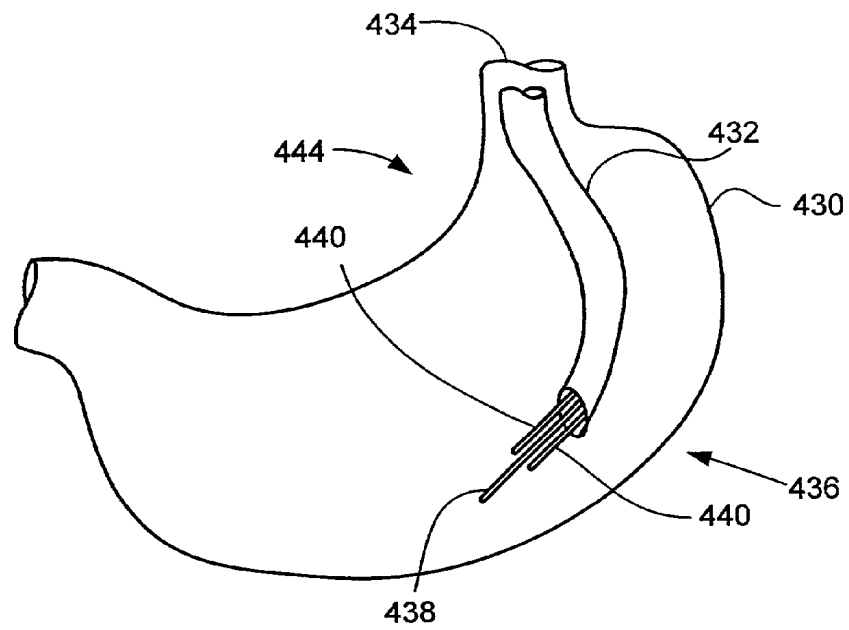
**FIG. 23C**



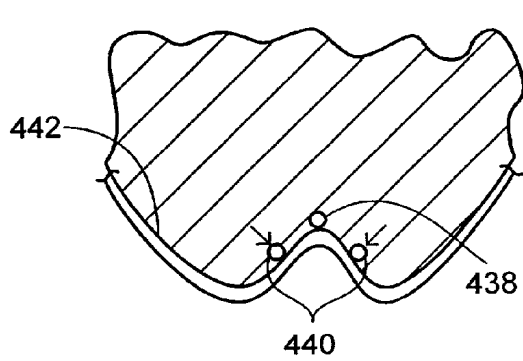
**FIG. 23D**



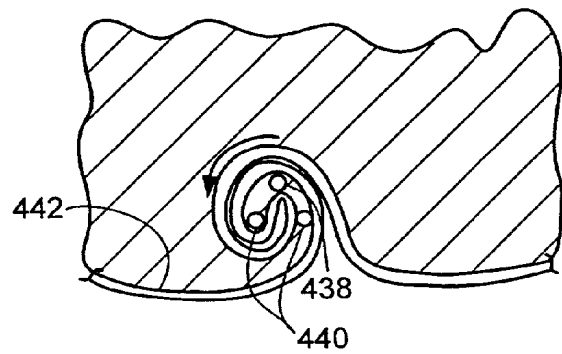
**FIG. 24C**



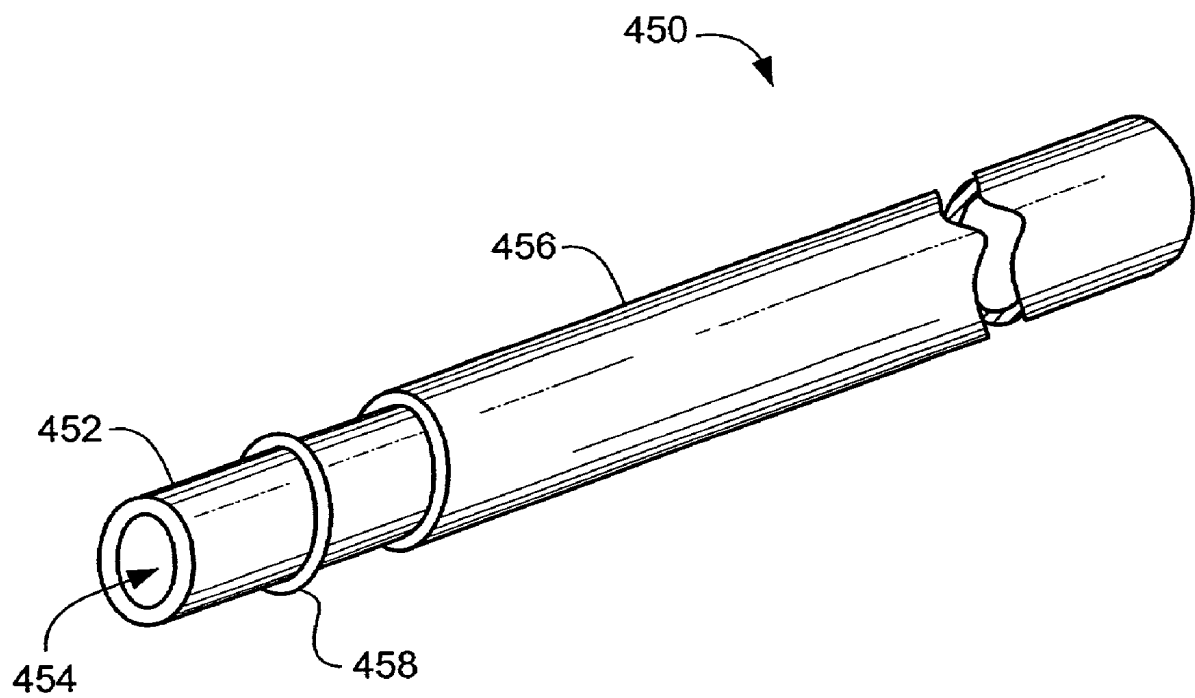
**FIG. 25A**

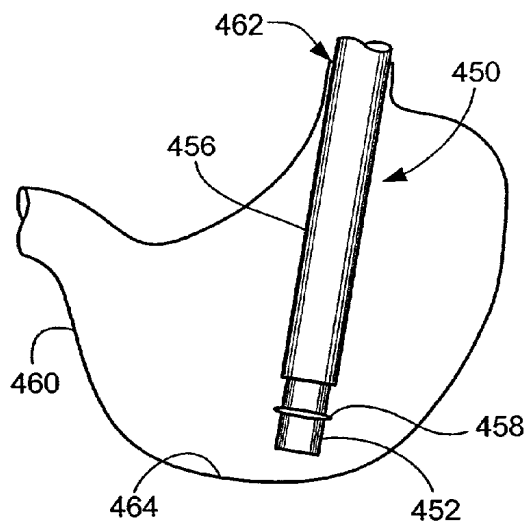


**FIG. 25B**

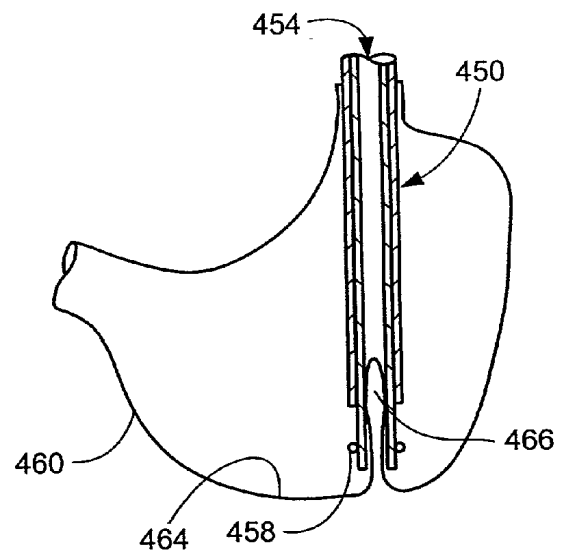


**FIG. 25C**

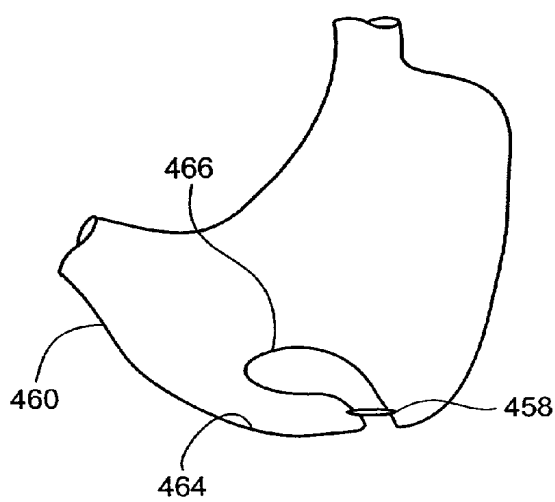
**FIG. 26**



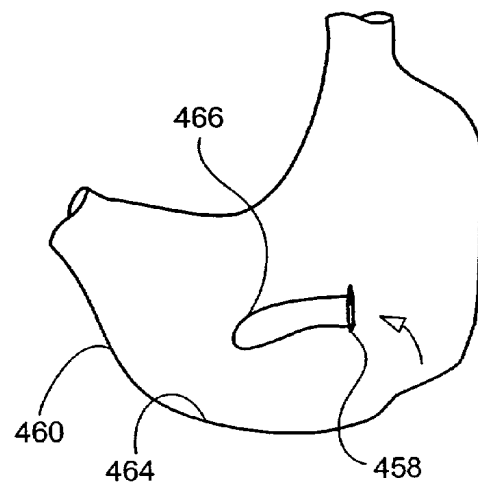
**FIG. 27A**



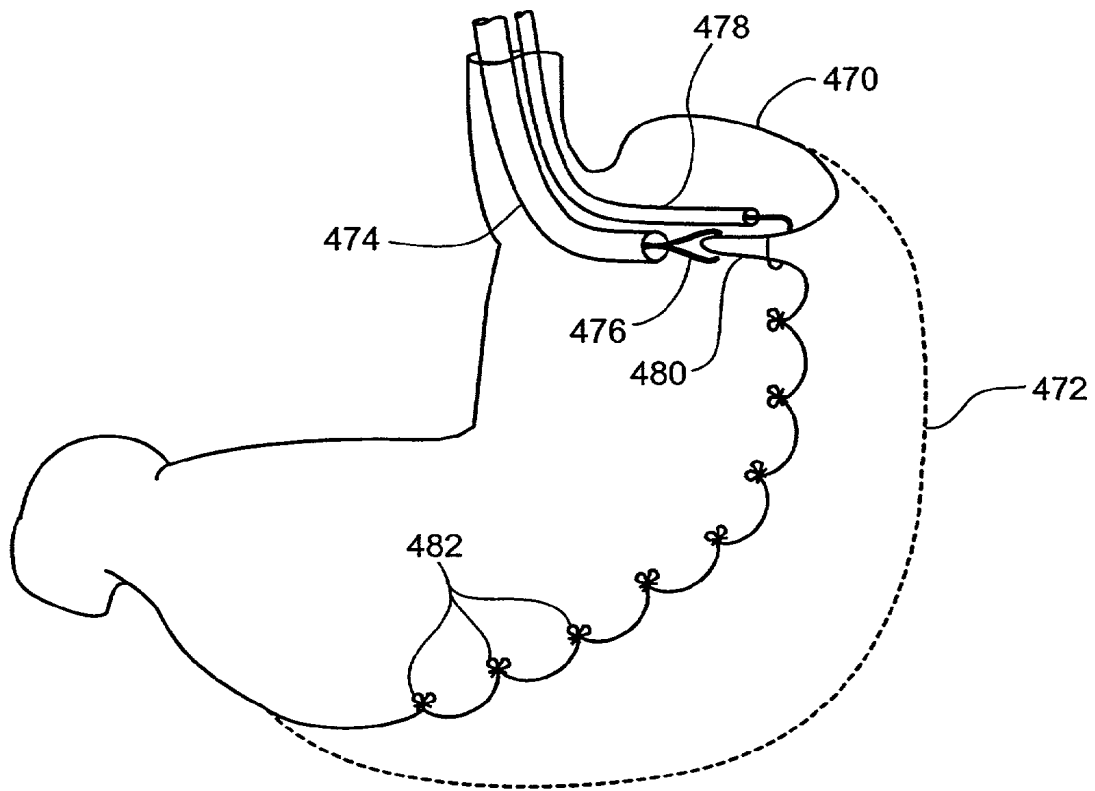
**FIG. 27B**



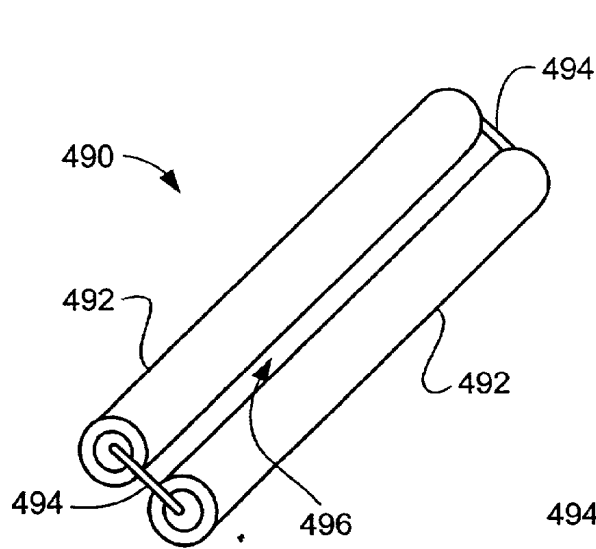
**FIG. 27C**



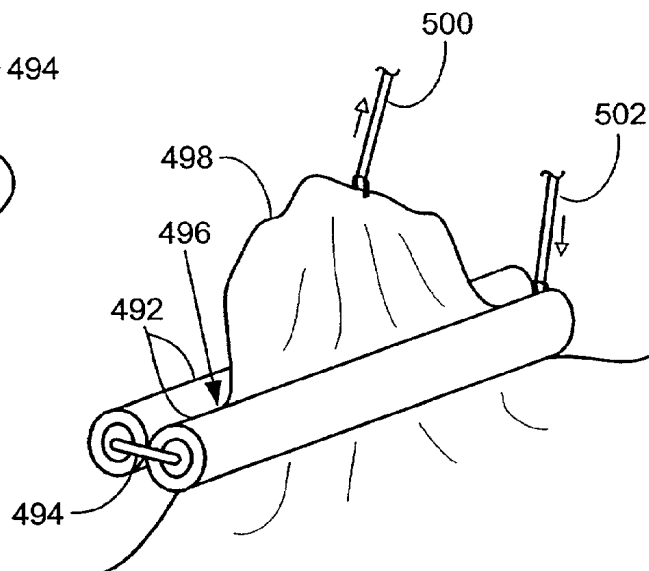
**FIG. 27D**



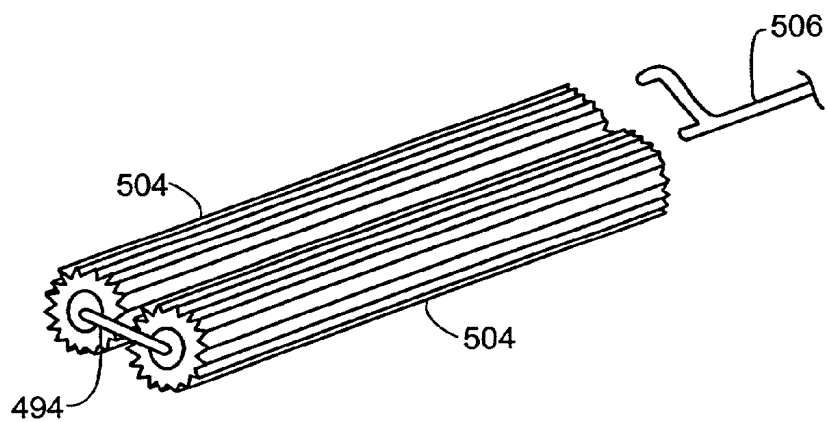
**FIG. 28**



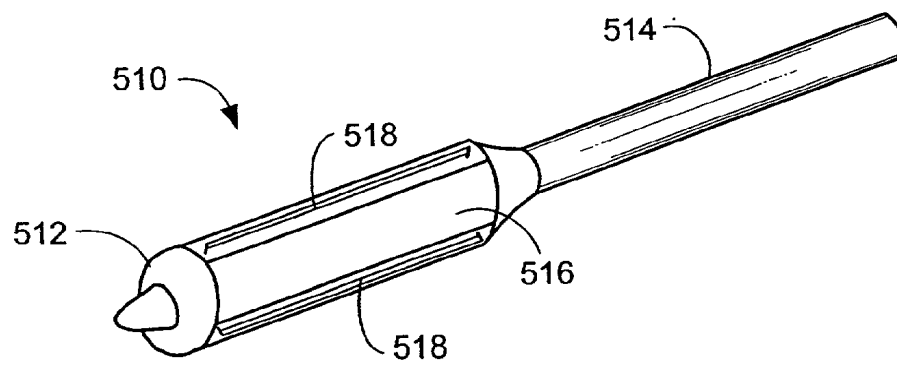
**FIG. 29A**



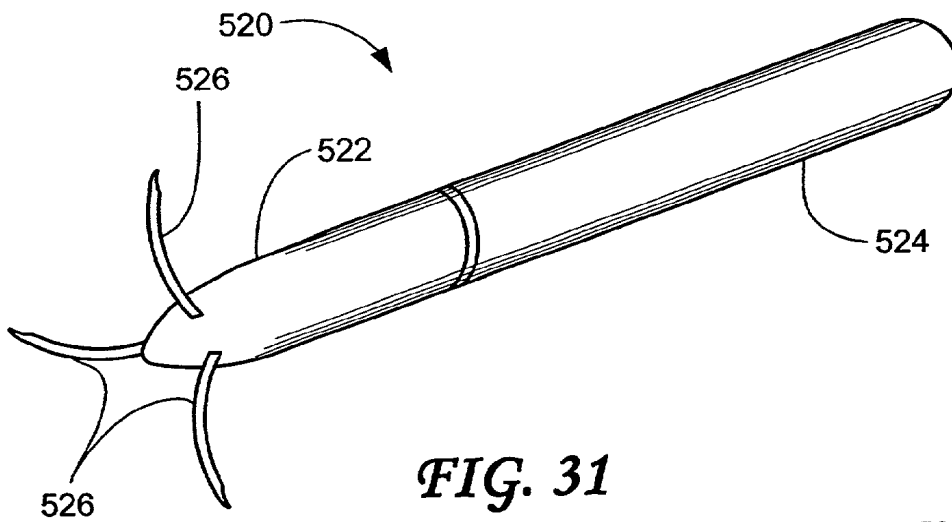
**FIG. 29B**



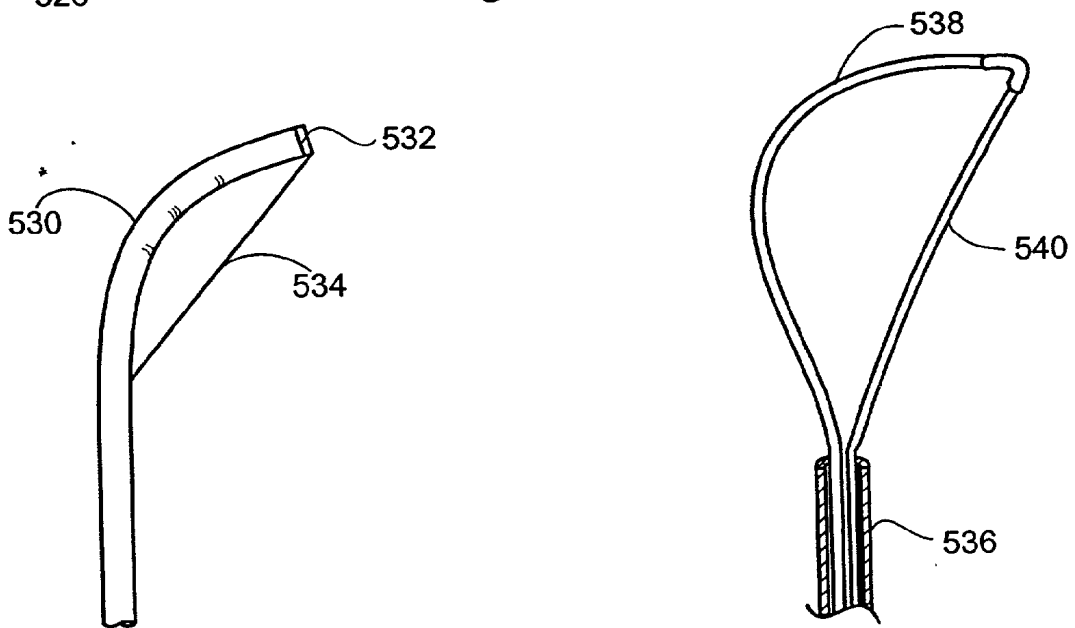
**FIG. 29C**



**FIG. 30**

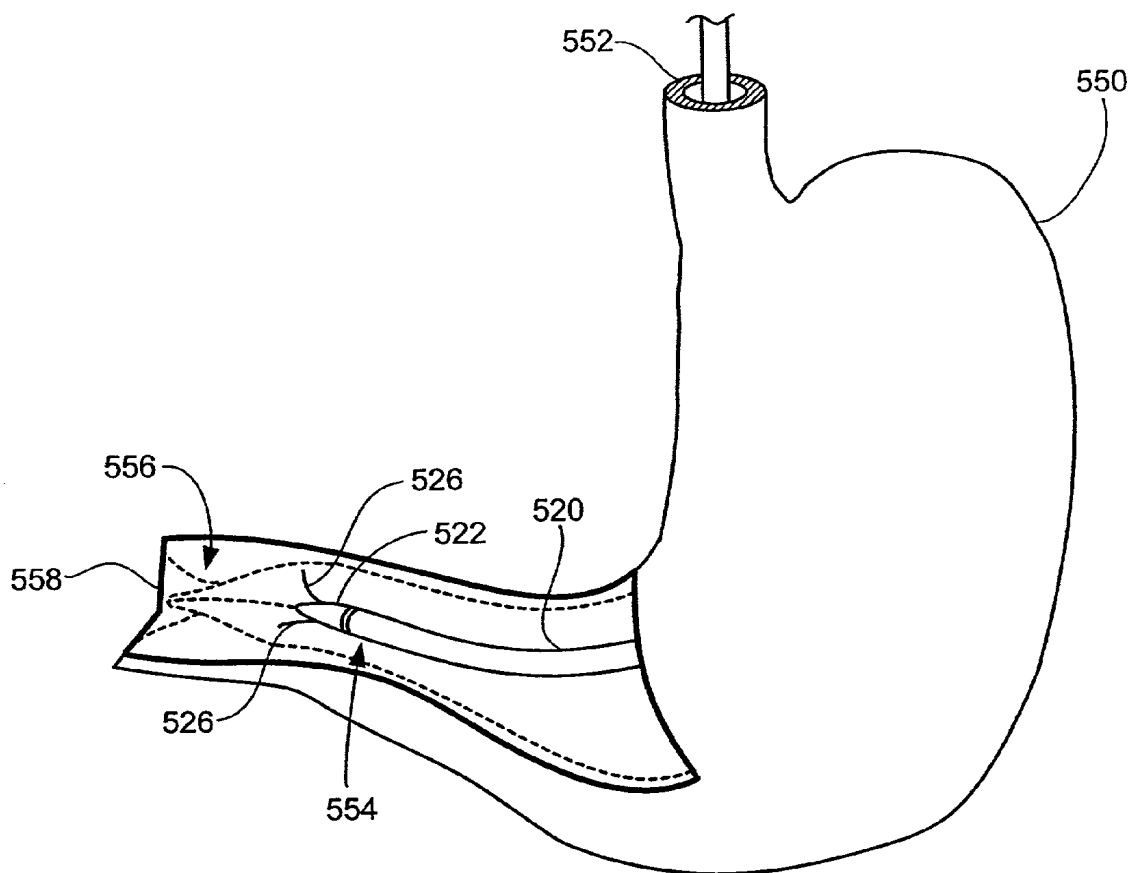


**FIG. 31**



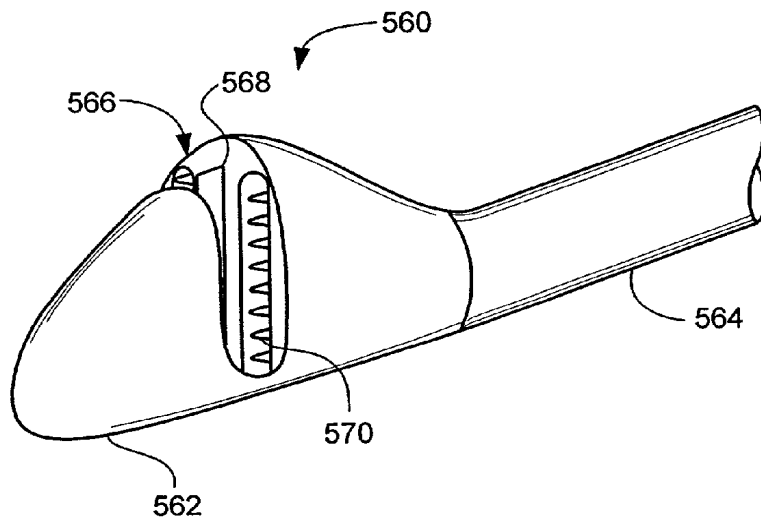
**FIG. 32A**

**FIG. 32B**

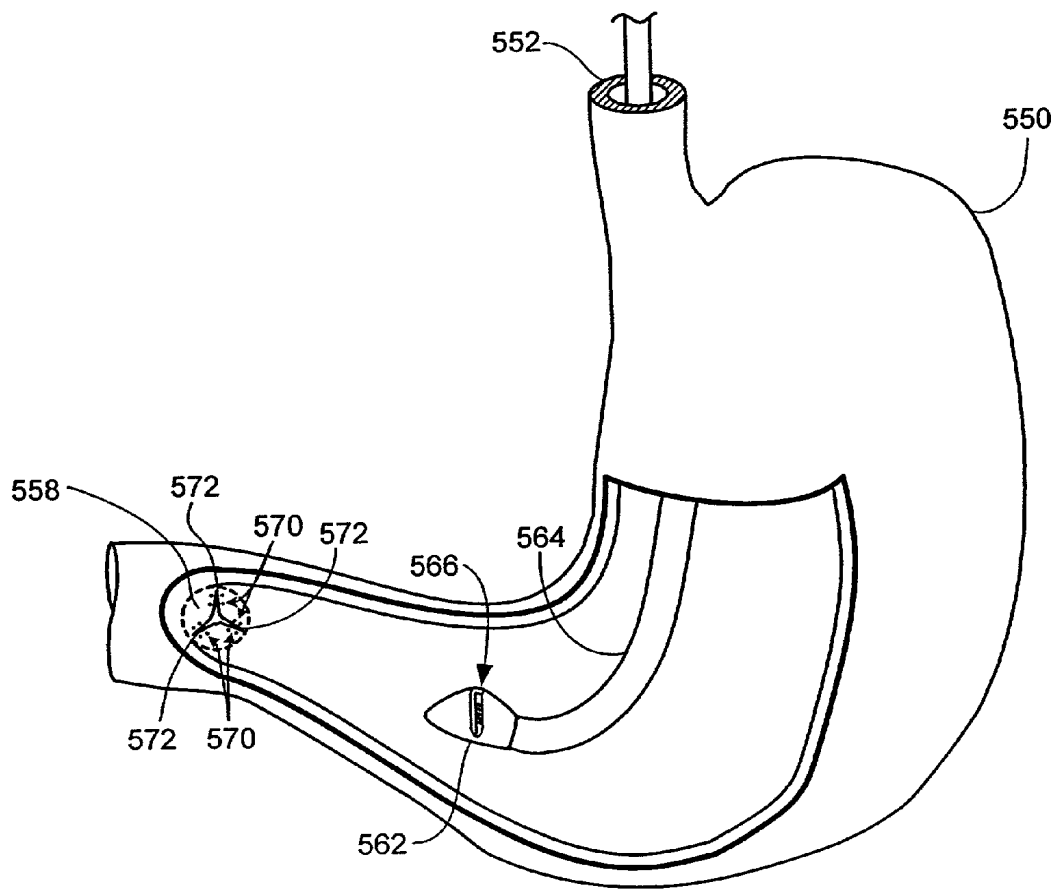


**FIG. 33**

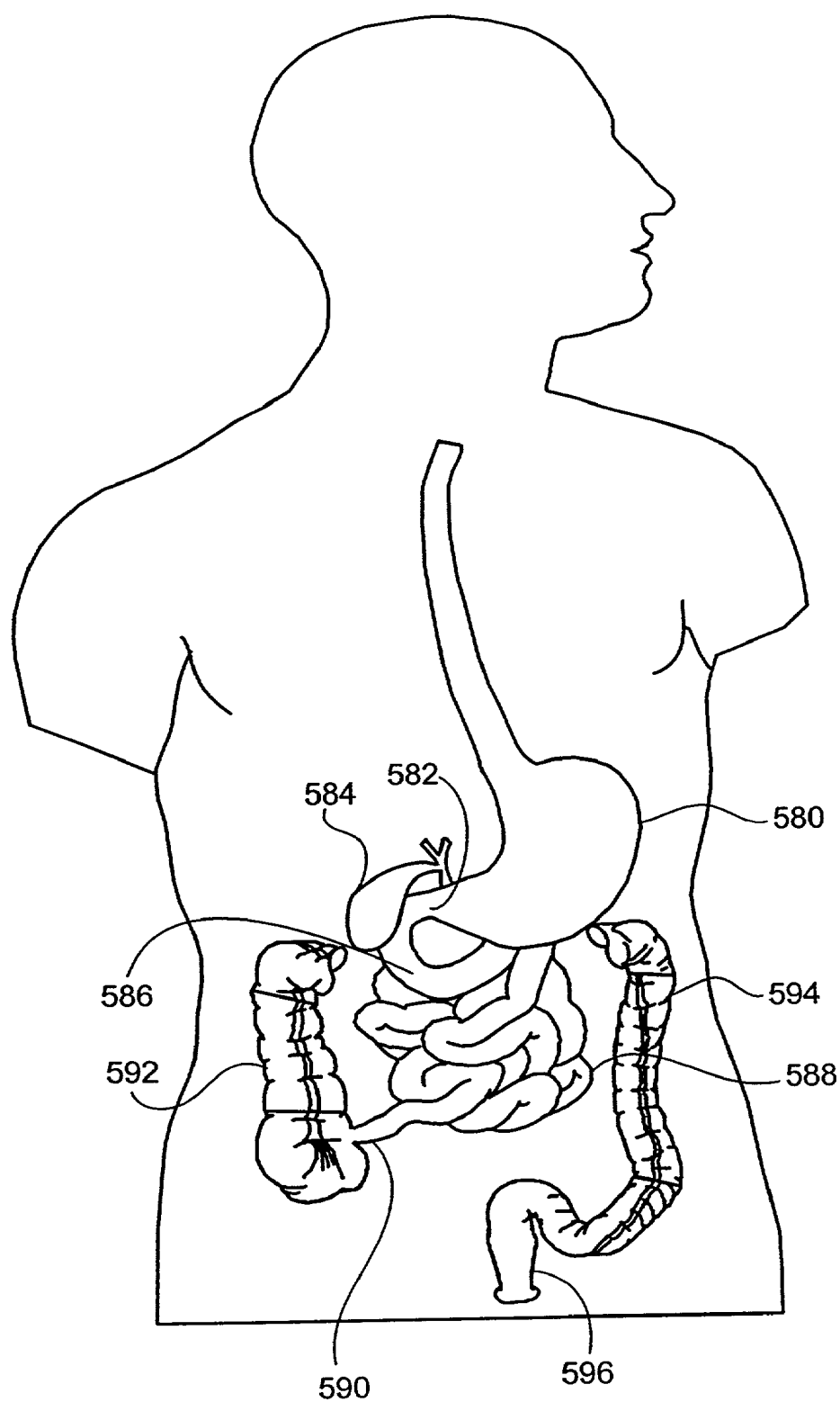




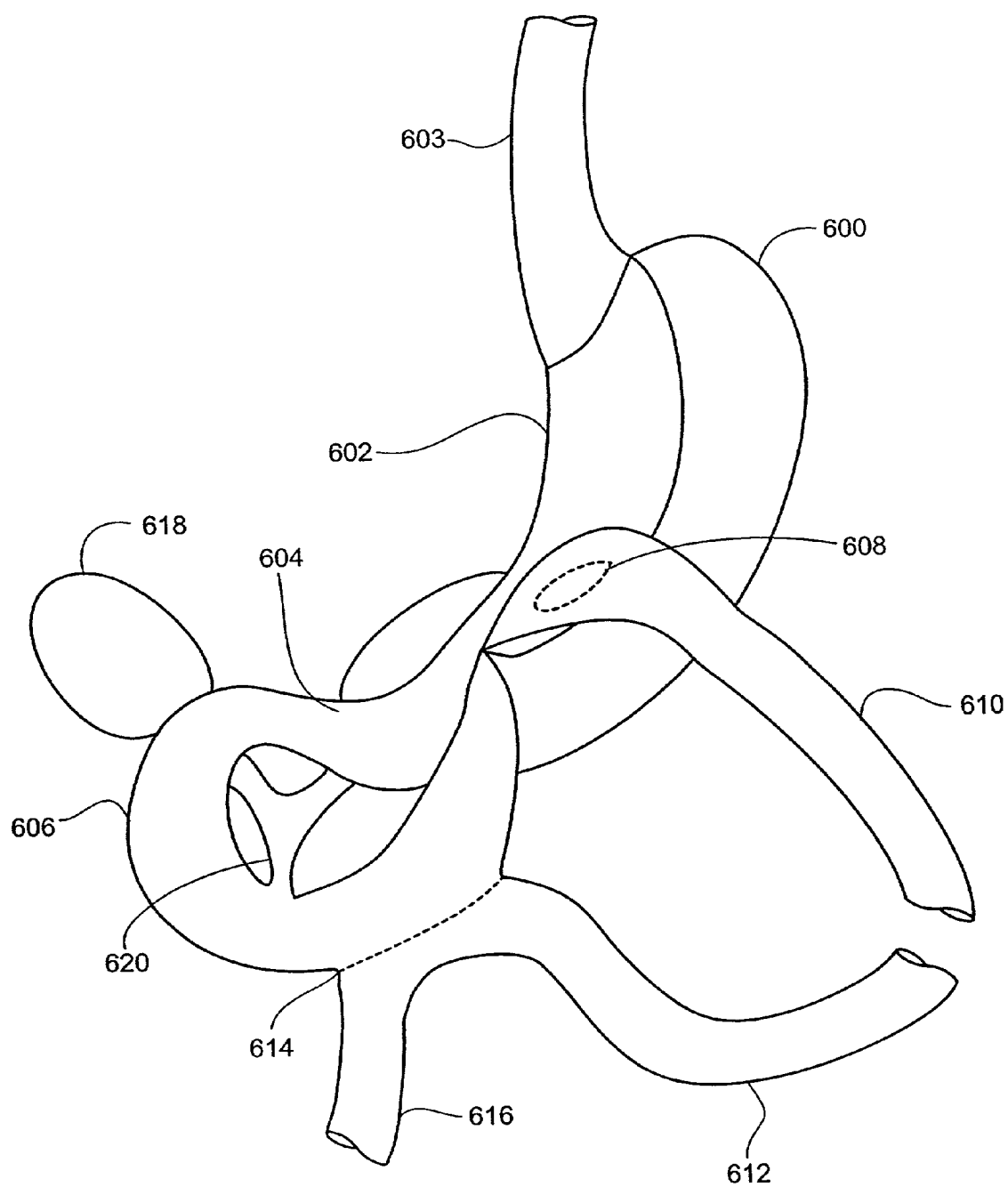
*FIG. 34A*



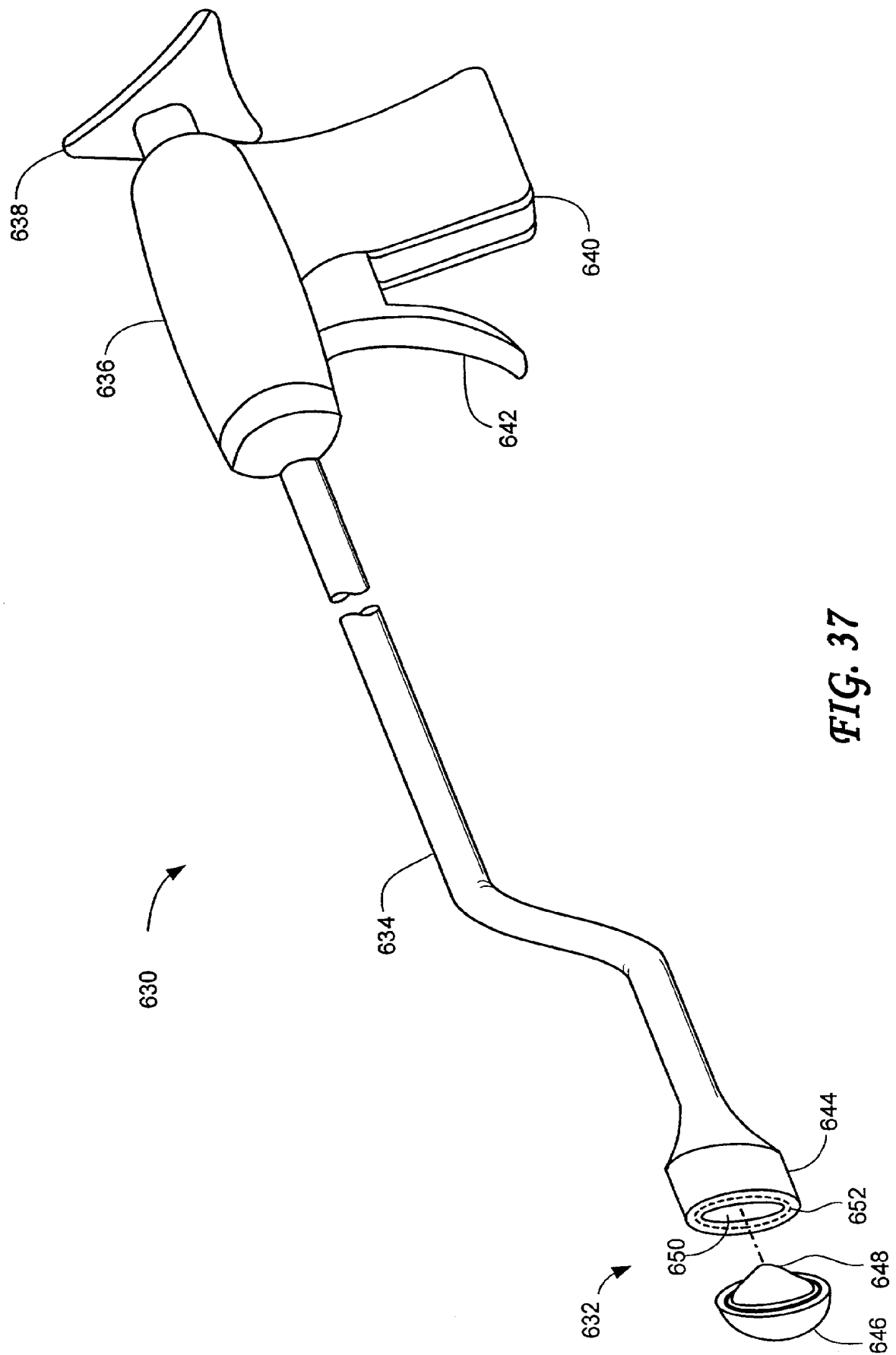
*FIG. 34B*



**FIG. 35**



**FIG. 36**



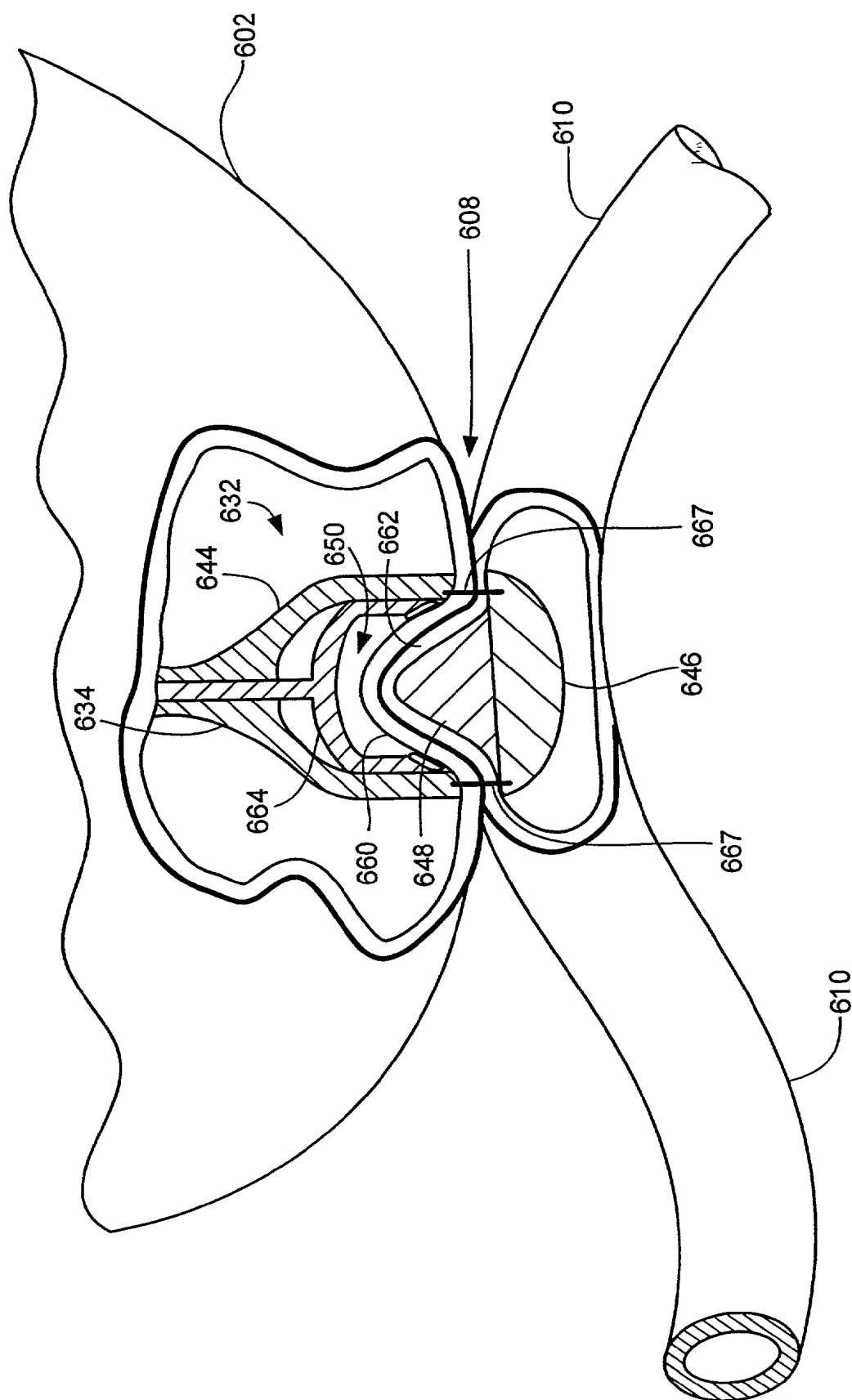
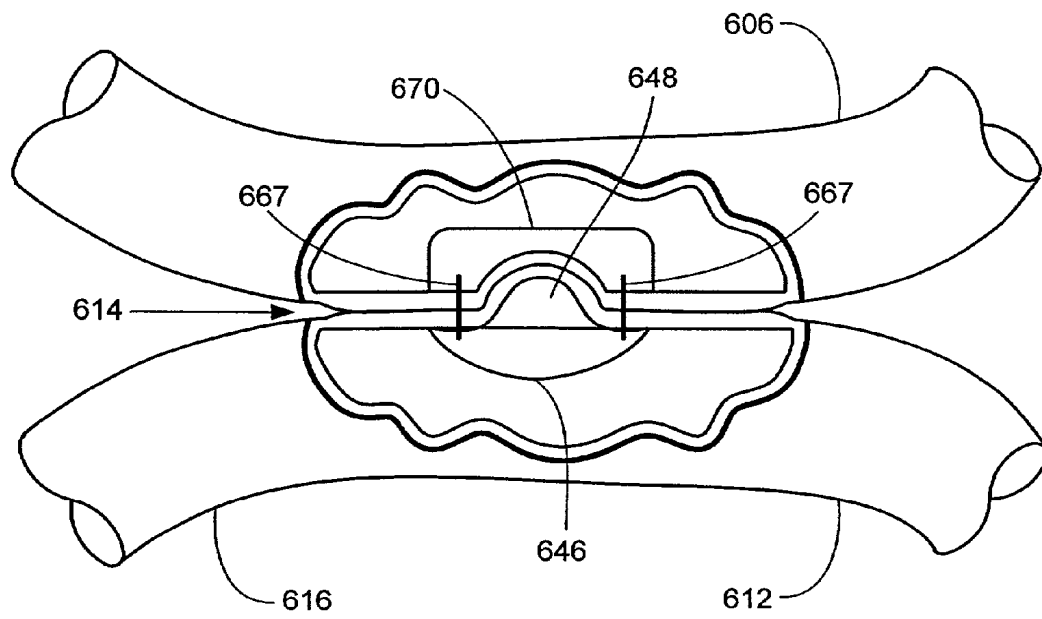


FIG. 38



**FIG. 39**

## OBESITY TREATMENT TOOLS AND METHODS

### TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates generally to tools and methods for the treatment of obesity. More particularly, the present invention relates to tools and methods for performing less traumatic gastroplasty procedures.

### BACKGROUND OF THE INVENTION

[0002] Obesity is considered a major health problem with annual associated costs reaching \$100 billion in the U.S. alone. Morbid obesity is a condition of obesity with the presence of a secondary debilitating progressive disease and is generally associated with a body mass index (BMI)  $\geq 40$  kg/m<sup>2</sup>. While the basic mechanism of obesity is simply an imbalance between caloric intake and burn rate, the underlying factors are varied and complex and conservative attempts at sustained weight loss with this population are almost always unsuccessful. Often, there are genetic and other biological influences that may override environmental causes. Consequently, obesity is a disease that eludes a simple treatment, with a recurrence rate above 90% for those who attempt to lose weight. Moreover, long-term results using conservative treatments for morbid obesity are generally unsuccessful and are typically associated with further loss of self-esteem with the regaining of weight. Hypertension, cardiovascular disease, diabetes, along with a host of other comorbidities all make morbid obesity second only to smoking as a preventable cause of death.

[0003] Surgical procedures for obesity date back to 1889 (Billroth) with the earliest peer reviewed procedure being the jejuno-ileal bypass in 1954 (Kreman). A successful procedure is commonly defined as one that results in at least 50% excess weight loss at 2 years. Today, the most commonly done operation is the Roux-en-Y gastric bypass (RYGB), with around 35,000 performed annually in the U.S. Other forms of bariatric surgery include Fobi pouch, bilio-pancreatic diversion, and gastroplasty or "stomach stapling". The single existing procedure that involves an implanted device is the Lap-Band, which is a laparoscopically installed inflatable cuff that is placed around the top of the stomach just below the lower esophageal sphincter (LES). This device affects satiety only (no reduced caloric absorption). Because there is more to obesity than simple overeating, it is unlikely that Lap-Band by itself will ever be as effective as a surgery that includes other physiologic feedback mechanisms.

[0004] The RYGB procedure is a procedure which has become very common in bariatric surgery. This procedure facilitates the movement of the jejunum to a high position by using a retrocolic Roux-en-Y loop. The procedure is generally performed through a 6-8 inch incision extending from the end of the breastbone to just above the navel. The stomach is completely divided into 2 unequal portions (a smaller upper and a larger lower gastric pouch) using an automatic stapling device with the raw surface reinforced with additional sutures. The upper pouch typically measures less than about 1 ounce or 20 cc, while the lower larger pouch remains generally intact and continues to secrete stomach juices flowing through the intestinal tract.

[0005] A segment of the small intestine (just distal of the duodenum or proximal of the jejunum) is then brought from

the lower abdomen and joined with the upper pouch to form an end-to-end anastomosis created through a half-inch opening, also called the stoma. This segment of the small intestine is called the "Roux loop" and carries food from the upper pouch to the remainder of the intestines, where the food is digested. The remaining lower pouch and the attached segment of duodenum are then reconnected to form another anastomotic connection to the Roux loop at a location approximately 50-150 cm (1.6-4.9 ft) from the stoma, typically using a stapling instrument. It is at this connection that the digestive juices from the bypassed stomach, pancreas, and liver enter the jejunum or ileum to aid in the digesting of food. Due to the small size of the upper pouch, patients are forced to eat at a slower rate and are satiated much more quickly, thereby reducing the caloric intake (typically between about 1000-1200 Calories).

[0006] Because the food enters the intestines directly, conditions known as the "dumping syndrome" are created when certain types of "junk foods" are consumed (usually sweets and other simple carbohydrates). This creates unpleasant feelings of nausea, diarrhea, nervousness, and sweating, which in turn discourages patients from developing unhealthy eating patterns. With the RYGB procedure, a loss of at least 50% of excess body weight (EBW) is maintained in approximately 60% of patients at 5 years with a reduced complication rate than other procedures.

[0007] In creating the anastomoses in the RYGB procedure, several methods have previously been developed to maintain channel integrity. However, the conventional RYGB procedure requires a great deal of operative time and because of the degree of invasiveness, post-operative recovery time can be quite lengthy and painful.

[0008] Aside from the RYGB procedure, another gastrointestinal disease which relates to the stomach is gastroesophageal reflux disease (GERD). The lower esophageal sphincter is located in a distal portion of the esophagus adjacent to the junction between the esophagus and the stomach. When food is digested, a properly functioning lower esophageal sphincter would allow food to pass from the esophagus to the stomach while preventing reverse flow. However, GERD is a disorder where the esophageal sphincter allows the stomach contents, which includes gastric acid and bile, to flow back into the distal portion of the esophagus. Some complications associated with GERD include heartburn, pulmonary disorders, chest pain, esophageal ulcers, esophagitis, Barrett's esophagus, and esophageal carcinoma.

[0009] Common treatments for GERD include the administration of prescription acid blockers. But these drugs afford only short term relief; additionally, these drugs can be expensive and may have long-term side effects. Surgical procedures have included a procedure called the Nissen fundoplication, where a portion of the gastric fundus is wrapped around the esophagus. The wrapped fundus applies pressure to the esophagus to limit the reverse flow of the stomach contents. Effectively elongating the esophagus by fundoplication or by extending it via a staple line may be done to treat GERD. Conventional fundoplication procedures may be effective at treating GERD, but they also have disadvantages. For instance, many of these procedures require large incisions to be made in a patient. Laparoscopic procedures typically require several smaller incisions

formed in the abdominal wall for the insertion of instruments into the patient's body. However, such procedures can be expensive and they can increase the risks of post-operative hernias, accidental organ perforations, and other related drawbacks.

[0010] Examples related to the field of gastroplasty are described below.

[0011] U.S. Pat. No. 5,549,621 to Bessler et al., which is incorporated herein by reference in its entirety, pertains to an apparatus and method for performing vertical banded gastroplasty without the use of staples. The described device uses at least two clamping bars to create a tubular-shaped pouch. However, the device is deployed laparoscopically onto the external surface of the stomach.

[0012] U.S. Pat. No. 5,382,231 to Shlain, which is incorporated herein by reference in its entirety, describes a device for transesophageal stomach retraction by a device having vacuum ports utilized to draw the stomach over the device. However, this device is used for manipulating and retracting a patient's stomach from the inside during a variety of surgical procedures and is not a permanent procedure for creating an internal pouch within the stomach itself.

[0013] U.S. Pat. No. 5,345,949 to Shlain, which is incorporated herein by reference in its entirety, relates to laparoscopic methods and tools for inserting a banding device to bring the walls of the stomach adjacent to one another between the proximal pouch and the distal region of the stomach. But there is no procedure for the creation of an internal pouch internally created from the stomach.

[0014] Examples related to the field of GERD treatment are described below.

[0015] U.S. Pat. No. 6,159,146 to El Gazayerli, which is incorporated herein by reference in its entirety, relates to a device which is inserted transesophageally and engages the inside anterior wall of the fundus and secures it to the side of the esophagus.

[0016] U.S. Pat. No. 6,113,609 to Adams, which is incorporated herein by reference in its entirety, pertains to a system which includes placement of a distal anchor through a hole formed in the wall of the esophagus and through a hole formed in the gastric wall, which are then fastened together.

[0017] U.S. Pat. No. 5,571,116 to Bolanos et al., which is incorporated herein by reference in its entirety, pertains to an invagination device which approximates the lower esophagus and the fundus of the stomach.

[0018] However, all of these examples are limited to treatments for GERD which involves the attachment of the fundus, or upper portion of the stomach, to the esophagus.

#### SUMMARY OF THE INVENTION

[0019] Various tools and methods of treatment for obesity are described herein which are less traumatic and less invasive than procedures currently available. A variety of methods for the treatment of obesity, as well as other gastric-related diseases, e.g., gastroesophageal reflux disease (GERD), are disclosed. One method involves reducing the size of the stomach pouch to limit the caloric intake as well as to provide an earlier feeling of satiety. This may be

done by creating a smaller gastric pouch within the stomach. This procedure optionally may be enhanced by performing a pyloroplasty prior to and/or in conjunction with the pouch size reduction, i.e., rendering the pyloric sphincter incompetent. This increases the rate of stomach emptying, allowing sugars and fats to pass directly into the bowel, thereby inducing dumping. Moreover, the food in the stomach may be made to also bypass a proximal portion of the bowel, i.e., a portion of the duodenum and jejunum, by creating a gastric anastomosis thereby creating a malabsorption of sugars and fats which are mostly absorbed in the bypassed portion of the duodenum and jejunum. Sugars and fats entering the bowel directly from the stomach rather than passing through the pylorus and proximal duodenum and jejunum may cause "dumping" syndrome and diarrhea. This in turn may create enforced behavioral modifications, thereby discouraging the patient from eating these types of high-caloric foods.

[0020] In forming a modified pouch, a marking device, such as a bougie, may be used at the beginning of the procedure, to create a dye marker "road map" on the interior surface of the stomach from the pylorus to the esophagus. This may enable visualization by, e.g., an endoscope, to give the physician a clear reference point for staple or fixation element placement. A distal balloon, which is preferably attached to an inflation tip at a distal end, may be inserted into the pylorus to stabilize the bougie during the procedure and may be inflated from the proximal end of the tubing by the physician.

[0021] In reducing the stomach size, one variation involves grasping the interior walls of the stomach, preferably via an endoscope advanced trans-esophageally, and placing one to several individual fixation elements on opposing interior walls and then bringing those fixation elements together. The stomach pouch may be modified and/or created by a variety of other device variations utilizing other methods, e.g., stapling opposing sides of a stomach together to form two separate lumens from within the interior surface of the stomach. An endoscopic stapling device may be used to accomplish such a task. Such an endoscopic stapler preferably brings two regions of tissue into apposition and may then apply a fastening element, e.g., staples, clips, tags, screws, etc., into the two regions of tissue to affix them together.

[0022] In addition to endoscopically applied stapling and clip devices, rotating and rotatable probes may also be used to form a modified smaller lumen within a main lumen. Such probes generally may be inserted into a stomach endoscopically and may engage a portion of the interior lining of the stomach and may then be rotated to roll the engaged portion of the stomach wall around the probe itself to bring the wall in apposition with another portion of the stomach wall. Such rotating probes may be used to create a blind-ended pouch of stomach within the main stomach lumen, or as with the other devices, may be used to create a smaller pouch exiting into the pylorus. Once the roll of stomach wall is brought into apposition, a row or a plurality of fasteners, e.g., staples, blind staples, clips, tags, adhesives, screws, etc., may be used to maintain the stomach. Moreover, other variations may include gastric volume reduction devices as part of the present invention. Such volume reduction devices generally may be inserted into a stomach trans-esophageally through the use of, e.g., an endoscope. The reduction device may be used to draw or engage a portion of the interior lining of the



stomach; the drawn or engaged portion may then be eventually removed, either actively or through natural processes, e.g., pressure necrosis.

[0023] To aid in the overall effect, a pyloroplasty procedure may also be performed to enhance treatment. The pyloroplasty may be performed prior to (preferable), in conjunction with, or following the gastric reduction procedure. A pyloroplasty procedure typically results in the pyloric sphincter being rendered incompetent. Generally, a pyloroplasty device may be passed endoscopically through the esophagus, into the stomach, and preferably into position in or across the pylorus. Energy or a stimulus is then preferably applied to the pylorus to render it incompetent.

[0024] Moreover, an additional anastomosis gastric bypass procedure may also be performed to further enhance treatment. The anastomosis procedure may be performed preferably prior to, in conjunction with, or following the gastric reduction and pyloroplasty procedures (if performed at all). The procedure generally involves endoscopically or laparoscopically creating a side-to-side anastomosis preferably from within the stomach and bowel and within the digestive tract. This procedure may be similar to the Roux-en-Y gastric bypass procedure but with minimal trauma.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1A shows an example of a modified stomach having a smaller pouch created from the interior surface lining.

[0026] FIG. 1B shows a partial superior view of the cross section from FIG. 1A.

[0027] FIG. 2 shows a variation on a marking device or bougie for marking the interior surface of a stomach.

[0028] FIG. 3A shows a variation on positioning a marking device inserted into a stomach.

[0029] FIG. 3B shows a cross section view from FIG. 3A of a deflated stomach around the marking device.

[0030] FIG. 3C shows the cross section view from FIG. 3B of an insufflated stomach with the resulting marks.

[0031] FIG. 4A shows a view of the interior of the lesser curvature of a stomach with anchors attached.

[0032] FIG. 4B shows a cross section view from FIG. 4A with the anchors attached.

[0033] FIG. 5A shows a side view of a crimping variation on a fastening device.

[0034] FIGS. 5B and 5C show a superior and side view, respectively, of several interlocked crimping devices from FIG. 5A.

[0035] FIG. 6A shows an isometric view of a zip-tie or ratcheted variation on a fastening device.

[0036] FIG. 6B shows a superior view of the device of FIG. 6A attached to the stomach wall.

[0037] FIG. 6C shows a superior view of another double zip-tie variation on a fastening device.

[0038] FIG. 6D shows the stomach of FIG. 6B with the fasteners cinched.

[0039] FIG. 6E shows a superior view of another perpendicular zip-tie variation on a fastening device.

[0040] FIGS. 7A and 7B show a superior view of an extendable double hook device attaching to a stomach wall.

[0041] FIG. 7C shows the device of FIG. 7A locked by a crimping variation.

[0042] FIGS. 8A and 8B show a superior view of a modified stomach maintained by a fastening staple.

[0043] FIGS. 9A and 9B show isometric views of a variation on an endoscopic stapling device.

[0044] FIG. 10 shows an isometric view of a variation on a box stapling device.

[0045] FIG. 11A shows an assembly view of another stapling device variation.

[0046] FIG. 11B shows a side view of the device of FIG. 11A.

[0047] FIG. 12A shows an isometric view of a crescent shaped variation of a stapling device.

[0048] FIG. 12B shows an end view of the device of FIG. 12A showing a staple deploying.

[0049] FIG. 12C shows an interior side view of the device of FIG. 12A with a translating wedge sequentially deploying staples.

[0050] FIG. 13 shows an interior view of a stomach with an example of stapling device placement.

[0051] FIG. 14 shows an interior view of a stomach with an example of a modified stapling device which may be used for the treatment of GERD.

[0052] FIG. 15A shows an assembly view of a variation on an approximating device.

[0053] FIGS. 15B to 15D show the process of invaginating stomach interior lining and fastening using the device of FIG. 15A.

[0054] FIGS. 15E shows the assembly view of another variation of the device of FIG. 15A wherein the clip may be replaced by a screw.

[0055] FIGS. 15F to 15H show the process of invaginating stomach interior lining and fastening using the device of FIG. 15E.

[0056] FIG. 16A shows an example of a modified stomach created by a rotating device variation.

[0057] FIG. 16B shows a superior cross section view of the stomach of FIG. 16A where the modified lumen may be created by rotating the interior stomach lining upon itself.

[0058] FIG. 16C shows an alternate superior cross section view of the stomach of FIG. 16A where the modified lumen may be created by rotating apposed portions of the interior stomach lining upon itself.

[0059] FIGS. 17A and 17B show an isometric and cross section view, respectively, of a vacuum tube variation.

[0060] FIGS. 18A and 18B show an isometric and cross section view, respectively, of a counter-rotating vacuum tube variation.

[0061] FIGS. 19A and 19B show an isometric and cross section view, respectively, of a vacuum tube variation with attachment points.

[0062] FIGS. 20A and 20B show an isometric and cross section view, respectively, of a split tube variation.

[0063] FIG. 21 shows an example of placement within a stomach of a rotatable device variation.

[0064] FIGS. 22A and 22B show the possible creation of a rotated lumen using the device of FIGS. 19A and 19B.

[0065] FIGS. 23A to 23D show the possible creation of a rotated lumen using the device of FIGS. 20A and 20B.

[0066] FIG. 24A shows an isometric view of a variation on a dual rotatable tube device.

[0067] FIGS. 24B and 24C show an end view and cross section view, respectively, of the device of FIG. 24A.

[0068] FIG. 25A shows a variation on an endoscopic vacuum device in a stomach.

[0069] FIGS. 25B and 25C show an end view of a variation on lumen creation from the interior surface of the stomach using the device of FIG. 25A.

[0070] FIG. 26 shows an isometric view of a variation on a gastric volume reduction device.

[0071] FIGS. 27A to 27D show the device of FIG. 26 inserted into a stomach to draw or cinch up lining tissue to reduce a volume of the stomach.

[0072] FIG. 28 shows another variation on a gastric volume reduction device utilizing a grasping device and a ligating device.

[0073] FIGS. 29A and 29B show an isometric view on a variation of a gastric volume reduction device utilizing tractive rollers to draw tissue up between them.

[0074] FIG. 29C shows another variation of the device of FIGS. 29A and 29B with ratcheted rollers.

[0075] FIG. 30 shows an isometric view of a variation on a pyloroplasty device with an angioplasty balloon.

[0076] FIG. 31 shows an isometric view of another variation on a pyloroplasty device with extendable probes.

[0077] FIGS. 32A and 32B show variations on sphincterotome arms for use in a pyloroplasty procedure.

[0078] FIG. 33 shows a stomach with a distal portion of the wall of the lesser curvature removed to show a possible use for the device of FIG. 31.

[0079] FIG. 34A shows an isometric view of another variation on a pyloroplasty device with a combination cutting and stapling notch.

[0080] FIG. 34B shows the device of FIG. 34A in a possible use in a stomach.

[0081] FIG. 35 shows a representative and normal gastrointestinal system of a person.

[0082] FIG. 36 shows an example of a gastro-intestinal system modified by a preferable anastomosis procedure.

[0083] FIG. 37 shows an isometric view of a variation on an anastomosis deployment device.

[0084] FIG. 38 shows a cross section view of an anastomosis assembly mating a portion of the stomach with a portion of the intestinal tract.

[0085] FIG. 39 shows a cross section view of another anastomosis assembly mating two different portions of the intestinal tract.

#### DETAILED DESCRIPTION OF THE INVENTION

[0086] With obesity becoming an increasing problem, various tools and methods of treatment are described herein which are less traumatic and less invasive than procedures currently available. As described in further detail below, a variety of methods for the treatment of obesity, as well as other gastric-related diseases, are disclosed. Generally, the size of the stomach pouch may be reduced to limit the caloric intake as well as to provide an earlier feeling of satiety. This may be accomplished by creating a smaller gastric pouch within the stomach by a variety of methods. This procedure optionally may be enhanced by performing a pyloroplasty prior to and/or in conjunction with the pouch size reduction, i.e., rendering the pyloric sphincter incompetent. Additionally, the food in the stomach may be made to also bypass a proximal portion of the bowel, i.e., a portion of the duodenum and jejunum, by creating a gastric anastomosis thereby creating a malabsorption of sugars and fats which are mostly absorbed in the bypassed portion of the duodenum and jejunum. Sugars and fats entering the bowel directly from the stomach rather than passing through the pylorus and proximal duodenum and jejunum may cause "dumping" syndrome and diarrhea. Moreover, rendering the pylorus incompetent may also lead to dumping syndrome partly because of the rapid gastric emptying which may occur. This in turn may create enforced behavioral modifications, thereby discouraging the patient from eating these types of high-caloric foods.

[0087] FIG. 1A shows an example of a modified stomach 10 which may be created, by any one of the methods described below, as part of the present invention. Greater curvature 12 and lesser curvature 14 is seen in modified stomach 10, as well as the distal end of esophagus 16 and pylorus 18. As part of the present invention, stomach 10 may be divided along junction 24 into modified pouch 22, which is preferably less than about 1 ounce in volume, and main pouch 20. FIG. 1B shows a partial superior view of the cross section of main pouch 20 and modified pouch 22 as viewed from cutting plane P from FIG. 1A. As seen, modified lumen 26 is preferably formed by junction 24 from main lumen 28 by joining a portion of stomach wall 30. During ingestion of food, modified pouch 22 accepts food from esophagus 16 and preferably passes it directly through modified lumen 26 into pylorus 18. Main pouch 20 may remain intact and function normally, but preferably sees little or no food. Acids and other fluids that may be generated in main lumen 28 may drain through the reduced outlet near pylorus 18 and may pass through the digestive system normally.

#### [0088] Marking Tools and Methods

[0089] As part of forming a modified pouch, a marking device may be used, preferably at the beginning of the procedure, to create a dye marker "road map" on the interior surface of the stomach from the pylorus to the esophagus. Once such dye marks are placed, they may be visualized,

e.g., endoscopically, thereby giving the physician a clear reference point for staple or fixation element placement. An example of such a marking device is shown in **FIG. 2** as marking device or bougie **40**. Bougie **40** is preferably an elongated device made from tubing member **44** which may have several channels defined within. Tubing **44** may be made from any variety of biocompatible materials, e.g., stainless steel, plastics, etc., and preferably has a diameter and cross section which is similar to that of the finished modified lesser pouch. Along the length may be defined a series of dye ports **46** through which the marking dye may be channeled through from the proximal end of bougie **40**. Any variety of biocompatible dyes which preferably enhance visualization may be used, e.g., methylene blue, thionine, acridine orange, acridine yellow, acriflavine, quinacrine and its derivatives, brilliant green, gentian violet, crystal violet, triphenyl methane, bis naphthalene, trypan blue, and trypan red. Also along the length and on either side of dye ports **46** may be a series of vacuum ports **48**, which are optional. A distal balloon **52**, which may be inserted into the pylorus to stabilize bougie **40** during the procedure, is preferably attached to inflation tip **50** at distal end **42** and may be inflated from the proximal end of tubing **44** by the physician.

[0090] **FIGS. 3A to 3C** show bougie **40** during one method of use. **FIG. 3A** shows stomach **60** as bougie **40** is inserted down through esophagus **62**. As bougie **40** is advanced down to pylorus **76**, distal balloon **52** may be inflated through inflation tip **50**, thus securing the device. Bougie **40** preferably follows lesser curvature **64** and may alternatively be shaped to approximate lesser curvature **64**. Bougie **40** is also preferably rotated such that dye ports **46** face away from lesser curvature **64** and face towards greater curvature **66**. Then the air and fluids contained within stomach **60** are preferably removed, either through vacuum ports **48**, if they are included in bougie **40**, or through another vacuum port which may be introduced endoscopically through esophagus **62**. **FIG. 3B** shows cross section **3B-3B** from **FIG. 3A** as deflated stomach **60**. Once deflated, modified lumen **70** may take shape around bougie **40**, separate from deflated main lumen **68**. In this deflated state, the dye may be channeled through dye ports **46**, thereby leaving dye marks **72** on interior lining **74**. Once the staining has been performed, lumen **68** may be insufflated, as shown in **FIG. 3C**, and bougie **40** may then be removed. As seen in **FIG. 3C**, dye marks **72** mark or delineate the junction region where anchors or fasteners may be placed to draw interior lining **74** together to form the modified lumen.

[0091] Gastric Reduction Tools and Methods Using Fasteners

[0092] One variation of reducing the stomach size involves grasping the interior walls of the stomach, preferably via an endoscope advanced trans-esophageally, and placing one to several fixation elements on opposing interior walls and then bringing those fixation elements together.

[0093] Several examples of different possible variations on fasteners are shown and described below. These variations are not intended to be limiting but are merely given as illustrative examples.

[0094] **FIG. 4A** shows a view of the interior of the lesser curvature of stomach **60** with part of the greater curvature wall removed. As seen, individual anchors **80** may be

secured to the interior surface along the junction **24** where modified pouch **22** from **FIG. 1A** would form. Anchors **80** may be of any biocompatible material, e.g., stainless steel, polymers, etc., which may be formed into a variety of fasteners, e.g., staples, ratcheted wires, zip ties, clips, tags, eyelets, crimps, and screws. Anchors **80** may be placed by estimating the junction boundary, but they are preferably located along dye mark **72**, which may be formed by methods and tools described above, prior to anchor **80** placement, as shown in **FIG. 4B**, which is cross section **4B-4B** from **FIG. 4A**. After anchors **80** have been fastened, suture **82** may be drawn through each of the anchors **80**, preferably in a zig-zag manner, and then suture **82** may be drawn tight to bring the opposing surfaces of interior lining **74** together in apposition along dye marks **72** to form the modified lumen. Alternatively, individual anchors **80** may be preloaded or prefastened by suture **82**, and anchors **80** may be fastened to interior lining **74** in this manner.

[0095] **FIG. 5A** shows a side view of a variation on a fastening device in crimping member **90**. Crimping member **90** is preferably made from a biocompatible material, e.g., stainless steel, nitinol, etc., and may be formed to have elbow **92** extend into two opposing anchoring ends **94**. **FIG. 5B** shows a superior view of a created modified lumen **100** formed from main lumen **98** by any of the methods described herein. In this variation, several crimping members **90** may be attached or fastened to interior lining **96** by anchoring ends **94**. As they become attached, each of the members **90** are preferably configured to interlock with an adjacent crimping member **90**, much like a zipper. **FIG. 5B** shows the interlocked members **90** from the top to form lumen **100** and **FIG. 5C** shows the view from **5C-5C** from **FIG. 5B** where each of the crimping members **90** are shown interlocking at their elbows **92** like a zipper.

[0096] **FIG. 6A** shows an isometric view of another variation on a fastening device in ratcheted wire or zip tie **110**. This particular variation shows a distal tip or male end **112** and a corresponding proximal end or female end **114**, with ratcheted length **116** between those two ends. **FIG. 6B** shows a superior view of stomach wall **120** just prior to the formation of modified lumen **124** from main lumen **122**. As seen, male end **112** of first zip tie **110'** may be pierced through one side of interior lining **118** and second zip tie **110"** may be pierced through the opposing side of interior lining **118** such that the male ends **112** of each zip tie preferably correspond to the female ends **114** of the other zip tie. To then form the lumen **124**, each zip tie **110'**, **110"** may be drawn together and tightened accordingly, as shown in **FIG. 6D**. A plurality of zip ties **110** are preferably used to form modified lumen **124** by aligning them by any of the methods described above.

[0097] An alternative zip tie device which may be used is a perpendicular type version of zip tie **110**. As shown in **FIG. 6E**, first perpendicular zip tie **134'** and second perpendicular zip tie **134"** may be used in place of zip tie **110** and lumen **124** may be formed in much the same manner as described above to result in the modified stomach as shown in **FIG. 6E**. A further alternative is shown in **FIG. 6C** where male zip tie **126** preferably has dual piercing male ends with catcher tubes **128**. In this variation, a vacuum-type device, as described below in detail, or forceps may be used to draw portions of stomach wall **120** in apposition. As the apposed stomach walls **120** are positioned, needles **130**, which are

preferably passed through a double female zip tip **132**, may be used to pierce through tissue **120** and lock into catcher tubes **128**. Needles **130** may then be drawn back through tissue **120**, while simultaneously pulling male ends/catcher tubes **128** back through tissue **120** and into the corresponding double female zip tie **132**. The locked zip tie **126** may then be drawn tight against female zip tie **132**, trimmed, and then released. This procedure may be repeated for any number of zip ties which may be used to draw the stomach lining together to form the smaller pouch and may also be used with the dye marking device **40** and procedure as described above.

[0098] A further variation on the individual anchoring fasteners is shown in **FIG. 7A**. This variation shows gasping device **140** with retaining tube **142** and extendable members **146** which may extend from distal opening **144**. Extendable members **146** are preferably made from a biocompatible material, e.g., superelastic or shape memory alloy such as nitinol, which may be biased to urge away from a longitudinal axis defined by tube **142** once extended beyond distal opening **144**. As members **146** extend, they may reach out to grasp apposed portions of interior lining **150** by hooks **148**. As above, the locations where hooks **148** grasp may be defined by the marking device as described above and viewed by the physician through, e.g., an endoscope. Once hooks **148** have grasped the appropriate portion of lining **150**, members **146** may then be drawn back through distal opening **144**, as shown in **FIG. 7B**, and a retaining device, such as crimp **152**, may be slid over a distal section of members **146**, as shown in **FIG. 7C**, to maintain the position of hooks **148** and apposed lining **150** to create the desired lumen.

[0099] Gastric Reduction Tools and Methods Using Stapling Devices

[0100] Aside from individual anchoring and fastening devices, the stomach pouch may be modified and/or created by a variety of other device variations utilizing other methods. **FIG. 8A** shows the cross sectioned superior view of **FIG. 1B** with the addition of staple **160** maintaining junction **24**. The figure shows an example of how, e.g., an endoscopically applied stapler, may be used to retain and hold junction **24** to form modified lumen **26**. **FIG. 8B** shows a close-up view of the junction **24** and staple **160** which was applied from within lumen **26**.

[0101] To staple opposing sides of a stomach together to form two separate lumens from within the interior surface of the stomach, an endoscopic stapling device may be used to accomplish such a task. Such an endoscopic stapler preferably brings two regions of tissue into apposition and may then apply a fastening element, e.g., staples, clips, tags, etc., into the two regions of tissue to affix them together. These stapling devices may optionally incorporate the use of the marking device or bougie **40**, as described above, as a preliminary step as a guide to vacuum placement and/or stapling to form the desired modified lumen. The fastening elements, e.g., staples, are preferably made of a biocompatible material such as stainless steel, titanium, polymers, sutures, nitinol, or any other similar metals and alloys, etc. and may be in any conventional shape such as C-shaped and U-shaped staples or any of the other shapes as described herein. The two regions of tissue may be adhered to the stapling device by a variety of attachment methods, e.g.,

tines, barbs, hooks, vacuum, or any combinations thereof. In an adhering device utilizing a vacuum to hold the apposing regions of tissue together, such a device may be a tubular or wand-shaped member and preferably has at least two windows which may be spaced about the circumference of the tube or wand. These windows may be separated by an arc in a range of about 20° to 180° about the longitudinal axis defined by the length of the tube or wand, and are preferably separated by an arc in a range of about 90° to 180°.

[0102] Several examples of different possible variations on the stapling device are shown and described below. These variations are not intended to be limiting but are merely given as illustrative examples.

[0103] **FIG. 9A** shows a variation of an endoscopic stapling device in the isometric view of anvil stapling device **170**. Stapling unit **172** is shown attached to the distal end of tube **174**. Within stapling unit **172** is staple enclosure **176** where staples may be loaded and vacuum ports **178** which are seen in an alternating fashion with staple slots **180**, through which the staples may be deployed. **FIG. 9B** shows a reverse isometric view of the device of **FIG. 9A**. As seen, stapling unit **172** may have septum **184** insertable into septum slot **186**, which is preferably midway between the sides of staple enclosure **176** and which may separate the interior of staple enclosure **176** into two separate chambers. Septum **184** may serve several functions, one of which may be to allow selective activation of opposing sides of vacuum ports **178** of unit **172** as tissue is selectively adhered to the device. Other functions of septum **184** are discussed below.

[0104] In operation, stapling unit **172** may be inserted trans-esophageally into a stomach and a first portion of the interior lining may be adhered to a single side of staple enclosure **176** through a vacuum created within vacuum ports **178**. The vacuum may be created in stapling unit **172** through tube **174** and activated from the proximal end of tube **174** from outside the patient's body. Once the first portion of the interior lining is adhered to one side of staple enclosure **176**, the opposite set of vacuum ports **178** may be activated and unit **172** may be used to draw the first portion to an opposing second portion of the interior lining, which may then be adhered to the device such that the first portion and the second portion are preferably in apposition to each other. This action preferably forms the modified lumen **26** of **FIGS. 8A and 8B**. As the tissue is held to unit **172**, septum **184** may be withdrawn from septum slot **186** by introduced forceps through, e.g., an endoscopic or through an integral actuator, to form a single chamber within staple enclosure **176**. Removal of septum **184** may then bring the first and second portions of tissue into contact apposition. The side surfaces **188** of septum **184** may incorporate a cutting, abrading, scoring, heating, freezing, chemically damaging, or some other damaging surface to tissue. Such a surface **188** may damage the interior lining contacting each other upon removal of septum **184** as surface **188** slides past. This damage may encourage a more vigorous healing response and a more permanent fixation between the damaged tissue once stapled or affixed together.

[0105] After removal of septum **184**, the staples loaded within staple enclosure **176** may be fired through staple slots **180** to affix the tissue. As the staples are fired, anvil **182** may be used as an anvil to secure the staples to the tissue, thereby resulting in the modified lumen **26** as shown in **FIG. 8B**. The

length of stapling device 170 may be made according to the desired junction length and the size of the patient's stomach. This particular variation may be withdrawn from the area after the stapling procedure by first pushing the stapling device 170 past the resulting staple line.

[0106] FIG. 10 shows an isometric view of another variation in box stapling device 190. Stapling unit 192 is shown as being attached in fluid communication to vacuum tube 193. Stapling device 190 may be inserted and operated in the same manner as device 170 described above. Stapling unit 192 may have vacuum ports 194 activated selectively on either side of septum 196 as described above. The tips of staples 198 are shown partially deployed for illustration purposes, but are preferably not deployed until septum 196 is first retracted preferably in the direction as indicated. Septum 196 may also be configured to damage the contacting tissue upon septum 196 withdrawal in the same manner as described above. Stapling device 190 may be easily applied and removed after staples 198 have been deployed.

[0107] FIG. 11A shows an assembly isometric view of another variation in stapling device 200. This variation 200 shows curved tube 202 which may have lumen 204 house staples 206 as well as act as a combination vacuum and staple slot 216. Tube 202 may be shaped in a variety of ways but is shown here as a C-shaped or U-shaped tube with first channel 210' and second channel 210'', for adhering the two apposed portions of tissue, preferably separated by removable septum 212. With this variation 200, tissue may be adhered within the channels 210', 210'' through vacuum/staple slot 216 and once positioned, staples 206 may be deployed while septum 212 is removed simultaneously by the use of curved wedge 218. In operation, curved wedge 218 may be drawn within lumen 204 from the tube 202 distal end to the proximal end by, e.g., a pull-wire attached to wedge 218. As wedge 218 is advanced proximally, wedge 218 would preferably force pivot 208 of staple 206 against contact edge 214 of septum 212. As wedge 218 is advanced further proximally, urging end 220 may then urge the curved ends of staple 206 to rotate about pivot 208 and deploy through slot 216. While staple 206 is deploying, notch 222, preferably located at a distal end of wedge 218, may engage contact edge 214 and begin to slide septum 212 simultaneously towards the proximal end of tube 202. FIG. 11B shows a side view of stapling device 200 of FIG. 11A. As seen, curved wedge 218 preferably contacts septum 212 via notch 222 and pushes while simultaneously urging staple 206 to deploy. The figures show a single staple 206 for illustrative purposes only and any plurality of staples 206 may be used in practice depending upon the desired results.

[0108] FIG. 12A shows an isometric view of yet another variation in stapling device 230. This variation may omit a removable septum. Curved tube 232 is preferably curved in this variation in a crescent shape forming contact channel 234. Within contact channel 234, a number of vacuum ports 236 and staple slots 238 may be defined in an alternating pattern, as shown. A possible W-shaped staple 240 preferably having pivot 242 at the staple 240 midpoint is shown outside of tube 232 for illustrative purposes in a possible orientation for insertion within staple slots 238. FIG. 12B shows cross section 12B-12B from FIG. 12A. As seen, tube 232 defines lumen 244, which preferably runs the length of tube 232, and translating wedge 246 which is preferably slidably disposed within lumen 244. As seen in FIGS. 12B

and 12C, which is a side view of the interior of tube 232, wedge 246 may be translated by pull-wire 248. Pull-wire 248, which may be made of any high-strength material, e.g., stainless steel, nitinol, nylon, polymers, etc., may be manipulated by a physician from the proximal end of tube 232 from outside of the patient's body. Like the device 200 of FIGS. 11A and 11B, once vacuum ports 236 have acquired the interior tissue lining to be approximated, translating wedge 246 may be advanced proximally. Advancing wedge 246 may urge staples 240 to deploy through staple slots 238 sequentially as shown to hold the tissue and form the desired lumen.

[0109] An example of deployment for any of the stapling devices described above is shown in FIG. 13. As shown, stomach 250 with the wall partially cut out is seen with stapling device 252 inserted within. Stapling device 252 is shown merely as an example of insertion and could comprise any of the devices described herein. Device 252, which is preferably advanced trans-orally into stomach 250 and through esophagus 256, is preferably located at the distal end of delivery/vacuum tube 254. Once inserted, device 252 may be located by the assistance of the lesser curvature 258 of stomach 250. Also shown are vacuum/staple ports 260, which may be any of the configurations as described herein. In a preferable variation, stapling device 252 may be configured to produce a staple line or junction following the lesser curvature beginning from cardiac notch 264 down towards pylorus 262. Accordingly, device 252 may have the length and vacuum/staple ports 260 configured such that the distal end of device 252 points towards pylorus 262.

[0110] FIG. 14 shows stapling device 270 in a slightly different configuration for the treatment of other gastrointestinal diseases such as gastroesophageal reflux disease (GERD), as discussed above. The stomach 250 of FIG. 13 is shown, but for the treatment of GERD, stapling device 270 may be slightly modified such that the device 270 and vacuum/staple ports 272 may be straight or flared away from, rather than towards, lesser curvature 258 and pylorus 262 as described above. As such, vacuum/staple ports 272 would preferably produce a staple line or junction beginning from cardiac notch 264 and then flares away from lesser curvature 258 and pylorus 262. Device 270 may be any of the devices described and operated herein, but for the flared modification. Likewise, any of the devices described herein may be used for the treatment of GERD by simply angling the device to produce a flared staple line. Alternatively, a simple non-flared staple line may also suffice for treating GERD. The staple line may act as a Heimlich valve which preferably closes down in response to pressure exerted from the greater or main lumen. Moreover, the smaller volume of the modified lumen in-line with esophagus 256 may provide a smaller volume of acid available for esophageal reflux.

[0111] An isometric view of a single channel vacuum device variation is shown in FIG. 15A in approximating device 280. Tube 282 is preferably a tubular device which may be inserted into a stomach through the esophagus of a patient. A lumen 284 may run through tube 282 from a proximal end to the distal end of tube 282. At the distal end, two or more windows or slots 286 are preferably defined opposite of one another, as shown. The lengths and widths of slots 286 may vary and is preferably long enough to approximate the desired length of the boundary or junction line of the modified lumen; likewise, the width is preferably

wide enough to accommodate at least two layers of the stomach interior lining. Approximating clip **288** is shown having at least two piercing ends **290** and may be loaded into tube lumen **284** from either the proximal end or distal end of tube **282** preferably prior to inserting the device **280** into the patient. Clip **288** is preferably made of a biocompatible material as described above. Biodegradable plug **292** may be placed into the distal end of tube **282** prior to insertion into the patient and is preferably made of a biocompatible biodegradable material, e.g., biodegradable polymers such as polylactide, polyglycolide, and their copolymers. Plug **292** may be alternatively made from a non-biodegradable material and may simply pass after the procedure. Plug **292** may aid in maintaining a vacuum seal through slots **286** during the approximation procedure, as described below.

[0112] FIG. 15B shows an end view from section 15B-15B from FIG. 15A of tube **282** in operation. As shown, opposing portions of stomach interior lining **294** may be drawn into lumen **284** through opposing slots **286** by creating a vacuum within lumen **284**. Approximating clip **288** may be urged distally through tube **282** such that each of ends **290** may be drawn through a corresponding slot **286** over and/or pierced through lining **294** within lumen **284**. As lining **294** is approximated within lumen **284**, biodegradable plug **292** may become invaginated within lining **294**. Accordingly, as clip **288** and ends **290** are positioned over lining **294**, tube **282** may be withdrawn from the area while clip **288** preferably slides through the distal end of tube **282** leaving the approximated interior lining **294** held in position by ends **290**, as seen in FIG. 15D. Removal of tube **282** may urge plug **292** to slide off the distal end of tube **282** and remain within the newly formed lumen to become degraded over time or to pass through the patient's system.

[0113] FIG. 15E shows the device of FIG. 15A, but in this variation, clip **288** may be replaced by screw **289**, which is preferably in the shape of a helix or coil having a tapering width or diameter. The first few turns or coils of screw **289** may have the same or similar diameter than the remaining tapering coils; this may enable piercing end **291** to engage interior **294** and may also allow screw **289** to be advanced at the desired orientation through the tissue. Screw **289** preferably maintains a parallel orientation with tube **282** during delivery into the tissue, i.e., a longitudinal axis defined by screw **289** is preferably parallel, or close to parallel, with the longitudinal axis defined by tube **282**. Moreover, the outer diameter of the first few turns or coils are preferably the same diameter, or slightly less than, the inner diameter of tube **282**. This may further enable screw **289** to be advanced through lumen **284** at the proper orientation prior to engaging interior **294**.

[0114] As described above for the device of FIGS. 15A to 15D, opposing portions of stomach interior lining **294** may be drawn into lumen **284** through opposing slots **286** by creating a vacuum within lumen **284**, as shown in FIG. 15F. Screw **289** may then be urged through lumen **284** and rotated in the direction of the arrow shown until piercing end **291** engages the invaginated lining **294**. Piercing end **291** preferably is sharp and needle-like to enable piercing through multiple layers of lining **294**. As screw **289** is further rotated, it may be further advanced distally through the remaining portion of invaginated lining **294**. The tapering diameter and decreasing width may also begin to further approximate the opposing edges of lining **294** towards one another, as shown

in FIG. 15G. Finally, as seen in FIG. 15H, further advancement of screw **289** preferably draws the opposing surfaces into contact with one another. Tube **282** may then be removed, as described above. Although the fixation of one screw **289** is described, multiple screws **289** may be fastened one after another to form a continuous fixation line.

[0115] Screw **289** may be made of a bioabsorbable or biocompatible material, as described herein such as a polymer or superelastic alloy, and may be integrally formed with barbs or whisker-like filaments protruding along its length to help prevent screw **289** from backing out once it has been engaged within the lining **294**. An example of a spiraling suturing needle or screw which may be used in this variation is shown and described in U.S. Pat. No. 5,330,503 to Yoon, which is incorporated herein by reference in its entirety. Another example of a helical fastener or screw and applicator which may be used in this or another variation is shown and described in U.S. Pat. No. 5,582,616 to Bolduc et al., which is also incorporated herein by reference in its entirety. Other examples of helical fasteners or screws and applicators are also shown in U.S. Pat. No. 5,810,882; U.S. Pat. No. 5,824,008; and U.S. Pat. No. 5,964,772; all to Bolduc et al., each of which is incorporated herein by reference in their entirety.

[0116] Gastric Reduction Tools and Methods Using Rotatable Devices

[0117] Aside from endoscopically applied stapling and clip devices, rotating and rotatable probes may also be used to form a modified smaller lumen within a main lumen. Such probes generally may be inserted into a stomach endoscopically and may engage a portion of the interior lining of the stomach and may then be rotated to roll the engaged portion of the stomach wall around the probe itself to bring the wall in apposition with another portion of the stomach wall. Such rotating probes may be used to create a blind-ended pouch of stomach within the main stomach lumen, or as with the other devices, may be used to create a smaller pouch exiting into the pylorus. Once the roll of stomach wall is brought into apposition, a row or a plurality of fasteners, e.g., staples, blind staples, clips, tags, adhesives, etc., may be used to maintain the stomach. The tubes themselves may be made of any variety of biocompatible materials which preferably have sufficient strength to undergo a torsional load, e.g., stainless steel, nickel, platinum, etc.

[0118] An example of a stomach modified by such a rotating probe or device is shown in FIG. 16A. Main pouch **300** is seen with modified pouch **302** formed along the lesser curvature of the stomach and delineated by junction **304**. This example shows modified pouch **302** extending from esophagus **306** and terminating in pouch opening **308** proximally of pylorus **310**. Pouch opening **308** may also be made to terminate at pylorus **310**.

[0119] FIG. 16B shows a superior view from cross section 16B-16B from FIG. 16A of one variation on producing modified pouch **302** having modified lumen **314** from main pouch **300** having main lumen **312** where junction **304** may be formed by rotating the stomach upon itself. FIG. 16C shows an alternative superior view from cross section 16B-16B from FIG. 16A where modified pouch **302'** having modified lumen **314'** may be formed from main pouch **300'** having main lumen **312'**. In this particular variation, junction **304'** may be formed by taking apposed sides of the interior

stomach lining near the lesser curvature and approximating them to form modified lumen 314'.

[0120] Several examples of different possible variations on the rotating probe or device are shown and described below. These variations are not intended to be limiting but are merely given as illustrative examples.

[0121] FIG. 17A shows vacuum tube 320 which may have an elongate tubular body. Tube 320 may be inserted into a patient's stomach trans-esophageally via, e.g., an endoscope. Accordingly, distal end 322 is preferably rounded or gently tapered to be atraumatic to the patient. An opening or window 324 may be defined in the wall of tube 320 near distal end 322 and as seen in FIG. 17B, opening 324 is preferably in communication with lumen 326, which may run throughout tube 320. The geometry of opening 324 is preferably large enough to accommodate the invagination of tissue from the interior stomach lining by a vacuum created within lumen 326 and opening 324. The vacuum may be activated by the physician from a proximal end of tube 320 from outside of the patient. Once tissue is invaginated within window 324, a fastening member may be inserted and deployed to secure the interior stomach lining thereby reducing its overall volume, as described in further detail below. As shown in FIG. 17B, which is cross section 17B-17B from FIG. 17A, tube 320 preferably has a diameter and cross section which may approximate a final geometry of the newly created lumen within the stomach.

[0122] FIG. 18A shows an isometric view of another variation in counter-rotating tube 330. Counter-rotating tube 330 may have a gently tapered distal end 332 with an opening 334 defined in the tube wall near distal end 332. Preferably contained within tube 330 is an additional inner tube 336, which may be geometrically similar to tube 330 but with a diameter small enough to allow free rotation about the longitudinal axis preferably shared by both tubes 330 and 336. Inner tube 336 likewise may have inner opening 338, which may allow communication between lumen 340 and openings 334 and 338. As above, a vacuum may be activated from a proximal end of tube 330 to draw tissue from the interior stomach lining through lumen 340 and into openings 334 and 338 when they are aligned. As shown in FIG. 18B, which is cross section 18B-18B from FIG. 18A, once the tissue has become invaginated within openings 334, 338, inner tube 336 may be rotated to effectively pinch and firmly hold the tissue in place, as shown in FIG. 18B. The addition of the pinching action in addition to the vacuum may aid in holding the tissue, thereby aiding in the rotation of both tube 330 and inner tube 336 when forming the modified lumen. Both tubes 330 and 336 may be manipulated and rotated from a proximal end of the tubes from outside of the patient.

[0123] FIG. 19A shows an isometric view of another variation in barbed tube 350. Tube 350 may be similar to vacuum tube 320 described above. Distal end 352 is preferably tapered and opening 354 may be defined in the wall of tube 350 near distal end 352. Additionally, at least one and preferably several attachment points 356, e.g., tines, barbs, or hooks, may be defined along at least a single edge around opening 354. Attachment points 356 are preferably defined along the leading edge of opening 354 for rotation of tube 350. FIG. 19B, which is cross section 19B-19B from FIG.

19A, shows opening 354 preferably in communication with lumen 358 and a preferred orientation of attachment point 356.

[0124] FIG. 20A shows an isometric view of yet another variation in split tube 360. Split tube 360 may be formed of at least two splittable halves, e.g., first half 364 and second half 366, which may be joined together longitudinally along split 370. When first half 364 and second half 366 are joined together, split tube 360 preferably forms a tapered distal end 362. Split tube 360 may also define a lumen 372 which may run throughout the length of split tube 360. This variation may also comprise at least one and preferably several attachment points 368 on each of first half 364 and second half 366. As shown in the figure, first half 364 may have a row of attachment points 368 preferably aligned along a portion of split 370 and second half 366 may likewise have a row of attachment points 368 juxtaposed and preferably mirroring those located on first half 364. Attachment points 368 may be of any type described above and the number and positioning of attachment points 368 may depend upon the desired length of the resulting junction formed upon rolling the stomach. FIG. 20B, which is cross section 20B-20B from FIG. 20A, shows split 370 and an example of the juxtaposed relationship of attachment points 368.

[0125] FIG. 21 shows an example of a rotatable probe device during insertion into stomach 380. As seen, tube 384 may be inserted into stomach 380 via esophagus 382, preferably endoscopically. Tube 384 may be any of the devices described above and is shown generally as an example of how such devices may be inserted into an organ, e.g., stomach 380. As tube 384 is inserted, it may engage a portion of the interior of stomach 380, preferably along lesser curvature 386. The engagement may be accomplished by any of the methods described herein, e.g., attachment points partially piercing the stomach lining, a vacuum adhering a portion of the lining, etc. Once engaged, tube 384 may then be rotated to roll the engaged portion of the stomach wall around the probe itself to bring the wall in apposition with another portion of the stomach wall.

[0126] FIG. 22A shows a variation on partial cross section 22/23-22/23 from FIG. 21 with tube 350 from FIGS. 19A and 19B in a preferred operation. As shown, interior lining 390 may be adhered to tube 350 via a vacuum created in opening 354 through lumen 358 and/or via attachment points 356 which may partially pierce lining 390, as described above. The location for adhering tube 350 may also be determined or aided by the use of marking device 40, as described above. Once the desired location of interior lining 390 has been established, tube 350 may be rotated about its longitudinal axis, following the arrow as shown, by at least about 180° and preferably at least about 360°. Lining 390 is preferably rotated until the adhered portion contacts a second portion of lining 390 to result in the modified lumen 314 of FIG. 22B, also shown in FIG. 16B. Once modified lumen 314 has been formed, fasteners may be fired or deployed through opening 354 or via a separate endoscopic stapling device at location 392 to secure and maintain modified lumen 314. Fasteners may comprise any of the fasteners as described herein, e.g., staples. Once modified lumen 314 has been secured, tube 350 may then be removed. FIG. 16B shows newly created modified pouch 302 with modified lumen 314 and, as seen, interior lining 390 also forms the interior surface defining modified lumen 314.

[0127] FIGS. 23A to 23D show another variation on partial cross section 22/23-22/23 from FIG. 21 with split tube 360 from FIGS. 20A and 20B. Split tube 360 may be inserted into the stomach either as separate halves 364, 366 individually or as a whole tube which may then be split while in the stomach. Once separated, first half 364 and second half 366 may be engaged to interior lining 390 by attachment points 368 at a slight distance from one another. The separation distance may be determined by the desired resulting size of the lumen. Alternatively, the separation distance may be determined or aided by the use of marking device 40, as described above.

[0128] Once first half 364 and second half 366 have engaged interior lining 390, as shown in FIG. 23A, each of free ends 394 of halves 364, 366 may then be rotated in the direction of the arrow, as shown. Free ends 394 may be configured to simply contact each other or to interlock with each other and rotate about a hinge or pivot. As first half 364 and second half 366 continue to be rotated, FIGS. 23B and 23C show the progression of lumen formation as attachment points 368 draw around and towards one another. Finally in FIG. 23D, as split tube 360 is preferably formed again, modified lumen 314' may be formed, as also shown in FIG. 16C, to then be secured or maintained preferably by fasteners, e.g., staples, which may be deployed through junction 304'.

[0129] A further variation on a rotating device is shown in the isometric view of dual tube device 400 shown in FIG. 24A. Dual tube device 400 may have at least two elongate members, first member 402 and second member 404, which may be rotatably attached to controlling device 406 and may be parallel to each other. The members 402, 404 are preferably counter-rotating and may be rotated by a rotation control 408, which is preferably located on controlling device 406. First member 402 may have first distal end 410 offset slightly from the longitudinal axis of first member 402 by first bend 412. First opening 414 is also preferably defined in the wall of first member 402 proximally of first distal end 410. Second member 404 is preferably similar to first member 402 and may have second distal end 416 offset slightly from the longitudinal axis of second member 404 by second bend 418. Near second distal end 416, second opening 420 may be defined in the wall of second member 404.

[0130] FIG. 24B shows end view 24B-24B from FIG. 24A. Distal ends 410, 416 are seen as preferably being parallel and mirror images of one another. Also, the preferable counter-rotating action may be seen by the directional arrows. FIG. 24C shows cross section 24C-24C from FIG. 24A. As shown, the relationship between first and second opening 414, 420, respectively, and first and second lumen 422, 424, respectively, may be seen in the figure. Lumens 422, 424 preferably run through the length of members 402, 404, respectively, and are in communication with openings 414, 420. A vacuum may be created in openings 414, 420 through lumens 422, 424, respectively, from the controlling device 406. In operation, members 402, 404 may be inserted trans-esophageally into a patient's stomach. A vacuum may then be created in first and second openings 414, 420 to engage a portion of the stomach interior lining. Once engaged, a modified pouch may be created from the interior lining in much the same manner as described for FIGS. 23A to 23D, except the individual counter-rotating members 402,

404 do not form a split tube. The operation of the vacuum application and counter-rotation may be controlled through controlling device 406 which is preferably located outside the patient's body.

[0131] FIG. 25A shows yet another variation in vacuum device 432 shown inserted into stomach 430. Vacuum device 432 may be an endoscopic device inserted trans-esophageally into stomach 430 through esophagus 434. Device 432 may have vacuum member 438 and at least two grasping members 440, preferably disposed on either side of vacuum member 438. Once device 432 has been introduced into stomach 430, vacuum member 438 may be steered towards a desired area of interior lining 442, as seen in FIG. 25B which is a cross section view of device 432 attached to stomach interior lining 442. The desirable area of interior lining 442 may be located along greater curvature 436 or alternatively along lesser curvature 444, depending upon the desired results. In position, a vacuum may be activated in member 438 to draw a portion of interior lining 442 preferably between grasping members 440. As lining 442 is adhered to vacuum member 438, grasping members 440 may be used to pinch and grasp the drawn portion of lining 442. Then, device 432 may be rotated in the direction of the arrow indicated in FIG. 25C to result in the formation of a modified lumen. Afterwards, grasping members 440 may be locked in place, disengaged from device 432, and left as an implant. Alternatively, lining 442 may be fastened to maintain the created lumen by any of the methods described herein and grasping members 440, along with the rest of device 432, may be removed from stomach 430.

[0132] Gastric Reduction Tools and Methods Using Volume Reduction Devices

[0133] Aside from the use of rotating and rotatable probes, gastric volume reduction devices may also be used as part of the present invention. Such volume reduction devices generally may be inserted into a stomach trans-esophageally through the use of, e.g., an endoscope. The reduction device may be used to draw or engage a portion of the interior lining of the stomach; the drawn or engaged portion may then be eventually removed, either actively or through natural processes.

[0134] Several examples of different possible variations on the gastric volume reduction devices are shown and described below. These variations are not intended to be limiting but are merely given as illustrative examples.

[0135] FIG. 26 shows an isometric view of a variation on the gastric volume reduction device in concentric tube device 450. Device 450 may have inner tube 452 defining lumen 454, which preferably runs throughout inner tube 452. Pusher sleeve 456 may be disposed concentrically over inner tube 452 such that pusher sleeve 456 may be allowed to slide freely along inner tube 452. Pusher sleeve 456 is also preferably disposed over inner tube 452 such that the distal end of inner tube 452 is open to allow ring 458 to be rolled or stretched onto the distal end. Ring 458 is preferably made of an elastic type material which would allow ring 458 to elastically cinch onto inner tube 452.

[0136] During use, FIG. 27A shows a view of concentric tube device 450 within stomach 460 preferably inserted through esophagus 462. The distal end of device 450, particularly inner tube 452, may be brought into position



near a location of interior surface **464** where tissue may be desirably removed. As shown in **FIG. 27B**, once device **450** is in place, a vacuum may be actuated within lumen **454**. The vacuum may then draw a portion of withdrawn lining tissue **466** up into lumen **454**, as seen in the cross section of device **450**. While lining tissue **466** is held within lumen **454**, pusher sleeve **456** may be pushed or urged distally along inner tube **452**. As pusher sleeve **456** advances, it may also push or urge elastic ring **458** distally along inner tube **452** until ring **458** is pushed entirely off the distal end of inner tube **452** and onto a portion of lining tissue **466**, as seen in **FIG. 27C**. Device **450** may then be removed from stomach **460** after ceasing the vacuum, thereby leaving lining tissue **466** with elastic ring **458**. After time, as seen in **FIG. 27D**, pressure necrosis may cause lining tissue **466** and ring **458** to simply fall off from the rest of interior surface **464** to be passed normally through the rest of the patient's body. The action of drawing up and removing a portion of interior surface **464** may effectively reduce the overall volume of stomach **460**, thereby reducing the available volume for the ingestion of foods. As such, this procedure may be repeated several times either sequentially or simultaneously until the overall volume of stomach **460** is reduced to a desirable volume depending upon the desired results.

[0137] **FIG. 28** shows another variation on the gastric volume reduction device. As shown, an endoscope **474** preferably having grasping device **476**, e.g., biopsy forceps, may be inserted into stomach **472**. A ligating apparatus, e.g., ring stapler, zip tie, etc., either as part of endoscope **474** or as a separately introduced ligation device **478**, is preferably also introduced within stomach **472**. Forceps **476** and ligation device **478** may be used in conjunction with one another by, e.g., having forceps **476** grasp withdrawn tissue **480** and then having ligation device **478** tie or ligate tissue **480**. Forceps **476** may then be used to excise and remove withdrawn tissue **480** above ties **482** to reduce the overall stomach volume. An example of a jaw structure which may be utilized is shown and described in U.S. Pat. No. 5,749,893 to Vidal et al., which is incorporated herein by reference in its entirety. Alternatively, ligated withdrawn tissue **480** may be left attached to stomach **470** to be removed naturally by pressure necrosis. Several excisions may be performed in reducing stomach volume from, e.g., stomach **472** (as shown by the dashed lines) down to a final reduced stomach **470**.

[0138] **FIG. 29A** shows yet another variation with tractive rollers **490**. This device may have at least two rigid rollers **492**, which are preferably elongated, connected to one another preferably at both ends by, e.g., elastic members **494**. The connection of rollers **492** may create channel **496** therebetween through which tissue may be drawn. **FIG. 29B** shows rollers **492** with a portion of stomach interior surface **498** being drawn through channel **496** by a grasping device, e.g., forceps **500**. Meanwhile, rollers **492** may be maintained within the stomach by, e.g., retaining forceps **502**, which may be used to hold rollers **492** relative to interior surface **498**. Elastic members **494** may pinch rollers **492** together, thereby creating a zone of pressure necrosis in withdrawn interior surface **498**. Also, as interior surface **498** is drawn up through channel **496**, rollers **492** may contain a ratcheting device within to prevent surface **498** from rolling out back through channel **496**. Once the desired amount of surface **498** has been drawn, it may either be excised or simply left to be removed naturally by necrosis. **FIG. 29C** shows an alternative variation with ratcheted rollers **504**. Ratcheted

rollers **504** may be operated in the same manner as described for rollers **492** but they preferably have a tractive surface to enhance traction between the tissue and the rollers **504**. Torquing device **506** may be used with ratcheted rollers **504** and may be introduced into the stomach endoscopically to mesh with one of rollers **504** for the purpose of causing it to rotate. Moreover, either rollers **492** or ratcheted rollers **504** may be used simply to gather stomach surface tissue to allow for fastening, e.g., suturing, stapling, etc.

#### [0139] Pyloroplasty Tools and Methods

[0140] Creating a smaller gastric pouch within the stomach may be accomplished by a variety of methods, as described above. To aid in the overall effect for the treatment of obesity, a pyloroplasty procedure may also be performed to enhance treatment. The pyloroplasty may be performed prior to (preferable), in conjunction with, or following the gastric reduction procedure. A pyloroplasty procedure typically results in the pyloric sphincter being rendered incompetent. However, in the case of treatments for GERD using the devices and methods described above, the pyloroplasty procedure as described herein may be omitted. Conventional pyloroplasty procedures may typically be performed surgically or through the use of standard peripheral angioplasty balloons, e.g., in the 7 mm range. However, in order to render a relatively healthy and normal pylorus permanently incompetent, a more aggressive procedure may be needed.

[0141] To accomplish this generally, a pyloroplasty device may be passed endoscopically through the esophagus, into the stomach, and preferably into position in or across the pylorus. Energy or a stimulus is then preferably applied to the pylorus to render it incompetent. Energy may be in the form of, e.g., heat, electrical, chemical, RF, etc., or a combination. Examples of chemical energy stimulus may comprise alcohol and sotrodecol. The stimulus may be in the form of, e.g., dilatation, cutting, ablation, viral, etc., or a combination. An example of a viral or chemical stimulus may be, e.g., a poison such as the botulinum toxin type A virus (Botox). An example of a method of use for Botox is described in U.S. Pat. No. 5,437,291 to Pasricha et al., which is incorporated herein by reference in its entirety. An incompetent pylorus may allow stomach contents to drain directly into the proximal duodenum with minimal resistance. Moreover, some of the mentioned pyloroplasty treatments may be selected or designed to last only for a specific time period, e.g., a week or several months, etc. For instance, the effects of simple dilatation or the injection of Botox may be designed to render the pylorus incompetent for only a few months, which may be a desirable time period for the patient to obtain the desired results of the procedure.

[0142] Several examples of different possible variations on pyloroplasty devices are shown and described below. These variations are not intended to be limiting but are merely given as illustrative examples.

[0143] **FIG. 30** shows an isometric view of one variation of a dilatation device in balloon device **510** which may have angioplasty balloon **512** located near or at the distal end of catheter **514**. Angioplasty balloon **512** may be used alone to simply dilate the pylorus. Alternatively, exterior balloon surface **516** may have at least one and preferably several stimulating members **518** disposed about surface **516**. Stimulating members **518** are shown in the figure as cutting blades or wires, but alternatively, they may include elec-

trodes, cryogenic dispensing probes or members, chemical dispensing probes, etc. Moreover, balloon **512** may alternatively be a dilation wire basket similarly disposed with stimulating members **518**.

[0144] FIG. 31 shows an isometric view of another variation in probe device **520**. Device **520** may have catheter or delivery member **524** with, e.g., probes **526**, which may extend from distal end **522**. Although three probes **526** are shown in the figure, at least one and up to several probes of varying thickness and lengths may be used. Probes **526** may be retractable so that during delivery through, e.g., the esophagus or stomach, probes **526** may be withdrawn within distal end **522** and then extended when treating the pylorus. Probes **526** may be electrically connected to a voltage or power source located outside the patient's body to deliver electrical, RF, or heat energy to the pylorus. Alternatively, they may be configured like a needle to deliver chemical or biological stimuli to render the pylorus incompetent. For example, probes **526** may be used to inject chemicals, e.g., alcohol, sotrodecil, or other ablative chemicals, or biological stimuli, e.g., Botox virus or some other incapacitating virus, into the pylorus. Such stimulants may be carried within distal end **522**, delivery catheter **524**, or they may also be delivered from the proximal end of catheter **524** and injected through to probes **526**.

[0145] Other variations which may be used for the pyloroplasty procedure are shown in FIGS. 32A and 32B. FIG. 32A shows sphincterotome arm **530** having a distal end **532**. Arm **530** may be bent as shown to allow cutting member **534** to be drawn between distal end **532** and a location proximal of distal end **532** along arm **530**. Another variation is seen in FIG. 32B where delivery member **536** may have an arcuate support member **538** to support cutting member **540**. The variations shown in FIGS. 32A and 32B may be delivered via a catheter or endoscope trans-esophageally and through the stomach to the pylorus where either cutting member **534**, **540** may be used to cut or saw into the tissue in or around the pylorus to render it incompetent. These particular variations of sphincterotomes shown in FIGS. 32A and 32B may be manufactured by Medi-Globe Corporation, located in Tempe, Ariz.

[0146] FIG. 33 shows stomach **550** with a distal portion of the wall of the lesser curvature removed for clarity. Device **520** may be delivered through esophagus **552** to a location proximal of pylorus **558**, e.g., first position **554**. If probes **526** were retracted during delivery, they may then be extended, as shown. Distal end **522** of device **520** may be advanced to, e.g., second position **556**, such that probes **526** may pierce pylorus **558** to deliver the stimulus.

[0147] FIG. 34A shows an isometric view of another variation with combination device **560**. Device **560** may have housing **562** on the distal end of delivery catheter or endoscope **564**. Housing **562** defines notch **566** which may be oriented perpendicularly relative to the longitudinal axis defined by endoscope **564**. Notch **566** preferably has a geometry large enough to accommodate part of pylorus **558** and housing **562** may be tapered at its distal end to allow for easy insertion into the pylorus **558** during the procedure. Within notch **566** may be cutting blade **568** and on either side of blade **568** may be fasteners **570**, e.g., individual anchors, staples, etc. In operation, FIG. 34B shows housing **562** and endoscope **564** delivered through esophagus **552**.

The wall of stomach **550** is partially cut away for clarity. Housing **562** may be inserted into pylorus **558**, then notch **566** is preferably aligned such that part of the pyloral sphincter lies within notch **566**. Alternatively, the pyloral tissue may also be drawn into notch **566** via a vacuum or grasping member. Once the pyloral tissue is within notch **566**, cutting blade **568** may be actuated to traverse notch **566** and sever part of the tissue of pylorus **558**. Fasteners **570** may then be deployed on either side of incision **572** to affix the incised tissue. The number of incisions **572** may vary depending upon the desired degree of pyloric disablement. Alternatively, an inflatable balloon may be attached on the back of notch **566** and inflated to push housing **562** into apposition with pylorus **558** and cause invagination of the tissue into notch **566**.

#### [0148] Anastomosis Tools and Methods

[0149] In addition to the tools and methods described above for gastric reduction and pyloroplasty procedures, an additional anastomosis gastric bypass procedure may also be performed to further enhance treatment. The anastomosis procedure may be performed preferably prior to, in conjunction with, or following the gastric reduction and pyloroplasty (if performed at all) procedures. In the case of treatments for GERD using the devices and methods described above, the anastomosis procedure as described herein may be omitted. The procedure generally involves endoscopically or laparoscopically creating a side-to-side anastomosis preferably from within the stomach and bowel and within the digestive tract. This procedure may be similar to the Roux-en-Y gastric bypass (RYGB) procedure but with minimal trauma. This procedure may also effectively bypass food from the stomach, past a proximal portion of the bowel, and preferably directly into a lower portion of the bowel. This bypassed portion may be considered a malabsorption zone.

[0150] A representative and normal gastrointestinal system of a person is shown in FIG. 35 for comparison. Stomach **580** is shown with pyloric sphincter **582** near gallbladder **584** and attached to the proximal section of duodenum **586**. The distal section of duodenum **586** is attached to the proximal section of jejunum **588**, the distal section of which is further attached to the proximal section of ileum **590**. Ileum **590** is then attached to ascending colon **592**, which continues through to the transverse colon (which has been removed for clarity), and then to descending colon **594** and finally to rectum **596**.

[0151] A gastro-intestinal system which may be modified by a preferable anastomosis procedure is shown in FIG. 36. Stomach **600** is shown in this variation as having been modified by creating modified pouch **602**, which may be created by any of the methods and tools as described above. Esophagus **603** is preferably connected to a proximal end of pouch **602**. As described above, the distal end of pouch **602** may be connected directly to pylorus **604** or alternatively, may be a blind-ended pouch and pylorus **604** is connected to the proximal end of duodenum **606**. A first anastomosis **608** may be created preferably between modified pouch **602** and a section of digestive tract either from the distal duodenum **606** or proximal jejunum **610**. First anastomosis **608** may be located in a range from about 20 to 50 cm from pylorus **604**. A second anastomosis **614** may be created preferably between a section of duodenum **606** and a section of ileum

**612.** The second anastomosis **614** may be located in a range from about 15 to 55 cm from pylorus **604** or about 150 to 200 cm down along the length of the small intestines from pylorus **604**. This procedure may allow for drainage of secretions created by stomach **600** to pass through pylorus **604** and secretions of bile and chyme from the pancreas and gallbladder **618** to pass through biliary duct **620** partly through duodenum **606** and then through second anastomosis **614** and directly into distal ileum **616** and out of the body. The bypassed stomach **600**, pylorus **604**, and proximal duodenum **606** may act as a malabsorption zone because sugars and fats which might normally be mostly absorbed in this zone may now be directly passed into the distal duodenum **606** or proximal jejunum **610**.

[**0152**] During the anastomosis procedure, both first and second anastomoses **608**, **614**, respectively, may be created first. Duodenum **606** may then be closed off between the two anastomoses **608**, **614**. Then, depending upon the length and size of the resulting modified stomach **602**, pylorus **604** may be closed off or left open, depending upon the desired result and which of procedures and tools are implemented. Finally, modified pouch **602** may be created after the anastomoses procedures. Alternatively, modified pouch **602** may be created prior to the anastomoses procedures, again depending upon the desired result and which of procedures and tools are implemented. If modified pouch **602** were created first, then the anastomoses procedure may be reversed to essentially end with the same result.

[**0153**] A conventional RYGB procedure is generally performed through a 6-8 inch incision extending from the end of the breastbone to just above the navel. However, the procedure described above may be performed entirely endoscopically or laparoscopically. **FIG. 37** shows an isometric view of an assembly which may be utilized to achieve part of the procedure. Deployment device **630** may have anastomosis assembly **632** preferably connected by steerable length **634** to manipulation handle **636**. Assembly **632** may be steerable during insertion, preferably trans-esophageally and through the stomach, by steering grip **638** which may be located on manipulation handle **636**. Control by a physician or surgeon of manipulation handle **636** may be facilitated by handle **640**.

[**0154**] Anastomosis assembly **632** may have stapler housing **644** configured to fit intimately with distal element **646** preferably by a magnetic force, the use of which is described below. Distal element **646** is preferably tapered or rounded on one side and may have a coring anvil **648** on its opposing side. Coring anvil **648** may be tapered or rounded and may fit intimately into coring mate **650** which is preferably located near or at the center of stapler housing **644**. Stapler housing **644** may also house several staples loaded within staple slots **652**, which may be disposed circumferentially around coring mate **650** and may be actuated from the proximal end of length **634** by staple trigger **642**.

[**0155**] **FIG. 38** shows a cross sectioned view of anastomosis assembly **632** mated with distal element **646** at first anastomosis **608** between modified pouch **602** and jejunum **610**. Part of the walls of modified pouch **602** and jejunum **610** have been removed for clarity. In creating first anastomosis **608**, distal element **646** may first be placed within the appropriate section of jejunum **610**. This may be done by orally passing distal element **646** through the esophagus,

stomach, and then through the duodenum. Distal element **646** is preferably magnetized, either by manufacturing distal element **646** from natural ferrous materials or artificially magnetizing it. Because of the magnetization, distal element **646** may be urged through the body and into place within the duodenum by, e.g., magnetic wands or magnetic pickups, which may be manipulated from outside the patient's body.

[**0156**] During or after placement of distal element **646**, stapler housing **644**, which may be attached to steerable length **634**, may be introduced trans-esophageally into the stomach **602** and placed into position along stomach wall **660** at the desired site of first anastomosis **608**. Once both stapler housing **644** and distal element **646** are in position, they may then be coupled together preferably by the magnetic force and attraction between the two. Moreover, the two may be brought into alignment either by alignment grooves (not shown) or by the mating of coring anvil **648** into coring mate **650**. As the mating occurs, part of stomach wall **660** and intestinal wall **662** are preferably held or maintained between stapler housing **644** and distal element **646**. To enhance the mating, fasteners may optionally be deployed from stapler housing **644** through staple slots **652** and preferably through both stomach wall **660** and intestinal wall **662** into distal element **646**. **FIG. 38** shows staples **667** deployed as fasteners, but they may comprise any type of mechanical fasteners as described above, as well as, e.g., grommet-type swages, snap lock fits, staples, screws, clips, and friction-fittings.

[**0157**] Once the fitting has been accomplished, the device may be left in apposition to maintain the position of stomach wall **660** and intestinal wall **662** for about one week. This may result in pressure necrosis of the tissue between stapler housing **644** and distal element **646** preferably causing the serosal layers of the gut to fuse, at which point the assembly may drop out and be passed, preferably leaving first anastomosis **608** behind. Alternatively, a coring device **664**, which may be slidably contained within stapler housing **644**, may first be advanced through the center of stapler housing **644** and both stomach wall **660** and intestinal wall **662** to create first anastomosis **608**. The remaining assembly may then be left to cause the pressure necrosis and fusing of tissue, as described. Another alternative may be to use stapler housing **644** and distal element **646** as a mechanism for a conventional end-to-end anastomosis (EEA) stapler. In this case, once they are aligned, a rod may be advanced through the center of the assembly to preferably lock distal element **646** to intestinal wall **662**. The rod may be drawn back, preferably pulling a distal stapler segment into stapler housing **644**. This action may cause staples to fire and a circumferential blade to cut out the center of the staple ring, thereby creating an anastomosis.

[**0158**] To create second anastomosis **614**, a similar approach may be taken as for creating first anastomosis **608**. An example of another magnetic anastomosis device which may also be used in this procedure is shown and described in U.S. Pat. No. 5,690,656 to Cope et al., which is incorporated herein by reference in its entirety. **FIG. 39** shows a portion of duodenum **606** juxtaposed to a portion of ileum **612** and distal ileum **616** with part of the intestinal walls removed for clarity. In this variation, proximal element **670** may be used and is preferably a magnetized mating element for distal element **646**. Distal element **646** may first be urged to the desired location preferably in ileum **612** by, e.g.,

magnetic wands or magnetic pickups, which may be manipulated from outside the patient's body, in the same manner as above. During or after placement of distal element **646**, proximal element **670** may also be delivered or urged to the desired location in the same manner. Once both elements **646**, **670** are in position, they are preferably mated together by a magnetic force. The mating may optionally be enhanced by fasteners, e.g., staples **667**, to hold both elements **646**, **670** in position. The intestinal wall inbetween may be cored, as described above, but it may also be simply left to undergo pressure necrosis between elements **646**, **670** eventually causing the serosal layers of the gut to fuse, at which point elements **646**, **670** may drop out and be passed, preferably leaving second anastomosis **614** behind.

[0159] The applications of the methods and tools discussed above are not limited to the treatment of obesity, but may include any number of further applications, e.g., GERD, which may involve manipulation of an organ interior. Modification of the above-described methods and tools for carrying out the invention, and variations of aspects of the invention that are obvious to those of skill in the art are intended to be within the scope of the claims.

We claim:

1. A method for forming a lumen from an interior of an organ comprising:

placing at least a first anchor on a first area of the interior;

placing at least a second anchor on a second area of the interior; and

drawing at least the first anchor and at least the second anchor in proximity to each other such that the lumen is formed.

2. The method of claim 1 wherein the organ comprises a stomach.

3. The method of claim 1 wherein the first anchor comprises a fastener selected from the group consisting of staples, ratcheted wires, zip ties, clips, tags, eyelets, crimps, and screws.

4. The method of claim 1 wherein the second anchor comprises a fastener selected from the group consisting of staples, ratcheted wires, zip ties, clips, tags, eyelets, crimps, and screws.

5. The method of claim 1 wherein placing at least the second anchor on the second area of the interior comprises placing the second anchor in apposition to the first anchor within the organ.

6. The method of claim 1 wherein drawing at least the first anchor and at least the second anchor in proximity comprises passing a suture through each of the anchors and pulling the suture such that the first area and the second area of the interior are drawn together.

7. The method of claim 6 wherein the suture is passed through each of the anchors in a zig-zag manner.

8. The method of claim 1 wherein the first anchor and the second anchor each comprise a crimping member.

9. The method of claim 8 wherein each of the crimping members are configured to interlock together.

10. The method of claim 1 further comprising interlocking the first anchor to the second anchor such that the first area and the second area of interior surface are in apposition.

11. A fastening device for securing tissue in an organ interior comprising:

a helical member having a distal end and a proximal end with a coiled length therebetween,

wherein at least two coils at the distal end of the helical member each comprise a diameter which is equal,

the helical member being configured for delivery through a lumen defined through a length of an elongate member having a proximal end and a distal end.

12. The fastening device of claim 11 wherein the diameter of the two coils is larger than a diameter of a proximal coil.

13. The fastening device of claim 11 wherein the coiled length is tapered.

14. The fastening device of claim 11 wherein the diameter of the two coils is equal to a diameter of the lumen of the elongate member.

15. The fastening device of claim 11 wherein the distal end of the helical member is configured to pierce tissue.

16. The fastening device of claim 11 wherein the helical member is configured to maintain an orientation parallel to a longitudinal axis of the elongate member during delivery.

17. The fastening device of claim 11 wherein the coiled length is at least partially covered with securing members.

18. The fastening device of claim 17 wherein the securing members are selected from the group consisting of barbs and whisker-like filaments.

19. The fastening device of claim 11 wherein the helical member comprises a bioabsorbable or biocompatible material.

20. The fastening device of claim 19 wherein the bioabsorbable or biocompatible material is selected from the group consisting of polymers and superelastic alloys.

21. A marking device for marking a location on an interior surface within an organ comprising:

an elongate member having a proximal end and a distal end with a length therebetween,

the length defining a shape which approximates a lumen to be formed from the interior surface,

the length further defining at least one dye port, the dye port being configured to contact an area of the interior surface and deliver dye.

22. The marking device of claim 21 further comprising an inflatable balloon at the distal end of the elongate member.

23. The marking device of claim 21 wherein the length further defines at least one vacuum port in communication with the distal end of the elongate member.

24. The marking device of claim 21 wherein the length further defines a plurality of additional dye ports.

25. The marking device of claim 21 wherein the organ comprises a stomach.

26. The marking device of claim 21 wherein the elongate member is curved.

27. The marking device of claim 26 wherein the curved elongate member is configured to follow a lesser curvature of a stomach.

28. The marking device of claim 26 wherein the dye port is defined along an outer radius of curvature of the curved elongate member.

29. The marking device of claim 21 wherein the elongate member is configured to be delivered to the interior surface trans-esophageally.

30. A method of marking a location on an interior surface within an organ comprising:

inserting a marking device into the organ, the marking device comprising an elongate member having a proximal end and a distal end with a length therebetween, the length defining a shape which approximates a lumen to be formed from the interior, the length further defining at least one dye port, the dye port being configured to contact an area of the interior surface and deliver dye;

reducing a volume of the organ such that the interior surface contacts the elongate member;

passing a dye through the dye port; and

increasing the volume of the organ.

**31.** The method of claim 30 wherein reducing a volume of the organ such that the interior surface contacts the elongate member comprises removing contents of the organ via a vacuum.

**32.** The method of claim 31 wherein the vacuum is created in a vacuum port defined along the length of the elongate member.

**33.** The method of claim 30 wherein passing a dye through the dye port further comprises marking the area of the interior surface in contact with the dye.

**34.** The method of claim 30 wherein the dye comprises a biocompatible dye selected from the group consisting of methylene blue, thionine, acridine orange, acridine yellow, acriflavine, quinacrine and its derivatives, brilliant green, gentian violet, crystal violet, triphenyl methane, bis naphthalene, trypan blue, and trypan red.

**35.** A method for forming a lumen from an interior of an organ comprising:

delineating a first boundary of the lumen on a first area and a second boundary of the lumen on a second area of the membrane using the method as described in claim **30**;

removing the marking device from the organ;

placing at least a first anchor along the first boundary;

placing at least a second anchor along the second boundary; and

drawing at least the first anchor and at least the second anchor in proximity to each other such that the lumen is formed.

**36.** The method of claim 35 wherein the first anchor comprises a fastener selected from the group consisting of staples, ratcheted wires, zip ties, clips, tags, eyelets, crimps, and screws.

**37.** The method of claim 35 wherein the second anchor comprises a fastener selected from the group consisting of staples, ratcheted wires, zip ties, clips, tags, eyelets, crimps, and screws.

**38.** The method of claim 35 wherein drawing at least the first anchor and at least the second anchor in proximity comprises passing a suture through each of the anchors and pulling the suture such that the first area and the second area of the interior surface are drawn together.

**39.** The method of claim 38 wherein the suture is passed through each of the anchors in a zig-zag manner.

**40.** The method of claim 35 wherein the first anchor and the second anchor each comprise a crimping member.

**41.** The method of claim 40 wherein each of the crimping members are configured to interlock together.

**42.** A device for forming a lumen from an interior of an organ comprising:

a tissue adhering member having a proximal end and a distal end with a length therebetween, the member having at least two releasably adherable regions for releasably positioning a first area of the interior near a second area of the interior,

whereby the lumen is formed upon fastening the first area to the second area.

**43.** The device of claim 42 further comprising at least one fastener disposable within the tissue adhering member for fastening the first area to the second area.

**44.** The device of claim 42 wherein the first area is positioned adjacent to the second area.

**45.** The device of claim 42 wherein the first area is in apposition to the second area.

**46.** The device of claim 42 wherein the tissue adhering member defines a slot along the length, the slot being adapted to receive a retractable septum.

**47.** The device of claim 46 wherein the retractable septum defines at least one surface adapted to abrade an adjacent portion of the interior.

**48.** The device of claim 47 wherein the adjacent portion of the interior surface is abraded by the retractable septum using a method selected from the group consisting of cutting, scoring, heating, freezing, and chemical ablation.

**49.** The device of claim 42 wherein each of the two releasably adherable regions are separated by an angle between about 20° to 180° about a longitudinal axis defined by the length.

**50.** The device of claim 49 wherein the two releasably adherable regions are separated by an angle between about 90° to 180°.

**51.** The device of claim 42 wherein the first area and the second area are adhered to the tissue adhering member via a vacuum created in each of the two releasably adherable regions.

**52.** The device of claim 51 wherein each of the two releasably adherable regions are in fluid communication with a common channel defined within the tissue adhering member.

**53.** The device of claim 42 further comprising a delivery member having a proximal end and a distal end with a length therebetween, the tissue adhering member being attached to the distal end of the delivery member.

**54.** The device of claim 53 wherein the tissue adhering member is in fluid communication with the proximal end of the delivery member.

**55.** The device of claim 43 further comprising a wedge slidably disposed within an interior channel defined by the tissue adhering member, the wedge being adapted to urge the fastener from an open first configuration to a closed second configuration.

**56.** The device of claim 55 wherein the fastener comprises a mechanical fastener selected from the group consisting of C staples, U staples, clips, and tags.

**57.** The device of claim 55 further comprising a wire attached to the wedge.

**58.** The device of claim 42 wherein the length of the tissue adhering member is straight.

**59.** The device of claim 42 wherein the length of the tissue adhering member defines an arc approximating a curvature of the organ.

60. The device of claim 42 wherein a geometry of the tissue adhering member is adjustable.

61. The device of claim 42 wherein the distal end of the tissue adhering member flares away from a curvature of the organ.

62. The device of claim 42 wherein the organ comprises a stomach.

63. The device of claim 62 wherein the tissue adhering member is adapted to be inserted into the stomach endoscopically via an esophageal passageway.

64. The device of claim 43 wherein the fastener comprises a screw having a helical shape.

65. The device of claim 64 wherein a diameter of a distal end of the screw is larger than a diameter of a proximal end of the screw.

66. The device of claim 65 wherein a length between the distal end of the screw and the proximal end of the screw is tapered.

67. The device of claim 64 wherein at least two coils at a distal end of the screw each comprise a diameter which is equal.

68. The device of claim 64 wherein a distal end of the screw is configured to pierce tissue.

69. The device of claim 64 wherein the screw is at least partially covered with securing members.

70. The device of claim 69 wherein the securing members are selected from the group consisting of barbs and whisker-like filaments.

71. The device of claim 64 wherein the screw comprises a bioabsorbable or biocompatible material.

72. The device of claim 71 wherein the bioabsorbable or biocompatible material is selected from the group consisting of polymers and superelastic alloys.

73. The device of claim 66 wherein the screw is configured to alternately pierce a first area of tissue and a second area of tissue while approximating the first area of tissue and the second area of tissue together.

74. The device of claim 43 further comprising a plurality of additional fasteners, each of the fasteners being configured to fasten the first area to the second area while juxtaposed linearly to form a continuous fixation line.

75. A method for creating a lumen from an interior of an organ comprising:

releasably adhering a first area of the interior to a tissue adhering member;

displacing the first area of the interior via the tissue adhering member;

releasably adhering a second area of the interior to the tissue adhering member such that the first area is positioned near the second area; and,

fastening the first area to the second area to form the lumen.

76. The method of claim 75 wherein the first area and the second area are releasably adhered to the tissue adhering member via a vacuum created in at least two releasably adherable regions defined in the tissue adhering member.

77. The method of claim 75 wherein the first area is positioned adjacent to the second area.

78. The method of claim 75 wherein the first area is in apposition to the second area.

79. The method of claim 75 wherein releasably adhering a second area of the interior surface to the tissue adhering

member such that the first area is positioned near the second area further comprises removing a septum disposed in the tissue adhering member such that the first area contacts the second area.

80. The method of claim 79 further comprising inducing a healing response in the first area or the second area while removing the septum.

81. The method of claim 79 further comprising abrading the first area or the second area while removing the septum.

82. The method of claim 81 wherein abrading the first area or the second area comprises a method selected from the group consisting of cutting, scoring, heating, freezing, and chemical ablation.

83. The method of claim 75 wherein fastening the first area to the second area further comprises sliding a wedge disposed within an interior channel defined by the tissue adhering member such that the wedge urges a mechanical fastener to cinch the first area to the second area.

84. The method of claim 83 wherein the mechanical fastener is selected from the group consisting of C staples, U staples, clips, and tags.

85. The method of claim 75 further comprising disengaging the first area and the second area from the tissue adhering member.

86. The method of claim 75 wherein the organ comprises a stomach.

87. The method of claim 86 wherein the tissue adhering member is endoscopically inserted into the stomach via an esophageal passageway prior to releasably adhering a first area of the interior to a tissue adhering member.

88. The method of claim 75 wherein fastening the first area to the second area defines a boundary between the lumen and a remaining portion of the organ.

89. The method of claim 88 wherein the boundary is straight.

90. The method of claim 88 wherein the boundary approximates a curvature of the organ.

91. The method of claim 88 wherein the boundary is adjustable.

92. The method of claim 88 wherein the boundary flares towards the remaining portion of the organ.

93. The method of claim 75 wherein fastening the first area to the second area to form the lumen further comprises urging a fastener through an interior channel defined in the tissue adhering member to fasten the first area and the second area together.

94. The method of claim 93 wherein the fastener has a tapering helical shape with a piercing end.

95. The method of claim 93 wherein urging the fastener through the interior channel comprises rotating the fastener about a longitudinal axis defined by the fastener such that the first area and the second area cinches together.

96. A system for forming a lumen from an interior of an organ and for dilating an opening defined by the organ comprising:

a tissue adhering member having a proximal end and a distal end with a length therebetween, the member having at least two releasably adherable regions for releasably positioning a first area of the interior near a second area of the interior, whereby the lumen is formed upon fastening the first area to the second area; and,

an elongate device having a proximal end and a distal end with a length therebetween, the elongate device having a modifying region for contacting tissue in or around the opening and for delivering a stimulus to the tissue to dilate the opening.

**97.** The system of claim 96 further comprising at least one fastener disposable within the tissue adhering member for fastening the first area to the second area.

**98.** The system of claim 96 wherein the tissue adhering member defines a slot along the length.

**99.** The system of claim 98 wherein the slot is adapted to receive a retractable septum.

**100.** The system of claim 98 wherein the retractable septum defines at least one surface adapted to abrade an adjacent portion of the interior.

**101.** The system of claim 100 wherein the adjacent portion of the interior is abraded by the retractable septum using a method selected from the group consisting of cutting, scoring, heating, freezing, and chemical ablation.

**102.** The system of claim 96 wherein the first area and the second area are adhered to the tissue adhering member via a vacuum created in each of the two releasably adherable regions.

**103.** The system of claim 102 wherein each of the two releasably adherable regions are in fluid communication with a common channel defined within the tissue adhering member.

**104.** The system of claim 96 wherein the opening defined by the organ comprises a pylorus located at a distal end of the organ.

**105.** The system of claim 96 wherein the modifying region comprises a cutting member adapted to cut the tissue in or around the opening.

**106.** The system of claim 96 wherein the stimulus comprises a form of energy selected from the group consisting of heat energy, electrical energy, chemical energy, RF energy, and pressure.

**107.** The system of claim 96 wherein the elongate device comprises a dilatation device disposed near the distal end.

**108.** The system of claim 107 wherein the dilatation device comprises an angioplasty balloon.

**109.** The system of claim 96 wherein the elongate device comprises an angioplasty balloon disposed near the distal end, the balloon having the modifying region disposed on an exterior surface of the balloon.

**110.** The system of claim 109 wherein the modifying region comprises at least one cutting member disposed on the exterior surface.

**111.** The system of claim 110 wherein the cutting member is selected from the group consisting of blades and wires.

**112.** The system of claim 96 wherein the elongate device comprises a dilation wire basket disposed near the distal end, the dilation wire basket being adapted to deliver the stimulus to the tissue.

**113.** The system of claim 112 wherein the stimulus comprises a change in temperature.

**114.** The system of claim 96 wherein the modifying region comprises at least one probe extending from the distal end of the elongate device, the probe having a distal end adapted for piercing the tissue in or around the opening.

**115.** The system of claim 114 wherein the probe distal end is adapted to deliver a stimulus selected from the group consisting of heat energy, electrical energy, chemical energy, and RF energy.

**116.** The system of claim 96 wherein the stimulus comprises a chemical delivered through an opening defined in the modifying region.

**117.** The system of claim 116 wherein the chemical is ablative to the tissue in or around the opening.

**118.** The system of claim 117 wherein the chemical is selected from the group consisting of alcohol, snotrodecol, and Botox virus.

**119.** The system of claim 96 wherein the modifying region comprises a cutting wire extending between the elongate device distal end and a region proximal of the elongate device distal end.

**120.** The system of claim 96 wherein the modifying region is disposed at the distal end of the elongate device, the region defining a slot for receiving the tissue in or around the opening, and a cutting edge disposed between a plurality of staples slidably held within the slot.

**121.** A method for forming a lumen from an interior of an organ and for dilating an opening defined by the organ comprising:

releasably adhering a first area of the interior to a tissue adhering member;

displacing the first area of the interior via the tissue adhering member;

releasably adhering a second area of the interior to the tissue adhering member such that the first area is positioned near the second area;

fastening the first area to the second area to form the lumen; and

dilating the opening defined at a distal end of the organ.

**122.** The method of claim 121 wherein the first area of the interior is releasably adhered to the tissue adhering member via a vacuum created in a first opening defined in the tissue adhering member.

**123.** The method of claim 121 wherein the second area of the interior is releasably adhered to the tissue adhering member via a vacuum created in a second opening defined in the tissue adhering member.

**124.** The method of claim 121 wherein releasably adhering a second area of the interior to the tissue adhering member such that the first area is positioned near the second area further comprises removing a septum disposed in the tissue adhering member such that the first area contacts the second area.

**125.** The method of claim 121 wherein the opening comprises a pyloral sphincter.

**126.** The method of claim 121 wherein dilating the opening comprises applying a stimulus to tissue in or around the opening via an elongated device having a proximal end and a distal end with a length therebetween.

**127.** The method of claim 126 wherein the stimulus comprises a form of energy selected from the group consisting of heat energy, electrical energy, chemical energy, RF energy, and pressure.

**128.** The method of claim 126 wherein the elongated device comprises a dilatation device disposed near the distal end.

**129.** The method of claim 128 wherein the dilatation device comprises an angioplasty balloon.

**130.** The method of claim 128 wherein the angioplasty balloon comprises an expandable surface having at least one cutting member disposed thereon.

**131.** The method of claim 121 wherein dilating the opening defined at the distal end of the organ comprises piercing tissue in or around the opening with at least one elongate probe and applying a stimulus via the elongate probe.

**132.** The method of claim 131 wherein the stimulus comprises a chemical delivered through an opening defined in a distal end of the probe.

**133.** The system of claim 132 wherein the chemical is ablative to the tissue in or around the opening.

**134.** The system of claim 133 wherein the chemical is selected from the group consisting of alcohol, sotrodecol, and Botox virus.

**135.** The method of claim 126 wherein the elongated device comprises a combination cutting edge and stapler disposed near the distal end.

**136.** A system for forming a lumen from an interior of an organ, comprising a rotatable device for insertion into the organ, the device being specially adapted to adhere onto an internal surface while being rotated about a longitudinal axis defined by the device.

**137.** The system of claim 136 further comprising a fastening device specially adapted to fasten a rotated portion of the organ to a remaining portion of the organ.

**138.** The system of claim 136 wherein the device is rotated at least about 180°.

**139.** The system of claim 136 wherein the device is rotated at least about 360°.

**140.** The system of claim 136 further comprising a side-to-side anastomosis device for coupling adjacent regions of digestive tract, the anastomosis device comprising a distal segment and a proximal segment, the distal and the proximal segments each being adapted to align in apposition with each other while maintaining the regions of digestive tract therebetween.

**141.** The system of claim 137 wherein the rotated portion is mechanically fastened to the remaining portion by a fastener selected from the group consisting of staples, blind staples, clips, tags, screws, and adhesives.

**142.** The system of claim 136 wherein the rotatable device for insertion is inserted into the organ endoscopically via an esophageal passageway.

**143.** The system of claim 140 wherein the anastomosis device is inserted into the digestive tract endoscopically via an esophageal passageway.

**144.** The system of claim 140 wherein the anastomosis device is inserted into the digestive tract laparoscopically.

**145.** The system of claim 136 wherein the rotatable device for insertion comprises an outer tube having a proximal end and a distal end with a lumen defined therebetween, the outer tube defining an opening proximal of the distal end.

**146.** The system of claim 145 wherein the internal surface within the organ is adhered to the device via a vacuum created in the opening.

**147.** The system of claim 145 wherein the distal end comprises an enclosed, tapered end.

**148.** The system of claim 145 wherein the rotatable device for insertion further comprises an inner tube having a proximal end and a distal end with a lumen defined therebetween, the inner tube defining an opening proximal of the distal end.

**149.** The system of claim 148 wherein the opening of the inner tube is configured to align with the opening of the outer tube.

**150.** The system of claim 149 wherein the inner tube is counter-rotatable about the longitudinal axis with the outer tube.

**151.** The system of claim 145 wherein the outer tube further comprises a plurality of attachment points disposed adjacent to the opening, the internal surface within the organ adhering to the outer tube via the attachment points.

**152.** The system of claim 151 wherein the attachment points are selected from the group consisting of tines, barbs, and hooks.

**153.** The system of claim 136 wherein the rotatable device for insertion comprises a split tube having at least two halves, each of the halves being separatable along a partition defined along the tube, the split tube comprising a proximal end and a distal end with a lumen defined therebetween, the split tube further comprising a plurality of attachment points disposed on each half near the distal end.

**154.** The system of claim 153 wherein the attachment points are selected from the group consisting of tines, barbs, and hooks.

**155.** The system of claim 136 wherein the rotatable device for insertion comprises at least two adjacent tubes, each of the tubes having a proximal end and a distal end with a lumen defined therebetween, and each of the tubes defining an opening proximal of the distal end.

**156.** The system of claim 155 wherein each of the two adjacent tubes are adapted to counter-rotate.

**157.** The system of claim 155 wherein the internal surface within the organ is adhered to the device via a vacuum created in each of the openings.

**158.** The system of claim 136 wherein the rotatable device for insertion comprises at least one attachment tube and at least two compression members, the attachment tube being specially adapted to adhere to the internal surface within the organ, and the two compression members being adapted to compress a portion of the internal surface within the organ therebetween.

**159.** The system of claim 158 wherein the attachment tube defines an opening proximal of a distal end.

**160.** The system of claim 159 wherein the internal surface within the organ is adhered to the attachment tube via a vacuum created in the opening.

**161.** The system of claim 140 wherein the distal and the proximal segments are magnetically coupled together while maintaining the regions of digestive tract therebetween.

**162.** The system of claim 161 wherein the distal and the proximal segments are further coupled by mechanical fasteners.

**163.** The system of claim 162 wherein the mechanical fasteners are selected from the group consisting of grommet-type swages, snap lock fits, staples, screws, clips, and friction-fittings.

**164.** The system of claim 140 further comprising a deployment device comprising an elongate tubular member having a proximal end and a distal end with a lumen defined therebetween, the distal end being specially adapted to retain the proximal segment for alignment in apposition with the distal segment.

**165.** The system of claim 164 wherein the deployment device further comprises a coring ring in the distal end, the coring ring being adapted to pass through a center of the distal segment and the proximal segment for removal of the regions of digestive tract therebetween.



**166.** The system of claim 164 wherein the deployment device distal end is adapted to be manipulatable via the proximal end.

**167.** The system of claim 140 further comprising a locating device adapted to urge the distal segment into a predetermined location in the digestive tract.

**168.** The system of claim 167 wherein the locating device comprises a magnetized device selected from the group consisting of magnetic wands and magnetic pickups.

**169.** A side-to-side anastomosis device for coupling adjacent regions of digestive tract, the anastomosis device comprising:

- a distal segment and a proximal segment, the distal and the proximal segments each being adapted to align in apposition with each other while maintaining the regions of digestive tract therebetween; and

- a deployment device comprising an elongate tubular member having a proximal end and a distal end with a lumen defined therebetween, the distal end being specially adapted to retain the proximal segment for alignment in apposition with the distal segment.

**170.** The anastomosis device of claim 169 wherein the distal and the proximal segments are magnetically coupled together while maintaining the regions of digestive tract therebetween.

**171.** The anastomosis device of claim 170 wherein the distal and the proximal segments are further coupled by mechanical fasteners.

**172.** The anastomosis device of claim 171 wherein the mechanical fasteners are selected from the group consisting of grommet-type swages, snap lock fits, staples, screws, clips, and friction-fittings.

**173.** The anastomosis device of claim 169 wherein the deployment device further comprises a coring ring in the distal end, the coring ring being adapted to pass through a center of the distal segment and the proximal segment for removal of the regions of digestive tract therebetween.

**174.** The anastomosis device of claim 169 wherein the deployment device distal end is adapted to be manipulatable via the proximal end.

**175.** The anastomosis device of claim 169 further comprising a locating device adapted to urge the distal segment into a predetermined location in the digestive tract.

**176.** The anastomosis device of claim 175 wherein the locating device comprises a magnetized device selected from the group consisting of magnetic wands and magnetic pickups.

**177.** A system for organ volume reduction, comprising:

- a device for insertion into an organ, the device being specially adapted to draw up a portion of an interior of the organ; and

- a fastening device specially adapted to fasten the portion of interior.

**178.** The system of claim 177 further comprising a side-to-side anastomosis device for coupling adjacent regions of digestive tract, the anastomosis device comprising a distal segment and a proximal segment, the distal and the proximal segments each being adapted to align in apposition with each other while maintaining the regions of digestive tract therebetween.

**179.** The system of claim 177 wherein the device for insertion is inserted into the organ endoscopically via an esophageal passageway.

**180.** The system of claim 178 wherein the anastomosis device is inserted into the digestive tract endoscopically via an esophageal passageway.

**181.** The system of claim 178 wherein the anastomosis device is inserted into the digestive tract laparoscopically.

**182.** The system of claim 177 wherein the device for insertion comprises a tube having a proximal end and a distal end with a lumen defined therebetween, the lumen defining a passageway for drawing up the portion of the interior of the organ via a vacuum.

**183.** The system of claim 182 wherein the fastening device comprises an elastic band disposed about the distal end of the tube and adapted to slide over and secure the portion of the interior.

**184.** The system of claim 177 wherein the device for insertion comprises at least two elongate members, each member having a proximal end and a distal end with a length therebetween, the members being rotatably connected at the proximal end and the distal end such that the members are biased towards each other.

**185.** The system of claim 184 wherein the elongate members define an uneven surface.

**186.** The system of claim 177 wherein the device for insertion comprises an instrument having manipulatable grasping members at a distal end for grasping the portion of the interior of the organ.

**187.** The system of claim 186 wherein the fastening device comprises a catheter having a cinching distal end adapted to cinch the portion of the interior of the organ.

**188.** The system of claim 177 wherein the device for insertion comprises a tube having a proximal end and a distal end with a lumen defined therebetween, the distal end defining at least two slots.

**189.** The system of claim 188 wherein the slots are defined in apposition to each other.

**190.** The system of claim 188 wherein the device for insertion further comprises a plug adapted to fit into the distal end.

**191.** The system of claim 190 wherein the plug is biodegradable.

**192.** The system of claim 191 wherein the plug comprises a biodegradable polymer selected from the group consisting of polylactide, copolymers of polylactide, polyglycolide, and copolymers of polyglycolide.

**193.** The system of claim 177 wherein the fastening device comprises a clip adapted to be inserted into the lumen.

**194.** The system of claim 193 wherein the clip comprises two adjacent members attached at a proximal end, the distal ends of each member being configured to pierce tissue.

**195.** The system of claim 177 wherein the fastening device comprises a screw configured to be inserted into a channel defined within the device.

**196.** The system of claim 177 wherein the screw comprises a helical shape.

**197.** The system of claim 196 wherein a diameter of a distal end of the screw is larger than a diameter of a proximal end of the screw.

**198.** The system of claim 197 wherein a length between the distal end of the screw and the proximal end of the screw is tapered.

**199.** The system of claim 198 wherein the screw is configured to alternately pierce a first area of tissue and a second area of tissue while approximating the first area of tissue and the second area of tissue together.

**200.** The system of claim 177 further comprising a plurality of additional fastening devices, each of the fastening devices being configured to fasten the portion of interior while juxtaposed linearly to form a continuous fixation line.

**201.** A method of creating a side-to-side anastomosis in a digestive tract, comprising:

providing an anastomosis device comprising a distal segment and a proximal segment, the segments each being adapted to align in apposition with each other;

placing the distal segment into a section of digestive tract;

placing the proximal segment into a gastric pouch; and

aligning the distal segment with the proximal segment such that the segments are coupled together while maintaining a portion of the digestive tract and a portion of the gastric pouch therebetween.

**202.** The method of claim 201 wherein the distal segment and the proximal segment are aligned and coupled magnetically.

**203.** The method of claim 202 wherein the distal segment and the proximal segment are further coupled by mechanical fasteners.

**204.** The method of claim 203 wherein the mechanical fasteners are selected from the group consisting of grommet-type swages, snap lock fits, staples, screws, clips, and friction-fittings.

**205.** The method of claim 201 wherein the distal segment is placed into the section of digestive tract endoscopically via an esophageal passageway.

**206.** The method of claim 205 wherein the distal segment is placed into the section of digestive tract via a magnet located externally of the digestive tract.

**207.** The method of claim 201 wherein the distal segment is placed into the section of digestive tract laparoscopically.

**208.** The method of claim 201 wherein the proximal segment is placed into the gastric pouch endoscopically via an esophageal passageway.

**209.** The method of claim 201 further comprising advancing a coring device through a center of the proximal segment and the distal segment.

**210.** A method of creating a separate gastric lumen from a gastric pouch having a main lumen, comprising:

adhering a portion of interior of the gastric pouch to a device specially adapted to rotate;

rotating the device about a longitudinal axis defined by the device while maintaining adherence to the portion of interior, the device being rotated until the separate gastric lumen is defined; and

fastening the portion of interior to the gastric pouch such that the gastric lumen is maintained.

**211.** The method of claim 210 wherein the device comprises a tube having a proximal end and a distal end with a lumen defined therebetween, the tube defining an opening proximal of the distal end.

**212.** The method of claim 211 wherein the portion of interior is adhered to the device via a vacuum created in the opening.

**213.** The method of claim 211 wherein the portion of interior is adhered to the device via a plurality of attachment points disposed adjacent to the opening.

**214.** The method of claim 213 wherein the attachment points are selected from the group consisting of tines, barbs, and hooks.

**215.** The method of claim 210 wherein the portion of interior is fastened to the gastric pouch by a mechanical fastener selected from the group consisting of staples, blind staples, clips, tags, screws, and adhesives.

**216.** A method for gastric reduction, comprising:

creating a first side-to-side anastomosis between a first portion of digestive tract and a gastric pouch using the anastomosis device as described in claim 169;

creating a second side-to-side anastomosis between a second portion of digestive tract and a third portion of digestive tract using the anastomosis device as described in claim 169; and

creating a separate gastric lumen from the gastric pouch using the system as described in claim 136.

**217.** The method of claim 216 wherein the first portion of digestive tract comprises a predetermined section selected from the group consisting of duodenum and jejunum.

**218.** The method of claim 216 wherein the second portion of digestive tract comprises a predetermined section of duodenum.

**219.** The method of claim 216 wherein the third portion of digestive tract comprises a predetermined section of ileum.

**220.** The method of claim 216 wherein creating a second side-to-side anastomosis further comprises closing off a section of digestive tract disposed intermediate of the first portion and the second portion.

**221.** The method of claim 220 wherein the section of digestive tract disposed intermediate of the first portion and the second portion comprises duodenum.

**222.** The method of claim 216 wherein the first anastomosis is located about 20 to 50 cm from a pylorus of the gastric pouch.

**223.** The method of claim 216 wherein the second anastomosis is located about 15 to 55 cm from the pylorus of the gastric pouch.

**224.** The method of claim 216 wherein the second anastomosis is located about 150 to 200 cm along the digestive tract from the pylorus of the gastric pouch.

**225.** A modified gastric pouch, comprising:

a gastric pouch having an exterior surface and an interior surface defining a main lumen and a proximal gastric pouch opening proximal of the main lumen; and

a gastric lumen having a proximal end and a distal end and an interior surface between these ends formed from a rotated portion of the interior surface of the gastric pouch such that the gastric lumen defines a volume separate from the main lumen, the gastric lumen remaining in communication with an esophagus.

**226.** The modified gastric pouch of claim 225 further comprising a plurality of fasteners attached to an interface defined by the gastric lumen and the gastric pouch.

**227.** The modified gastric pouch of claim 226 wherein the fasteners comprise biocompatible mechanical fasteners selected from the group consisting of staples, tags, clips, sutures, screws, and adhesives.

**228.** The modified gastric pouch of claim 225 wherein the gastric lumen is straight.

**229.** The modified gastric pouch of claim 225 wherein the gastric lumen is tapered such that the distal end is larger than the proximal end.

**230.** The modified gastric pouch of claim 225 wherein the gastric lumen is tapered such that the proximal end is larger than the distal end.

**231.** The modified gastric pouch of claim 225 wherein the gastric lumen proximal end defines a gastric lumen proximal opening and the gastric lumen proximal end and the gastric lumen proximal opening are coaxially located.

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#### 摘要(译)

本文描述了各种肥胖症治疗工具和方法，以及其他胃相关疾病（例如GERD）的治疗。治疗包括减小胃袋的尺寸以限制热量摄入以及提供更早的饱腹感。这可以通过直接从胃内部在胃内形成较小的胃袋来完成。较小的袋可以通过使用单独的锚固装置，旋转探针或体积减小装置来制造。还可以进行幽门成形术以使幽门括约肌不能胜任。可以另外使用无创伤磁性吻合装置进行胃旁路手术，使得糖和脂肪在绕过胃时直接传递到肠。许多这些程序可以以各种组合进行。治疗可以通过阻止摄入高热量食物来产生强制性的行为改变。

