(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 April 2018 (12.04.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/067619 A1

(51) International Patent Classification:
A61J 15/00 (2006.01)

(21) International Application Number:
PCT/US2017/055006

(22) International Filing Date:
03 October 2017 (03.10.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/403,326 03 October 2016 (03.10.2016) US
62/545,339 14 August 2017 (14.08.2017) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

WO 2018/067619 A1

(54) Title: ENTERAL FEEDING TUBE HOUSING AND FIXATION DEVICES

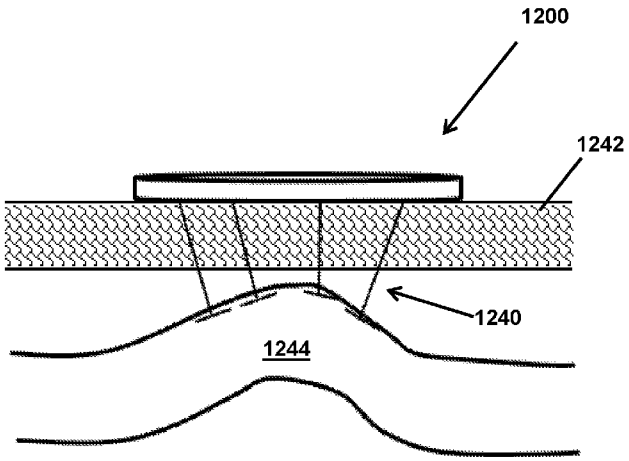


Figure 12

(57) Abstract: Enteric feeding tube housings configured to secure a feeding tube to the body are disclosed. The housing includes a disc having a hole configured to accommodate the feeding tube and two or more holes configured to accommodate fasteners. Also disclosed are enteric feeding tube housings that include a disc having a hole configured to accommodate the feeding tube and two or more holes configured to accommodate fasteners, and a plurality of fasteners. Also disclosed are surgical kits that include a housing, a plurality of fasteners, and a plurality of locking devices configured to adjustably secure the fasteners in the fastener receiving holes, and method of using the disclosed devices.

[Continued on next page]

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

ENTERAL FEEDING TUBE HOUSING AND FIXATION DEVICES

Cross Reference to Related Applications

[0001] The present application claims priority to U.S. Provisional Application No. 62/403,326, which was filed on October 3, 2016, titled "FEEDING TUBE HOUSING," and to U.S. Provisional Application No. 62/545,339, which was filed on August 14, 2017, titled "ENTERAL FEEDING TUBE HOUSING AND FIXATION DEVICES," both of which are hereby incorporated by reference in their entirety.

Technical Field

[0002] Embodiments relate to devices used in the securing of enteral feeding tubes, and, more specifically, to devices used external to the body to secure enteral feeding tubes.

Acknowledgement of Government Support

[0003] The disclosed invention was made with the support of the United States government under the terms of Grant Number U01 TR000128, which was awarded by the National Institutes of Health. The United States government has certain rights to this invention.

Background

[0004] Due to the dramatic increase of upper gastrointestinal malignancies worldwide, as well as surgical and medical problems in patients without cancer, there is an increased need for safe devices that provide access to the gastrointestinal tract. These devices allow patients who cannot accept oral intake to receive hydration, nutrition, and medication. Conventional surgical kits that are used to accomplish this access typically use a T-fastener system that secures a loop of bowel to the inside of the abdominal wall in four places. This system allows access to the bowel lumen for a flexible plastic feeding tube that is passed through the abdominal wall. An example of such a system is depicted in **Figure 1**. Such systems are prone to breakage, time-

consuming to place, and uncomfortable for the patient, as they cannot be adjusted once they have been placed.

[0005] In the past, additional commercially available kits were able to provide reliable, but uncomfortable enteral access. However, such kits have been removed from the market and are no longer available. This has resulted in surgeons using off- label devices or "patchwork" kits constructed from multiple sources. Not only is this approach dangerous for patients, but it also increases healthcare costs significantly. Serious complications, adverse medical outcomes, and increased hospital and healthcare costs have resulted from the failure of these alternate devices.

Brief Description of the Drawings

[0006] Embodiments will be readily understood by the following detailed description in conjunction with the accompanying drawings. Embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings.

[0007] **Figure 1** is an illustration of a prior art system with locking skin anchors that secure the bowel to the abdominal wall and allow access to the intestines via a flexible plastic feeding tube;

[0008] **Figure 2** is a top view of an example of a feeding tube housing as disclosed herein, in accordance with various embodiments;

[0009] **Figure 3** is a top view of the feeding tube housing of **Figure 2**, showing that lines passing through the first hole and pairs of opposing fastener receiving holes holes are substantially perpendicular, in accordance with various embodiments;

[0010] **Figure 4** is a perspective view of the feeding tube housing of **Figure 2**, in accordance with various embodiments;

[0011] **Figure 5** is a 3-D rendering of a second example of a feeding tube housing that includes a silicone pad, in accordance with various embodiments;

[0012] **Figures 6A-D** are four illustrations depicting a base member of a fixation device for use with a housing as disclosed herein, including a cross-sectional view (**Figure 6A**), a perspective view (**Figure 6B**), a top view (**Figure 6C**), and a side view (**Figure 6D**), in accordance with various embodiments;

[0013] **Figures 7A-D** are four illustrations depicting a pressure plate of a fixation device, including a top view (**Figure 7A**), a cross-sectional view (**Figure 7B**), a side view (**Figure 7C**), and a perspective view (**Figure 7D**), in accordance with various embodiments;

[0014] **Figures 8A-C** are three illustrations depicting a locking component of a fixation device, including a side view (**Figure 8A**), a top view (**Figure 8B**), and a perspective view (**Figure 8C**), in accordance with various embodiments;

[0015] **Figure 9** is a digital image of a third example of a feeding tube housing and four exemplary fixation devices installed therein, in accordance with various embodiments;

[0016] **Figure 10** is a digital image of an example of a fixation device, including a locking component, a pressure plate, and a base member, in accordance with various embodiments;

[0017] **Figure 11** is a digital image of another example of a fixation device, including a base member, a pressure plate, and a locking component, in accordance with various embodiments; and

[0018] **Figure 12** is an illustration of an example of a feeding tube housing in use, with a plurality of T-fasteners passing through the abdominal wall to secure the bowel to the abdominal wall and allow access to the intestines, in accordance with various embodiments.

Detailed Description of Disclosed Embodiments

[0019] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which are shown by way of illustration embodiments that may be practiced. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope. Therefore, the following detailed description is not to be taken in a limiting sense, and the scope of embodiments is defined by the appended claims and their equivalents.

[0020] Various operations may be described as multiple discrete operations in turn, in a manner that may be helpful in understanding embodiments; however, the

order of description should not be construed to imply that these operations are order dependent.

[0021] The description may use perspective-based descriptions such as up/down, back/front, and top/bottom. Such descriptions are merely used to facilitate the discussion and are not intended to restrict the application of disclosed embodiments.

[0022] The terms "coupled" and "connected," along with their derivatives, may be used. It should be understood that these terms are not intended as synonyms for each other. Rather, in particular embodiments, "connected" may be used to indicate that two or more elements are in direct physical or electrical contact with each other. "Coupled" may mean that two or more elements are in direct physical or electrical contact. However, "coupled" may also mean that two or more elements are not in direct contact with each other, but yet still cooperate or interact with each other.

[0023] For the purposes of the description, a phrase in the form "A/B" or in the form "A and/or B" means (A), (B), or (A and B). For the purposes of the description, a phrase in the form "at least one of A, B, and C" means (A), (B), (C), (A and B), (A and C), (B and C), or (A, B and C). For the purposes of the description, a phrase in the form "(A)B" means (B) or (AB) that is, A is an optional element.

[0024] The description may use the terms "embodiment" or "embodiments," which may each refer to one or more of the same or different embodiments. Furthermore, the terms "comprising," "including," "having," and the like, as used with respect to embodiments, are synonymous.

[0025] Embodiments herein provide systems and devices for securing an enteral feeding tube, such as a jejunal feeding tube, to the body of a patient for access to the intestines. In various embodiments, such systems and devices may include enteric feeding tube housings, improved fasteners, and fastener fixation devices. The disclosed systems and devices provide improved safety, ease of use, and reduced cost compared to conventional systems.

[0026] Many medical and surgical problems result in the inability of a patient to swallow and/or activate upper gastrointestinal tract mechanisms necessary for oral feeding and/or hydration. Additionally, there has been an increase in the incidence of upper gastrointestinal cancers worldwide, particularly esophageal and gastric cancers,

that may lead to oral feeding problems. For example, in the United States, the incidence of esophageal adenocarcinoma has increased by over 1600% during the second half of the 20th century. These malignancies may cause obstruction, and patients may be unable to swallow food, water, or medications. Consequently, there is a growing need for devices to provide enteral nutrition at a point beyond the stomach.

[0027] Enteral feeding tubes typically are placed in the jejunum, which is the upper portion of the small bowel. Safe jejunostomy kits are no longer commercially available, and alternative devices been shown to have significant shortcomings. Various problems have been identified with these "makeshift" devices, especially in obese patients.

[0028] Thus, there is an increasing need for enteral feeding access systems in hospital populations, and enteric access generally is accomplished using a laparoscopic surgical approach. However, enteral tube placement with laparoscopic assistance is a time-consuming and awkward procedure requiring advanced laparoscopic skills, and adding significant time and cost to surgery. The typical approach incorporates intraabdominal (e.g., intracorporeal) suturing to fix the jejunum against the inside of the abdominal wall and allow secure placement of the feeding tube (e.g., the jejunostomy tube). An alternate technique is to use a specific kind of fastener (called a T-fastener) to pull and fix the bowel to the abdominal wall in one or more places and provide a foundation through which a jejunostomy tube may be passed into the jejunum.

[0029] A typical, commercially-available T-fastener device comprises an 8-inch long nylon thread attached vertically to a small 3/8–inch long metal piece at its end, forming a T shape. The device may be fixed to the abdominal skin surface through a mechanical button or soft pledget on the nylon thread. Originally, this fastener was designed to be used as the only fixator of the bowel without needing to also use intracorporeal sutures. In this configuration, fasteners are deployed to fix the bowel segment in a diamond or square formation around the percutaneously placed jejunostomy tube. **Figure 1** is an illustration of an example of a fastener system with locking skin anchors that secures the bowel to the abdominal wall and allows access to the intestines via a flexible plastic feeding tube.

[0030] Such fasteners may break and may then require surgical intervention to salvage the jejunostomy and save the patient from sepsis. Additionally, fixation devices, such as the one depicted in **Figure 1,** may cause pain and local tissue compression that may promote skin infections and abscesses at the jejunostomy site. These complications may lead to poor patient outcomes and increased healthcare costs.

[0031] To prevent such device failings, alternate methods of jejunostomy placement have been developed, but such procedures may take over 30 minutes of expensive operating room time to install, as compared to a 15 minute procedure using current fastener systems. Thus, the presently-available jejunostomy systems and methods may result in patient discomfort, poor clinical outcomes, increased operating room utilization, and/or complications that increase the length of inpatient treatment.

[0032] Disclosed in various embodiments herein are feeding tube systems and devices, such as enteric feeding tube housings, improved fasteners, such as T-fasteners, and fastener fixation devices, that provide easier and more efficient placement of jejunal feeding tubes while also providing less pain and better clinical outcomes. Additionally, the disclosed systems and devices may save approximately 20 minutes of operating room time per procedure, compared to existing systems and methods. In various embodiments, this decrease in surgery time may also reduce anesthesia time and overall cost. Additionally, the systems disclosed herein provide a clean environment around the enteric access site and minimize patient pain and jejunal site leakage.

[0033] Disclosed herein are housings and fixation devices for providing access to the gastrointestinal tract and securing an enteral feeding tube to a subject's abdomen. In various embodiments, the feeding tube housing may include a disc, such as a substantially circular disc, with a first hole passing therethrough for accommodating a feeding tube. In various embodiments, this hole may be located in about the center of the disc, and the disc also may include a plurality of additional holes (e.g., second, third, fourth, fifth holes, etc.) that are referred to herein as fastener holes and that accommodate a corresponding plurality of fasteners, such as sutures and T-fasteners. Such an arrangement provides load distribution within the construct, thus addressing problems associated with individualized fixation devices.

[0034] While referred to as a disc, which may suggest a circular or substantially circular shape, the feeding tube housing may be any of a variety of shapes including oval, square, rectangular, etc. In some embodiments, the disc also may include a perforation, such as a substantially circular perforation, disposed about the first hole. In various embodiments, the perforation may divide the disc into two separate sections: a first section that includes the first hole, and a second section that includes the plurality of fastener receiving holes. In various embodiments, all of the holes may be substantially circular, although differently shaped holes may also be used such as oval, square, rectangular, etc.

[0035] Although T-fasteners are discussed throughout the disclosure, it should be understand that other fasteners (such as sutures and fasteners having one or more anchoring features that are not T-shaped) may be used provided they can be anchored at one end in the patient's tissue and at the other end coupled to the feeding tube housing.

[0036] In various embodiments, the housing may be constructed of any material, including plastic. In some embodiments, the housing also may include a silicone layer or pad coupled to the ventral (body-facing) side of the disc. In some embodiments, the silicone layer or pad may include an antibacterial composition, such as a composition that includes a silver compound.

[0037] Also disclosed in various embodiments are enteric feeding tube housing devices that include a disc having a first hole for accommodating a feeding tube, a plurality of fastener receiving holes disposed about the first hole and, a corresponding plurality of fasteners. In some embodiments, the fasteners are T-fasteners, and in particular embodiments each of the plurality of fasteners includes a graphene monofilament. Some embodiments of the device include a silicone pad coupled to a body-facing side of the disc, and the silicone pad may include an antibacterial composition.

[0038] Also disclosed herein are surgical kits that include a disc having a first hole for accommodating a feeding tube and a plurality of fastener receiving holes disposed about the first hole, a corresponding plurality of fasteners, and a corresponding plurality of fixation devices, each sized and shaped to fit within one of the

fastener receiving holes. Each of the plurality of fixation devices may include a base member that has a bottom portion sized and shaped to fit within one of the fastener receiving holes, an aperture for receiving one of the plurality of the fasteners, and a sidewall extending from the bottom portion. In some embodiments, the sidewall may include one or more features for receiving and securing a locking component, such as a plurality of angled slots disposed on an inward-facing surface of the sidewall.

[0039] In some embodiments, the fixation device also may include a locking component having a disc-shaped body that includes a plurality of protruding tabs sized to slide within the plurality of angled slots in the base member. Optionally, the surgical kit also may include a pressure plate sized and shaped to fit within the sidewall of the base member and having an aperture sized and shaped for receiving one of the plurality of fasteners.

[0040] In use, the end of each protruding tab is configured to be journaled in a corresponding angled slot in the base member**,** and the plurality of angled slots define a range of movement of the protruding tabs as they slide within each slot when the locking component is rotated about a central axis. In various embodiments, the locking component may include a handle for rotating the locking component within the base member, and rotation of the locking component may reversibly lock a fastener disposed in the fixation device into a desired position.

[0041] Further embodiments include methods of securing a feeding tube that include surgically securing a portion of an intestine adjacent to an abdominal wall with a plurality of fasteners, and externalizing a portion of each of the plurality of fasteners by passing it through the abdominal wall. The fasteners may then be coupled to an enteric feeding tube housing device that is retained against the subject's skin. The feeding tube housing device may include a disc that includes first hole for accommodating a feeding tube and a plurality of fastener receiving holes disposed about the first hole. Once the enteric feeding tube housing has been placed, a feeding tube may be advanced through the first hole, through the abdominal wall, and into the portion of the intestine. In some embodiments, the fasteners may be T fasteners, and the method may also include reversibly locking each of the fasteners to the enteric feeding tube housing using a fixation device.

[0042] Referring now to the figures, in various embodiments, the systems and devices disclosed herein may include an enteric feeding tube housing that includes a disc. **Figure 2** is a top view of one example of a feeding tube housing **100,** and includes a substantially circular disc **102** that includes a plurality of holes **104**, **106**; **Figure 3** is a top view of the feeding tube housing **100** of **Figure 2,** showing that lines passing through the first hole **104** (which receives the feeding tube) and opposing pairs of T-fastener holes **106a**, **106b**, **106c**, **106d** are substantially perpendicular; and **Figure 4** is a perspective view of the feeding tube housing **100** of **Figure 2**, all in accordance with various embodiments.

[0043] With reference to **Figures 2-4**, in various embodiments, the feeding tube housing **100** may have a first hole **104** that is sized and shaped to accommodate a feeding tube, such as a 10-20 French feeding tube. In various embodiments, the first hole **104** may be located in about the center of the disc **102**, and the feeding tube housing **100** also may include a plurality of fastener receiving holes **106** that are positioned to receive a corresponding plurality of fasteners. In some embodiments, the feeding tube housing **100** may include two, three, four, five, or even more fastener receiving holes **106.** Additionally, some embodiments may include a perforation **108** disposed around the first hole **102**, where the perforation **108** divides the disc into a first section and a second section. In the illustrated embodiment, the first section includes the first hole **104** and the second section includes the plurality of fastener receiving holes **106.** In some embodiments, perforation **108** may allow for securing or fixing the first section in place prior to or after the removal of the second section at the perforation line.

[0044] In some embodiments, such as those illustrated in **Figures 2-4**, the housing **100** may be constructed of plastic. **Figure 5** is a 3-D rendering of another example of a feeding tube housing **500** that includes a silicone pad **510**, In particular embodiments, such as the embodiment illustrated in **Figure 5**, the feeding tube housing **500** may include a silicone pad **510** coupled to a ventral (body-facing) side of the feeding tube housing **500**. In particular embodiments, the silicone pad **510** may include an antibacterial composition, such as a silver compound incorporated into the silicone matrix to provide antimicrobial properties.

[0045] In various embodiments, the intestine may be secured to the interior of the abdominal wall using a plurality of fasteners, such as T-fasteners, that include a graphene monofilament. As used herein, the term "graphene" refers to an allotrope of carbon in the form of a two-dimensional, atomic-scale, hexagonal lattice in which one atom forms each vertex. In various embodiments, replacing the nylon suture of the conventional T-fastener with graphene fiber suture affords greater tensile strength and flexibility to decrease the amount of shear stress over the skin and decrease the risk of failure and/or complications, especially in obese patients. In some embodiments, each graphene fastener may be permanently affixed to each corresponding fastener receiving hole **106, 506** in the housing **100, 500**. In other embodiments, each graphene fastener may be adjustably coupled to each corresponding fastener receiving hole in the housing using a fixation device as disclosed herein.

[0046] As disclosed herein, in various embodiments, the disclosed fasteners may be deployed into the bowel lumen, and the suture ends may be adjustably secured in fastener receiving holes, such as by using a fixation device that allows for adjustment of the suture length, and thus may be adjusted to better distribute pressure across abdominal wall and skin. Thus, in various embodiments, the tightness of the fastener may be easily adjusted by adjusting each fixation device, for example to accommodate swelling or increase comfort, or to prevent leaking. In various embodiments, the fixation device may include a base member that fits securely in the fastener receiving hole of a housing member as described above, a pressure plate to receive and secure the fastener, and a locking component to apply pressure to the pressure plate and lock the fastener in place. Each of these components of the fixation device is described in greater detail below.

[0047] **Figures 6A-D** are four illustrations depicting a base member **612** of a fixation device for use with a housing as disclosed herein, including a cross-sectional view (**Figure 6A**), a perspective view (**Figure 6B**), a top view (**Figure 6C**), and a side view (**Figure 6D**), in accordance with various embodiments. In various embodiments, the base member **612** may be generally cup-shaped, with a disc-shaped bottom portion **614** and a sidewall **616** extending therefrom. In various embodiments, the bottom portion **614** may include a generally central aperture **618** for receiving the suture end of

a fastener, and a plurality of angled slots **620** on the interior face of the sidewall **616**. In use, the ends of corresponding plurality of protruding tabs on the locking component may be journaled in each of the plurality of opposing angled slots **620,** and the angled slots **620** may define a range of movement of the corresponding plurality of protruding tabs as they slide within each slot **620** when the locking component is rotated about the central axis of the base member **612**. In some embodiments, slots **620** may include one or more bends, curves, or notches, for example to retain the locking component in the locked position.

[0048] **Figures 7A-D** are four illustrations depicting a pressure plate **722** of a fixation device, including a top view (**Figure 7A**), a cross-sectional view (**Figure 7B**), a side view (**Figure 7C**), and a perspective view (**Figure 7D**), in accordance with various embodiments. In various embodiments, pressure plate **722** may include a central aperture **724** for receiving the suture end of a fastener from the base member below, and a lateral slot **726** extending from the central aperture **724** to the edge of the pressure plate **722** for receiving and securing the suture end of the fastener in a desired position when pressure is applied from the locking component above. Additionally, in some embodiments, the bottom side of pressure plate **722** may include one or more concentric ridges **728** for compressibility. In various embodiments, the fixation device may be designed to be used with or without the pressure plate **722**.

[0049] **Figures 8A-C** are three illustrations depicting a locking component of a fixation device, including a side view (**Figure 8A**), a top view (**Figure 8B**), and a perspective view (**Figure 8C**), in accordance with various embodiments. In various embodiments, locking component **830** may include a disc-shaped body **832** with a plurality of protruding tabs **834** that correspond to and are sized to slide within the plurality of angled slots in the base member. In use, the end of each protruding tab **834** may be journaled in a corresponding angled slot in the base member**,** and the plurality of angled slots may define a range of movement of the protruding tabs as they slide within each slot when the locking component **830** is rotated about the central axis. In various embodiments, a handle **836** may be provided on the upper surface of the disc-shaped body **832** for rotating the locking component within the base member, thus locking the suture end of the fastener within the slot of the pressure plate.

[0050] **Figure 9** is a digital image of a third example of a feeding tube housing **900** and four exemplary fixation devices **938** installed therein; **Figure 10** is a digital image of an example of a fixation device **1038**, including a locking component **1030**, a pressure plate **1022**, and a base member **1012**, and **Figure 11** is a digital image of another example of a fixation device **1138**, including a base member **1112**, a pressure plate **1122**, and a locking component **1130**, all in accordance with various embodiments.

[0051] **Figure 12** is an illustration of an example of a feeding tube housing in use, with a plurality of T-fasteners passing through the abdominal wall to secure the bowel to the abdominal wall and allow access to the intestines, in accordance with various embodiments. In the illustrated embodiment, each fastener **1240** is anchored in the intestine **1244,** and passes through the abdominal wall **1242**, where it is externalized and secured by the feeding tube housing **1200.** One of skill in the art will appreciate that each fastener **1240** may be secured to the feeding tube housing **1200** in any of a number of ways, including the fixation devices described herein.

Examples

[0052] The following examples are for illustration only. In light of this disclosure, those of skill in the art will recognize that variations of these examples and other examples of the disclosed invention be possible without undue experimentation.

[0053] Mechanical laboratory testing may be used to demonstrate material robustness. This testing may include measurement of the tensile characteristics of the graphene T-fasteners, both separately and when combined with the support complex. Lateral and perpendicular shear and tear forces applied by the graphene threads on the foundation also are evaluated, as is the amount of pressure exerted over the silicon padding and distribution of the forces under the padding.

[0054] Animal testing is performed to assess the safety and effects of exposure of the skin to the product. Such testing may be done in smaller animals such as rabbits, without the need for jejunostomy. In other tests, the device is placed using laparoscopic surgery in a swine model. Product safety and stability is then evaluated for at least 3 weeks after placement.

[0055] Although certain embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a wide variety of alternate and/or equivalent embodiments or implementations calculated to achieve the same purposes may be substituted for the embodiments shown and described without departing from the scope. Those with skill in the art will readily appreciate that embodiments may be implemented in a very wide variety of ways. This application is intended to cover any adaptations or variations of the embodiments discussed herein. Therefore, it is manifestly intended that embodiments be limited only by the claims and the equivalents thereof.

Claims

What is claimed is:

1. An enteric feeding tube housing device comprising:

a disc comprising a first hole for accommodating a feeding tube and a plurality of fastener receiving holes disposed about the first hole.

2. The enteric feeding tube housing device of claim 1, wherein the plurality of fastener receiving holes comprises four fastener receiving holes.

3. The enteric feeding tube housing device of claim 1, wherein the disc comprises plastic.

4. The enteric feeding tube housing device of claim 1, further comprising a silicone pad coupled to a body-facing side of the disc.

5. The enteric feeding tube housing device of claim 4, wherein the silicone pad comprises an antibacterial composition.

6. The enteric feeding tube housing device of claim 1, further comprising a perforation disposed about the first hole, wherein the perforation divides the disc into a first section comprising the first hole and a second section comprising the plurality of fastener receiving holes.

7. The enteric feeding tube housing device of claim 6, wherein the perforation is substantially circular.

8. An enteric feeding tube housing device comprising:

a disc comprising a first hole for accommodating a feeding tube and a plurality of fastener receiving holes disposed about the first hole; and

a corresponding plurality of fasteners.

9. The enteric feeding tube housing device of claim 8, wherein the plurality of fastener receiving holes comprises four fastener receiving holes.

10. The enteric feeding tube housing device of claim 8, wherein the fasteners are T-fasteners.

11. The enteric feeding tube housing device of claim 8, wherein each of the plurality of fasteners comprises a graphene monofilament.

12. The enteric feeding tube housing device of claim 8, further comprising a silicone pad coupled to a body-facing side of the disc.

13. The enteric feeding tube housing device of claim 12, wherein the silicone pad comprises an antibacterial composition.

14. A surgical kit comprising:

a disc comprising a first hole for accommodating a feeding tube and a plurality of fastener receiving holes disposed about the first hole;

a corresponding plurality of fasteners; and

a corresponding plurality of fixation devices, each sized and shaped to fit a corresponding fastener receiving hole.

15. The surgical kit of claim 14, wherein the fasteners are T-fasteners.

16. The surgical kit of claim 14, wherein each of the plurality of fasteners comprises a graphene monofilament.

17. The surgical kit of claim 14, wherein each of the plurality of fixation devices comprises:

a base member comprising a bottom portion sized and shaped to fit within one of the fastener receiving holes and comprising an aperture for receiving one of the plurality of the fasteners, and a sidewall extending the bottom portion and comprising a plurality of angled slots disposed on an inward-facing surface of the sidewall; and

a locking component comprising a disc-shaped body comprising a plurality of protruding tabs sized to slide within the plurality of angled slots in the base member.

18. The surgical kit of claim 17, further comprising a pressure plate sized and shaped to fit within the sidewall of the base member and comprising an aperture sized and shaped for receiving one of the plurality of fasteners.

19. The surgical kit of claim 17, wherein the end of each protruding tab is configured to be journaled in a corresponding angled slot in the base member, and wherein the plurality of angled slots define a range of movement of the protruding tabs as they slide within each slot when the locking component is rotated about a central axis.

20. The kit of claim 18, wherein the locking component further comprises a handle for rotating the locking component within the base member.

21. The kit of claim 19, wherein rotation of the locking component reversibly locks a fastener disposed in the fixation device into a desired position.

22. A method of securing a feeding tube, comprising:

securing a portion of an intestine adjacent an abdominal wall with a plurality of fasteners;

externalizing a portion of each of the plurality of fasteners by passing it through the abdominal wall; and

coupling each of the plurality of fasteners to an enteric feeding tube housing device, the enteric feeding tube housing device comprising a disc comprising a first hole for accommodating a feeding tube and a plurality of fastener receiving holes disposed about the first hole.

23. The method of claim 22, further comprising advancing a feeding tube through the first hole, through the abdominal wall, and into the portion of the intestine.

24. The method of claim 22, wherein the plurality of fasteners comprises T-fasteners.

25. The method of claim 22, further comprising reversibly locking each of the fasteners to the enteric feeding tube housing using a fixation device.

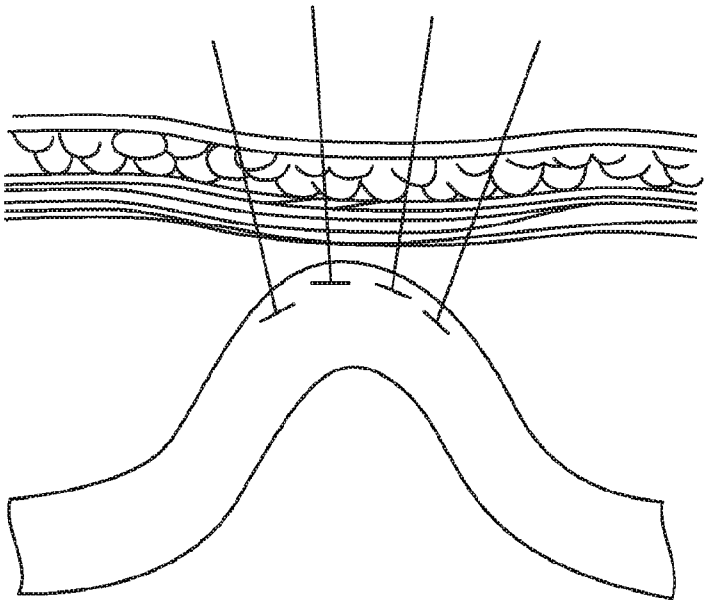


FIG. 1
PRIOR ART

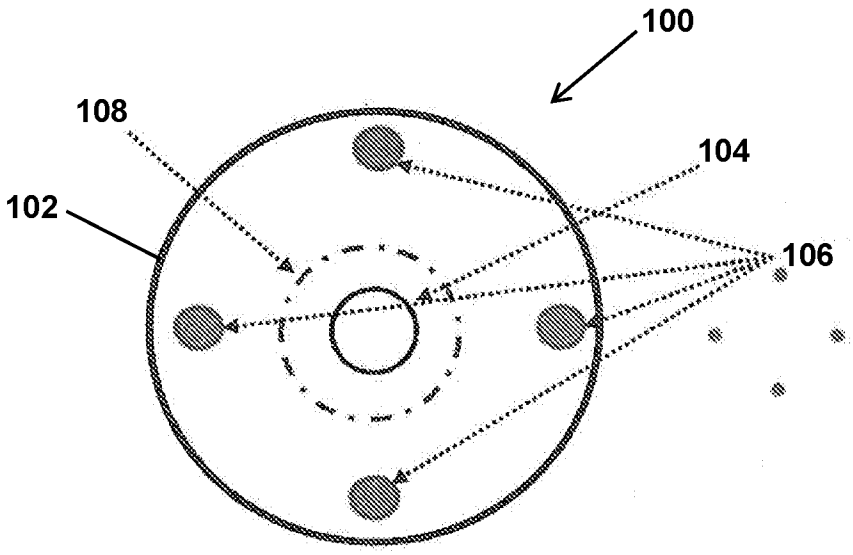


Figure 2

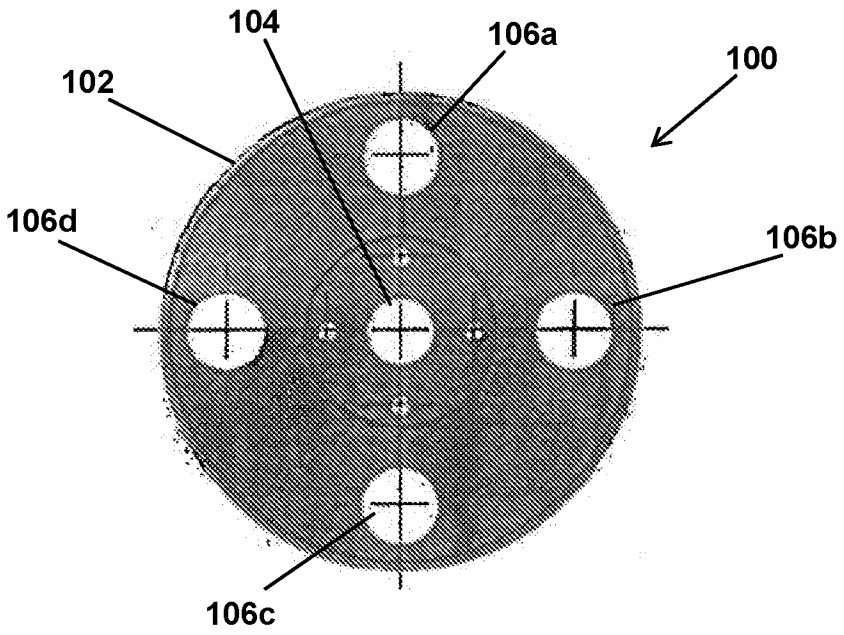


Figure 3

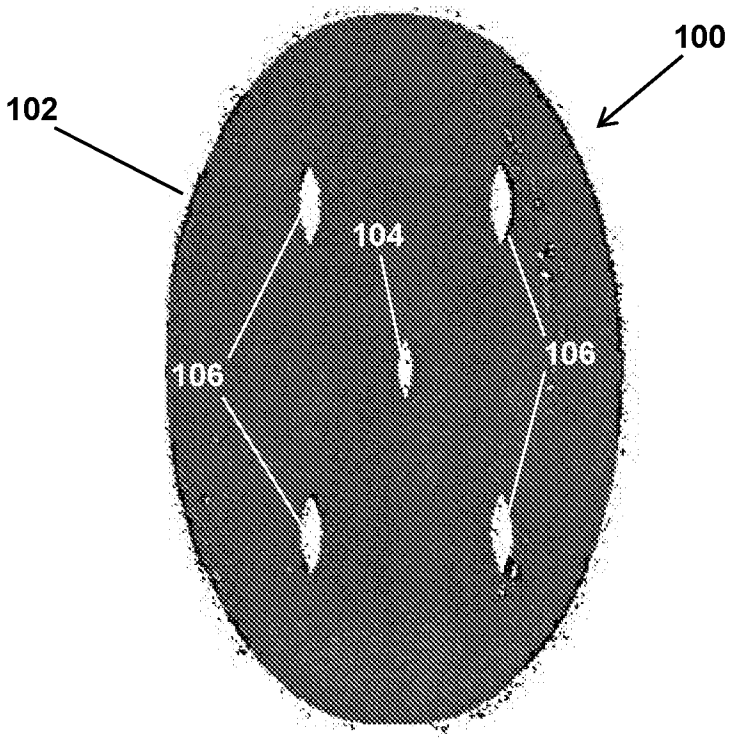


Figure 4

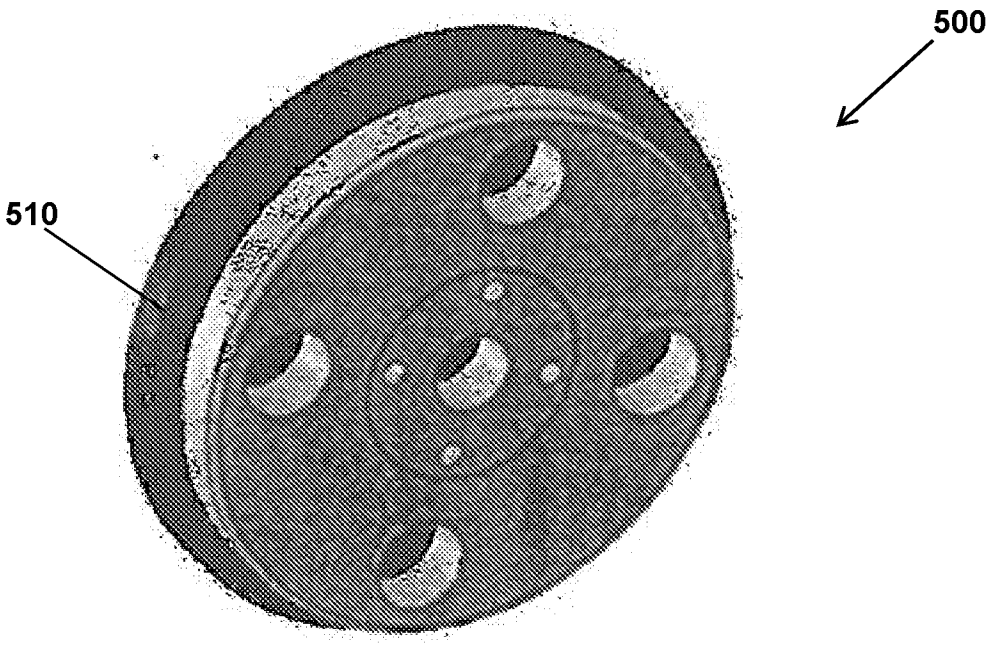


Figure 5

Figure 6A

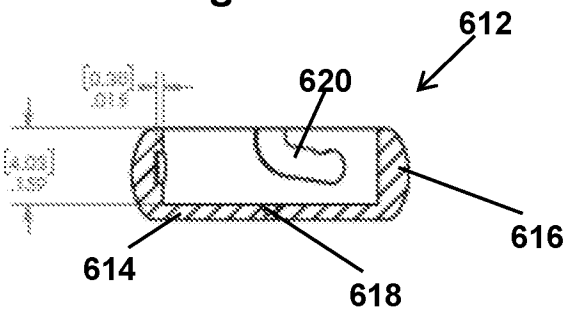
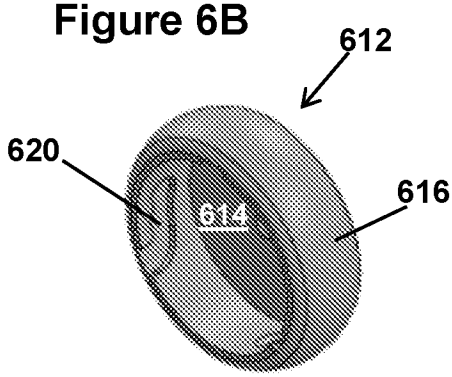


Figure 6B



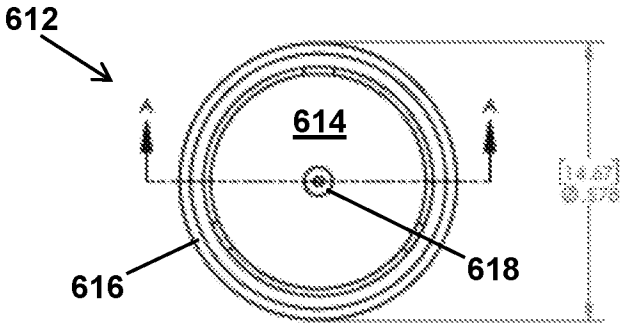


Figure 6C

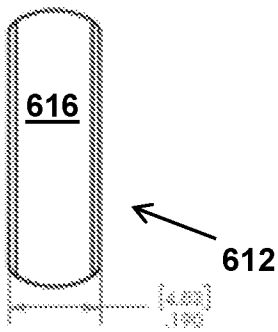
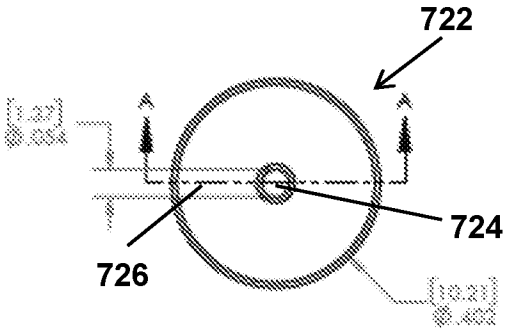


Figure 6D

Figure 7A



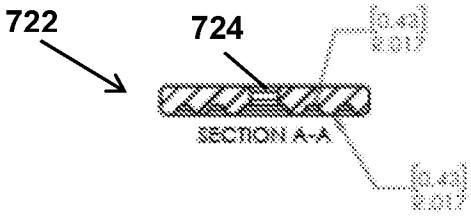


Figure 7B

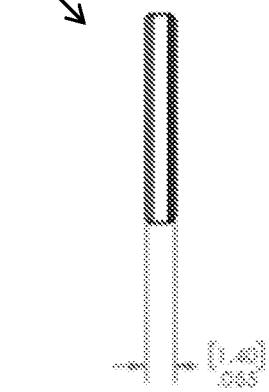


Figure 7C

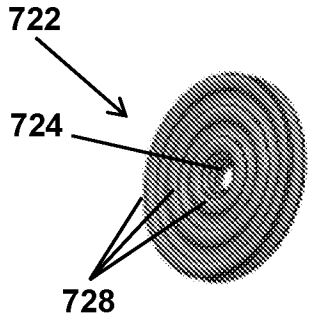


Figure 7D

Figure 8A

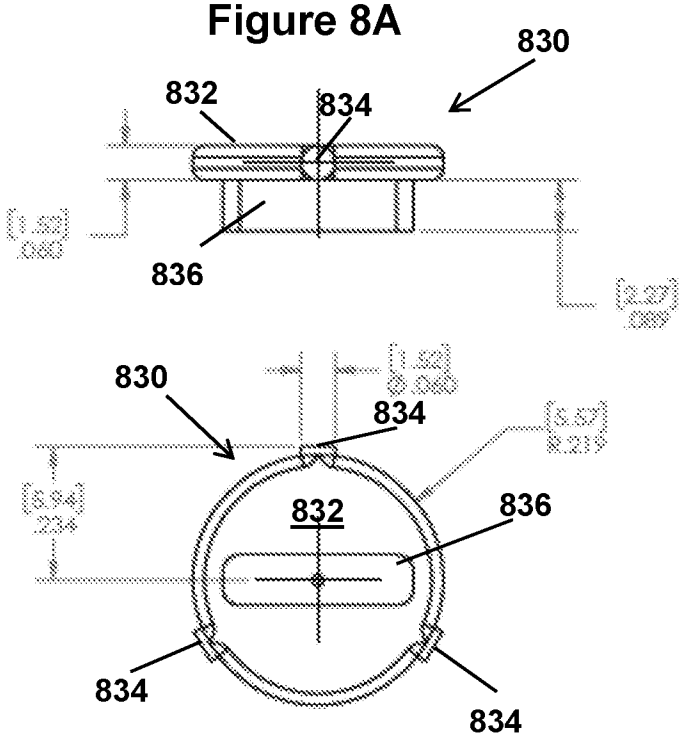


Figure 8B

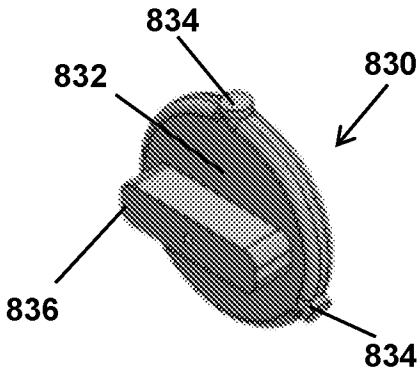


Figure 8C

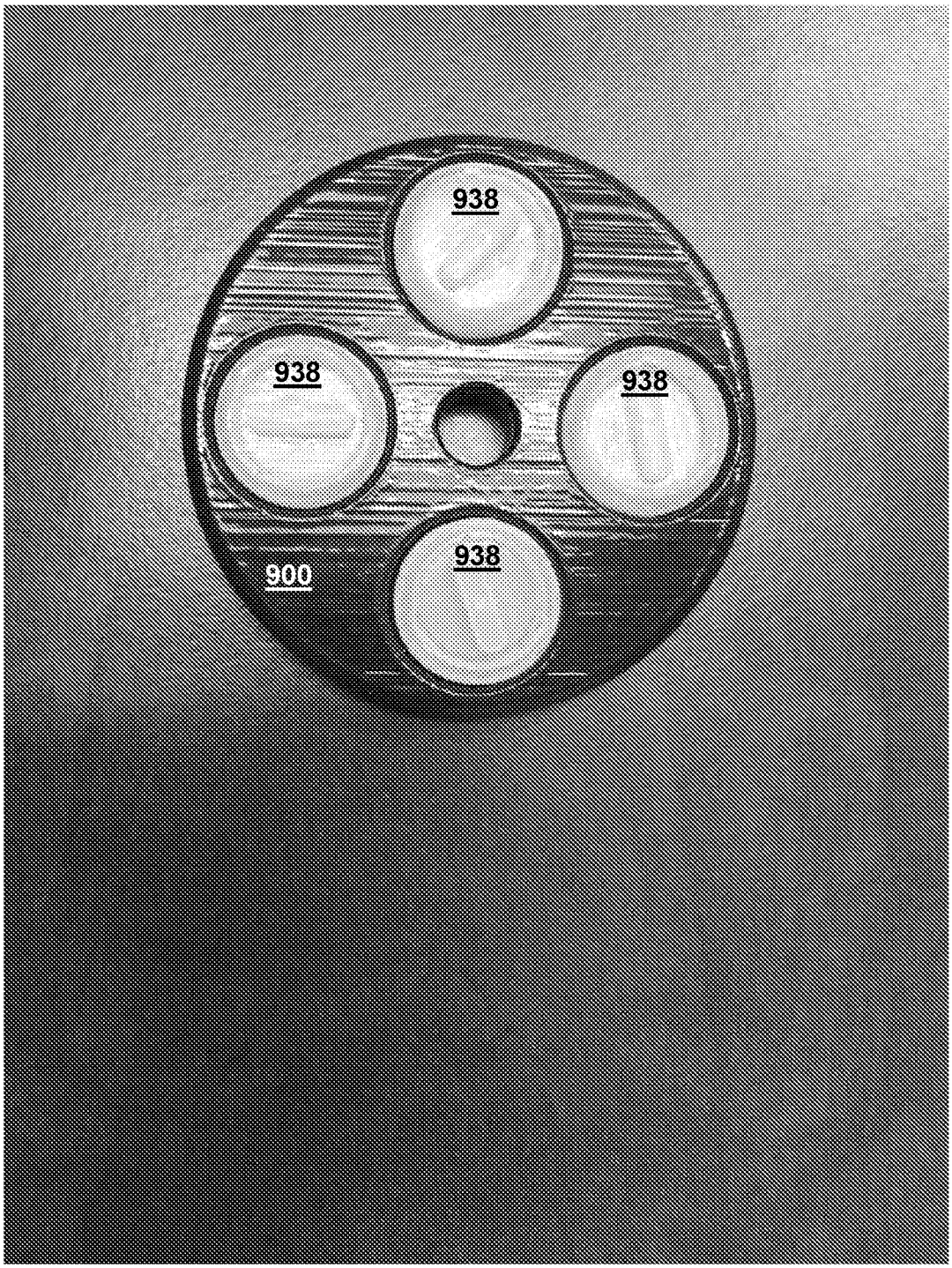


Figure 9

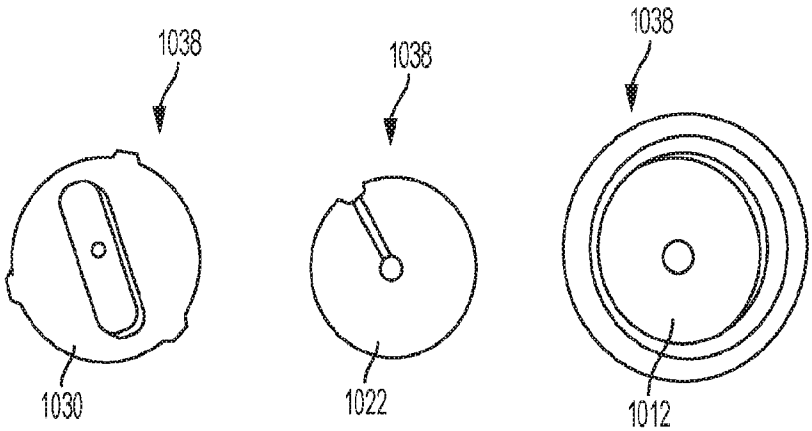


FIG. 10

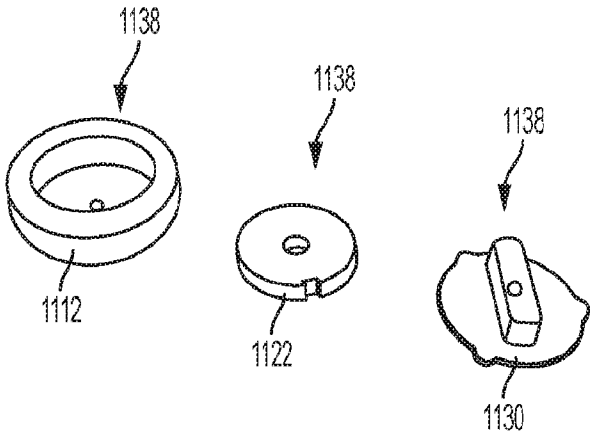


FIG. 11

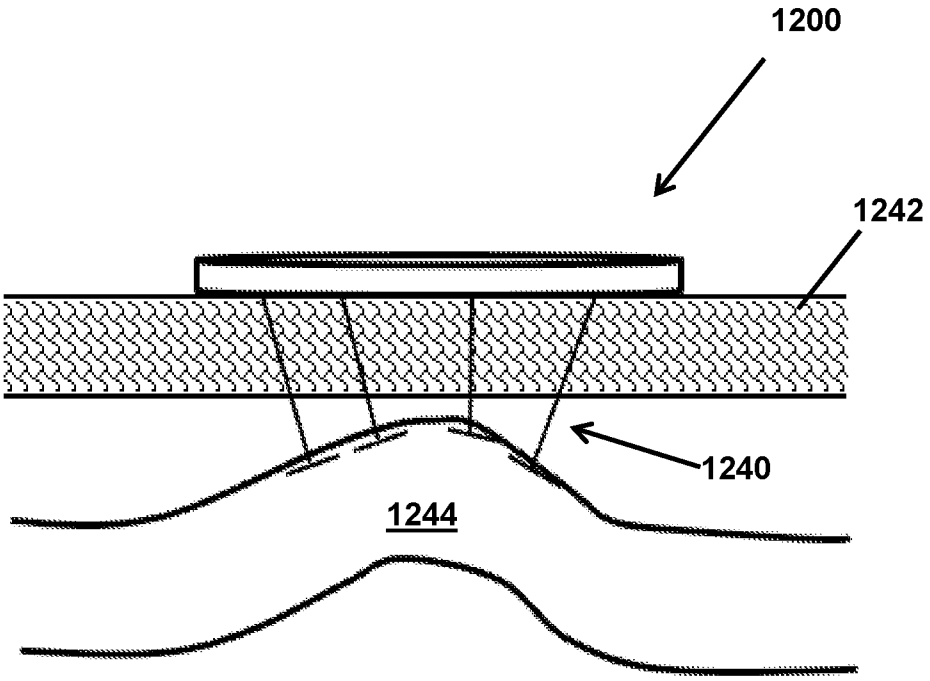


Figure 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/055006

A. CLASSIFICATION OF SUBJECT MATTER

A61J 15/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61J 15/00; A61M 25/02; A61F 13/00; A61M 1/00; A61B 17/068; A61L 17/00; A61B 17/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: abdominal, tube, feeding, holder, T shape, fastener, graphene, filament, suture, disc, surgical, secure, retainer, gastric, catheter, anchor, gastrointestinal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0807450 A1 (REDMOND, A. D.) 19 November 1997 See column 2, line 55 - column 3, line 52; claims 1-10; figures 1-3.	1-10,12,13
A		11,14-21
A	US 2008-0319397 A1 (MACALUSO, I.) 25 December 2008 See the whole document.	1-21
A	US 6765122 B1 (STOUT, C. K.) 20 July 2004 See the whole document.	1-21
A	US 8814902 B2 (BONUTTI, P. M.) 26 August 2014 See the whole document.	1-21
A	US 8323316 B2 (MAIORINO, N. et al.) 04 December 2012 See the whole document.	1-21

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

☒ See patent family annex.

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

Date of the actual completion of the international search	Date of mailing of the international search report
12 January 2018 (12.01.2018)	**12 January 2018 (12.01.2018)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
Kim, Yeonkyung
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/055006

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 22-25
because they relate to subject matter not required to be searched by this Authority, namely:
Claims 22-25 pertain to a method for treatment of the human body by surgery and thus relate to a subject matter which this International Searching Authority is not required, under PCT Article 17(2)(a)(i) and PCT Rule 39.1(iv), to search.

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/055006

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