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Description

Introduction

[0001] The invention relates to an implant and a system for the treatment of perianal fistulas.

[0002] A perianal fistula is an artificial tunnel that, in the majority of cases, develops from an infection that begins within a blocked anal gland. If the infection cannot be cleared from the anal gland an abscess forms and the infection burrows through the sphincteric muscles and exits at the buttocks integument. Patients experience pain associated with the tract and associated abscesses and suffer faecal and blood discharge from the fistula tract. Perianal fistulas may also result from gastrointestinal diseases such as Crohn's disease, ulcerative colitis, colorectal cancers and their associated treatment and complications due to rectal fissures and trauma.

[0003] The global incidence of perianal fistula is 2 per 10,000 population. Over 100,000 fistula procedures are performed between the United States and Western Europe each year. Thirty percent of the procedures performed are reoperations due to treatment failure contributing to a significant preventable cost to the healthcare systems.

[0004] Given the inadequate treatment options and poor surgical outcomes there is a defined clinical need for a more effective perianal treatment device.

[0005] There is currently no single "gold standard" technique that a surgeon can perform to effectively cure a perianal fistula and not render the patient incontinent. A common fistula treatment is a fistulotomy procedure. A fistulotomy involves the dissection of the sphincteric muscles and the laying open of the fistula tract. Fistulotomies have a relatively high cure rate, however, this procedure results in a high risk of faecal incontinence.

[0006] From a patient's point of view, many are happy to assume the risk of incontinence in order to resolve the painful fistula tract. However, this is obviously not an ideal treatment pathway and for many patient population groups the secondary outcome is far from acceptable.

[0007] Another commonly used fistula treatment methodology is the use of a seton. Setons are used as a sphincter sparing technique and is simply a suture or vascular strap that is passed through the tract of the fistula and the rectum and tied in a loop. The seton maintains tract patency allowing the infection in the fistula tract to drain, help the tract constrict in length and may cure the tract. If the tract is not cured by the seton the physician can perform a fistulotomy. This approach of trying to preserve the sphincter with setons has been used for over 2500 years and is still the preferred method used by surgeons today.

[0008] In an effort to provide a non-destructive perianal fistula treatment various glues and plugs have been developed and introduced to colorectal surgeons in the past 20 years. However, these techniques are not very successful and their use is not widespread. Such glues which

are injected into the fistula tract generally become brittle and are not able to occlude the tract for a long enough period to fully heal, faeces re-enter the tract resulting in abscess formation and refistulisation. Physicians often attempt to treat perianal fistulas with glues and plugs even though there may only be a 10 percent chance of effectiveness because it is a sphincter sparing technique and they can always resort to a seton and eventual fistulotomy if all fails.

[0009] Attempts have also been made to use plugs to occlude perianal fistula tracts. For example, US2005/004926A describes a plug-like fistula closure device with an attached flexible application string which also serves to evacuate liquids out of a fistula. However, generally the plugs fail because they become extruded from the tract, allowing faeces to enter the tract resulting in reinfection, abscess formation and refistulisation.

[0010] WO2007/090150 (Cook) describes medical graft products, systems, and methods for treating fistulae.

[0011] US2016/166380 (Medtronic) describes implants formed by a helically wound wire and methods of using same for the treatment of a mitral heart valve.

[0012] There is therefore a need for an improved method and device for the treatment of perianal fistulas.

Statements of Invention

[0013] According to the invention there is provided a fistula treatment device as set out in claim 1. The dependent claims 2 to 17 describe various optional aspects.

Brief Description of the Drawings

[0014] The invention will be more clearly understood from the following description of an embodiment thereof, given by way of example only, with reference to the accompanying drawings, in which Fig. 62-67 disclose implants and systems for treating a fistula according to the invention:

Fig. 1 is a cross-sectional view of an anatomy and disease state addressed by the invention;

Fig. 2 is a cross-sectional view of the treatment device of the invention being delivered through the fistula tract;

Fig. 3 is cross-sectional view of the device at a point of apposition to the mucosal surface at the site of the internal opening of the fistula tract;

Fig. 4 is cross-sectional view of the device partially delivered through the mucosal surface and into the sphincter muscle complex;

Fig. 5 is cross-sectional view of the device fully delivered into the sphincter muscle complex and de-

tached from the delivery mechanism;

Fig. 6 is a plan view illustrating the internal opening of a fistula tract at the mucosal surface;

Fig. 7 is a plan view illustrating the device located at the internal opening of a fistula tract in apposition with the mucosal surface;

Fig. 8 is a plan view illustrating the device partially delivered through the mucosal surface and beginning to gather tissue internally to the device resulting in narrowing of the fistula internal opening;

Fig. 9 is a plan view illustrating the device further delivered through the mucosal surface and into the sphincter muscle complex with further gathering of tissue internally to the device resulting in additional narrowing of the fistula internal opening;

Fig. 10 is a plan view illustrating the device completely delivered sub-mucosally and entirely into the sphincter muscle complex with tissue internal to the device resulting in complete closure of the fistula internal opening;

Fig. 11 is a front view of an embodiment of a perianal fistula treatment device;

Fig. 12 is a plan view of the device of Fig. 11;

Fig. 13 is a side view of the device of Fig. 11 and 12;

Fig. 14 is a front view of another fistula device with pointed tip;

Fig. 15 is a side view of the device of Fig. 14;

Fig. 16 is a plan view of the device of Figs. 14 and 15;

Fig. 17 is an isometric view of the device of Figs. 14 to 16;

Fig. 18 is an isometric view of a further fistula treatment device with pointed tip and centre feature;

Fig. 19 is a front view of the device of Fig. 18;

Fig. 20 is a side view of the device of Figs. 18 and 19;

Fig. 21 is a plan view of the device of Figs. 18 to 20;

Fig. 22 is an isometric view of a device with pointed tip and centre feature and seton;

Fig. 23 is an isometric view of a device with pointed tip and centre seton attachment feature with attached seton;

Fig. 24 is a cross-sectional view of a cross shape seton;

Fig. 25 is a cross-sectional view of an oval shape seton;

Fig. 26 is a cross-sectional view of a round shape seton;

Fig. 27 is a cross-sectional view of a round hollow shape seton;

Fig. 28 is an isometric view of a round hollow perforated embodiment of a seton;

Fig. 29 is a cross-sectional view of a hollow star shape seton;

Fig. 30 is a cross-sectional view of a star shape seton;

Fig. 31 is an isometric view of a star shape hollow perforated embodiment of a seton;

Fig. 32 is a cross-sectional view of a cross shape seton;

Fig. 33 is a cross-sectional view of a multi-braid embodiment of a seton;

Fig. 34 is an isometric view of an oval cross-section embodiment of the closure coil device;

Fig. 35 is an isometric view of a ribbon type tapered coil of a perianal fistula treatment device;

Fig. 36 is an isometric view of a triangular cross-section embodiment of a tapered coil;

Fig. 37 is an isometric view of a multi-faced cross-section embodiment of the tapered coil;

Fig. 38 is an isometric view of a hollow delivery mechanism of the tapered coil;

Fig. 39 is an isometric view of a solid coil to be delivered by the hollow delivery mechanism of Fig. 38;

Fig. 40 is an isometric view of the hollow delivery mechanism of Fig. 38 and the solid coil of Fig. 39 in place;

Fig. 41 is an isometric view of a solid core delivery mechanism with a hollow coil in place;

Fig. 42 is an isometric view of a rail support structure for delivering a mating coil;

Fig. 43 is an isometric view of a coil that mates with the support structure of Fig. 42;

Fig. 44 is an isometric view of the combination of a coil and rail type delivery mechanism;

Fig. 45 illustrates the component parts of the system;

Fig. 46 illustrates the delivery of the system through the fistula tract prior to deployment of the coil;

Fig. 47 illustrates the position of the coil prior to deployment;

Fig. 48 illustrates a ball type centre feature seton attachment mechanism;

Fig. 49 illustrates a hook type centre feature seton attachment mechanism;

Fig. 50 illustrates a cleat type centre feature seton attachment mechanism;

Fig. 51 illustrates a hollow type centre feature seton attachment mechanism;

Fig. 52 illustrates a hollow type centre feature seton attachment mechanism;

Fig. 53 illustrates a swage type centre feature seton attachment mechanism;

Fig. 54 illustrates a crimp type centre feature seton attachment mechanism;

Fig. 55 illustrates a thermal bond type centre feature seton attachment mechanism;

Fig. 56 illustrates a butt joint type centre feature seton attachment mechanism;

Fig. 57 is an isometric view of a coil with a partially straight section;

Fig. 58 and Fig. 59 are isometric views of a hollow coil delivery mechanism interfaced with a solid coil;

Fig. 60 and Fig. 61 are isometric views of a solid coil delivery mechanism interfaced with a hollow coil;

Fig. 62 and 63 are isometric views of another fistula treatment device according to the invention;

Fig. 64 and 65 are plan views of the device of Fig. 62;

Fig. 66 is an isometric view of a delivery coil for use with the fistula treatment device;

Fig. 67 is an isometric view of the delivery coil engaged with a fistula treatment device;

Fig. 68 is a view of a drainage seton;

Fig. 69 is a view of another drainage seton;

Fig. 70 is a view of a further drainage seton;

Fig. 71 is a view of another drainage seton;

Fig. 72 and 73 illustrate the fixing of a drainage seton into position in a tissue tract;

Fig. 74 and 75 are views of a stabilising device;

Fig. 76 is a diagram of a fistula treatment system;

Fig. 77 is a perspective view of a guide coil of the system;

Fig. 78 shows the system in a delivery configuration;

Fig. 79 illustrates an implant element in an activated configuration;

Fig. 80 is a diagram of a distal end of a delivery coil and an implant element having an anchor;

Fig. 81 shows the delivery coil in another configuration in which the anchor is exposed;

Figs. 82 and 83 illustrate another anchor;

Figs. 84 and 85 illustrate a further anchor;

Fig. 86 illustrates another guide and an implant element;

Fig. 87 illustrates deployment of the implant element of Fig. 86;

Figs. 88 and 89 show another guide and an implant element with a sharp distal tip;

Fig. 90 is a diagram of another implant;

Fig. 91 shows the implant of Fig. 90 in a deployed and activated configuration;

Fig. 92 is a diagram of a further fistula closure system in a delivery configuration;

Fig. 93 shows the implant element of Fig. 92 in an activated configuration;

Fig. 94 is a diagram of an implant delivery system;

Fig. 95 shows an implant being delivered from the delivery tube of Fig. 94;

Figs. 96 and 97 are views similar to Figs. 94 and 95 of another implant element;

Fig. 98 is an enlarged view of a delivery system for another implant;

Figs. 99 to 102 illustrate the deployment of another Implant element around a fistula; and

Figs. 103 and 104 are diagrams of a further fistula treatment system.

Detailed Description

[0015] The device is capable of one or more of the following:

- accommodating varied fistula tract physiology;
- occluding and sealing the internal opening of the tract;
- preventing faecal matter re-infecting the tract;
- preserving sphincteric function;
- enhancing fistula tract healing; and
- facilitating drainage during healing.

[0016] The perianal fistula treatment device ensures sparing of the sphincter, occluding of the fistula tract internal opening, and promotion of drainage and tissue healing.

[0017] The device consists of a head with anchoring and sealing mechanisms which is secured in the tissue tract and prevents re-infection of the wound. A tail section provides seton-like drainage and prevents re-abscessing due to premature closure of the skin site.

[0018] The anchoring and sealing mechanism of the device consists of a tapered coil. The coil geometry is designed to pull tissue together as it is deployed into the sphincter muscle complex, resulting in a strong anchor but also, importantly, an effective compressive seal preventing reinfection of the fistula tract and close tissue approximation to enhance tissue healing.

[0019] The perianal fistula treatment device preserves sphincteric and anatomical conditions and functions, prevents re-fistulisation, and improves healing time over the current treatment methods. The device consists of a tapered coil and a drainage seton. There may be a centering alignment feature. A delivery mechanism is also described. The coil may be led into the fistula tract by the drainage seton and centered into the tract by means of the centering feature. The larger diameter of the tapered coil is abutted against the tissue surface, surrounding the internal opening of the fistula tract with adequate margin. The delivery mechanism rotates the coil until it is just submucosal positioned. The coil closes the fistula internal opening by compressing the tract's surrounding tis-

sue inwardly such that the tissue is brought within close approximation creating a seal impermeable to foreign materials and promoting tissue growth across the closely approximated fistula tract. The drainage seton provides a conduit to drain any abscess and remaining or newly formed exudate and fluids from the fistula tract throughout the time of the healing process. The centering feature insures the coil device is placed easily into the fistula tract and the outer coil is placed within the adequate margins surrounding the fistula tract and acts as a securing mechanism for the drainage seton.

[0020] The following numerals are used in the drawings:

- | | |
|----|--|
| 15 | 1. Rectum |
| | 2. Anus |
| | 3. Internal Sphincter Muscle |
| | 4. External Sphincter Muscle |
| | 5. Dentate Line |
| 20 | 6. Fistula Tract |
| | 7. Internal Opening |
| | 8. External Opening |
| | 9. Anal Verge |
| | 10. Levator Ani Muscle |
| 25 | 11. Coil |
| | 12. Seton |
| | 13. Seton Distal End |
| | 14. Seton Attachment |
| | 15. Coil Distal Tip |
| 30 | 16. Delivery Mechanism Member |
| | 17. Delivery Mechanism Interface |
| | 18. Delivery Mechanism |
| | 19. Internal Opening Mucosal Surface |
| | 20. Mucosal Surface |
| 35 | 21. Internal Opening |
| | 22. Compressed Sphincter Muscle Tissue |
| | 23. Coil |
| | 24. First End |
| | 25. Second End |
| 40 | 26. Medial Portion |
| | 27. Coil Member |
| | 28. Pointed Tip |
| | 29. Delivery Mechanism Interface Feature |
| | 30. First End |
| 45 | 31. Second End |
| | 32. Coil Member |
| | 33. First End |
| | 34. Second End |
| | 35. Pointed Tip |
| 50 | 36. Centre Feature |
| | 37. Coil Member |
| | 38. Delivery Mechanism Interface Feature |
| | 39. Second End |
| | 40. Delivery Mechanism Interface Feature |
| 55 | 41. First end |
| | 42. Pointed Tip |
| | 43. Coil Member |
| | 44. Centre Seton Feature |

- 45. First End
- 46. Second End
- 47. Pointed Tip
- 48. Delivery Mechanism Interface Feature
- 49. Coil Member
- 50. Centre Feature
- 51. Seton Attachment Feature
- 52. Drainage Seton
- 53. Drainage Seton End
- 54. Cross Shape Seton Cross Section
- 55. Oval Seton Cross Section
- 56. Round Seton Cross Section
- 57. Outer Wall Hollow Round Seton Cross Section
- 58. Round Hollow Cross Section
- 59. Hollow Perforated Seton
- 60. First End
- 61. Second End
- 62. Hollow Centre Section
- 63. Perforation
- 64. Hollow Star Seton Cross Section
- 65. Solid Star Seton Cross Section
- 66. Hollow Perforated Star Seton
- 67. First End
- 68. Second End
- 69. Hollow Feature
- 70. Perforation
- 71. Cross Shape Seton Cross Section
- 72. Braided Seton Cross Section
- 73. Integument
- 200. Implant coil
- 201. Coil straight section
- 202. Coil tapered section
- 203. Transition from straight to tapered section
- 204. Hollow delivery assembly
- 205. Hollow delivery coil
- 206. Solid coil implant
- 207. Coil straight section
- 208. Coil tapered section
- 209. Interface
- 210. Solid delivery assembly
- 211. Hollow coil implant
- 212. Solid delivery coil
- 213. Coil straight section
- 214. Coil tapered section
- 220. Leading end
- 221. Trailing end

[0021] Fig. 1 illustrates an anal fistula tract 6, which is an abnormal connection between the rectum 1 and the integument of the buttocks 73. The internal opening 7 of the fistula is located at the mucosal surface 20 of the rectum 1. The fistula tract 6 may generally originate at the dentate line 5 and pass through the sphincteric muscle complex which consists of the internal sphincter muscle 3 and external sphincter muscle 4. The external opening 8 of the fistula tract 6 is located at the integument surface of the buttocks 73.

[0022] Fig. 2 shows the device consisting of a tapered

coil 11, drainage seton 13, and delivery mechanism 18 being drawn through the fistula tract by means of tension applied to second end of drainage seton 13.

[0023] The tapered coil 11 is brought into apposition to the mucosal tissue wall of the rectum 20 as shown in Fig. 3. The coil is centered on the internal opening of the fistula tract 7 at the dentate line 5 via tension applied to the second end 13 of the drainage seton 12 and the support of the bioabsorbable mechanism 18 interface 17.

[0024] The driver mechanism 17 delivers the coil 11 through the mucosal lining 20 of the rectum 1 via rotatory or other means (Fig. 4). The distal tip 15 of the coil 11 punctures through the mucosal lining surface 20 and engages initially with the internal sphincter muscle 3 surrounding the internal opening 7 of the fistula tract 6.

[0025] Fig. 45 illustrates the system component parts. The delivery mechanism interface feature 38 of the coil 11 is attached to the delivery mechanism member 16 of the delivery mechanism 18. The drainage seton 12 is attached to a coil centering feature 50 via the seton attachment feature 14.

[0026] Fig. 5 illustrates the coil 11 completely delivered through and past the mucosal surface 20 and into the sphincter complex consisting of the internal 3 and external 4 sphincter muscles. The delivery mechanism interface 17 located distally on the delivery mechanism member 16 detaches from the tapered coil 11 and the delivery mechanism 18 is removed from the surgical field.

[0027] The mechanism of action of the delivery of the tapered coil results in sphincter muscle complex tissue being drawn into the centre of the coil 11 construct. The mechanism of action is illustrated in Figs. 6 - 10.

[0028] Fig. 6 illustrates a plan view of an internal opening 21 of a fistula tract 6 located at the surface of the mucosal lining of the rectum 20 at the dentate line 5. Fig. 7 shows the closure coil 11 being brought into apposition to the mucosal surface 20 and being centred on the fistula tract 7 internal opening 21. As the closure coil 11 is delivered through the mucosal surface 20 and into the internal sphincter muscle 3 the sphincter muscle tissue begins to be gathered into the centre of the closure coil 11. Fig. 9 illustrates further delivery of the closure coil 11 resulting in an increased mass of sphincter muscle tissue being gathered internally in the coil. Fig. 10 illustrated complete delivery of the closure coil 11 entirely past the mucosal surface 20 and completely into the sphincter muscle complex including the internal 3 and external 4 sphincter muscles. The complete delivery of the coil 11 results in closure of the internal opening 21 of the fistula tract 6 by mechanism of gathering and compression of sphincter muscle tissue. This mechanism as described allows both the sphincter muscle tissue to knit together, and the mucosal surface to remodel to cover the site of delivery over a period of time, eventually resulting in complete resolution of the sphincter muscle defect associated with the internal opening of the fistula tract.

[0029] Referring to Figs. 11 to 13 there is illustrated a tapered coil 12 which has a leading end 24 and a trailing

end 25. The coil is in this case conical and decreases in lateral extent between the leading and trailing ends.

[0030] The implant is a coiled body structure. The leading end of the implant is the largest coil and initially surrounds the tissue defect with appropriate margin. As the implant is advanced the leading end provides a large surface area to effectively anchor the implant. Each subsequent coil provides (adds to) the anchoring and compression function. The smallest coil towards the trailing end provides the highest amount of tissue compression. As the implant is turned into the tissue each coil further compresses the captured tissue toward the centre of the tissue defect, thus effectively completely compressing the surrounding tissue inwardly. The close approximation of tissue allows for the tissue to heal together. This compression provides an effective seal against the pressures generated in the rectum and prevents entering of passing faeces into the fistula tract thus preventing re-infection. The smaller diameters of the implant coils retain the captured tissue from separating and prevents the breakdown of the healing process or foreign material from entering the tissue defect. This is a major advantage over sutures and suture based surgical techniques such as the advancement flap (dermal flap) and the LIFT procedures.

[0031] The compression ensures close approximation of tissue throughout the centre of the implant. At the most proximal surface the close approximation of tissue provides support to the healing mucosal lining of the rectum over the implant and tissue defect. Thus the healing tissue is fully supported by the implant during the healing process and is capable of surviving pressures of 150mmHg and upwards of 200mmHg which can be generated in the rectum.

[0032] The coil is delivered submucosal (at a predetermined depth) below the surface of the mucosa. This is to ensure that there is a full mucosal seal at the rectal mucosa surface to provide for a bacterial seal barrier. With the implant just below the surface the tissue is drawn inwards for complete compression and supports the mucosa healing process.

[0033] As the implant is turned into the tissue the compression becomes greater along the depth of the coil (progressive compression) and the length of the tract captured internal of the implant is compressed completely. This close approximation of tissue aids in the healing process.

[0034] Referring to Figs. 14 to 17 it will be noted that in this case the tapered coil 12 has a pointed tissue insertion tip 28. The coil 12 also has a delivery mechanism interface feature 29.

[0035] Figs. 18 to 21 illustrate another tapered coil 12 which also has a pointed tissue insertion tip 35 and a delivery mechanism interface feature 38. In this case the coil also has a centering feature 36. The centering feature 36 passes through the centre of the fistula tract and allows attachment of the drainage seton. The centering feature 36 allows centering of the coil in a concentric fashion to the fistula tract internal opening.

[0036] It will be appreciated that a coil device with a centering feature such as the centering feature 36 illustrated in Figs. 18 to 21, with or without an attached seton, may be used to close fistula openings that may commonly occur in other areas of the body, such as: biliary (created during gallbladder surgery, connecting bile ducts to the surface of the skin), cervical (either an abnormal opening into the cervix or in the neck), craniosinus (between the space inside the skull and a nasal sinus), enterovaginal (between the bowel and vagina), faecal or anal (the faeces is discharged through an opening other than the anus), gastric (from the stomach to the surface of the skin), metropertitoneal (between the uterus and peritoneal cavity), umbilical (between the navel and gut). These fistulas may be:- blind also known as a sinus (open on one end only, but connects to two structures); complete (has both external and internal openings); horseshoe (connecting the anus to the surface of the skin after going around the rectum); or incomplete (a tube from the skin that is closed on the inside and does not connect to any internal structure).

[0037] Fig. 22 illustrates a coil device with a centre seton feature 44. In this embodiment the coil, centre feature and drainage seton are constructed from a single continuous monolithic structure.

[0038] Fig. 23 illustrates a coil which has a centre feature 50 with a seton attachment feature 51 at the distal end. A drainage seton 52 is attached to the feature 50.

[0039] It will be appreciated that the tapered coil may be of any suitable shape in transverse cross section. Some examples are illustrated in Figs. 34 to 44. For example, the coil may be round, oval, triangular, multifaced or ribbon-like. In some cases the coil may be hollow.

[0040] The coil may be intended for subsequent removal or may be bioabsorbable.

[0041] Typical materials for the coil include

- Bioabsorbable magnesium (including MgFe and other magnesium alloys) would be a material of choice because it offers the strength of stainless steel and similar metals, yet is bioabsorbable. MgFe alloys are well studied and have been used in medical products.
- PLA) and PLGA (poly(lactic-co-glycolic acid)) are bioabsorbable polymers and would be a material of choice as they are commonly used bioabsorbable materials and have been well studied and used in medical products for over 70 years.
- The coil may also be constructed from other common materials used for suture applications

[0042] A bioabsorbable tapered coil would be beneficial to treatment of perianal fistulas due to the body's natural tendency to reject foreign materials.

[0043] The system of the invention also comprises a delivery device for the perianal fistula treatment device.

[0044] The delivery device may comprise a hollow element such as illustrated in Fig. 38 through which the

tapered coil is delivered. The hollow delivery element may comprise a coil. Fig. 39 illustrates a solid coil to be delivered by a hollow delivery element of Fig. 38 and Fig. 40 shows the hollow delivery element with the solid coil in place.

[0045] The system consists Fig. 40 of a hollow delivery element Fig. 38 that contains (houses) the implantable element Fig. 39. The implantable element Fig. 39 is housed in the delivery element Fig. 38 during the rotational delivery process. Once the delivery element Fig. 38 has reached the desired delivery position, it is uncoupled from the implantable element Fig. 39 and then rotated in the opposite direction of the direction of delivery (most commonly counter clockwise), leaving the implantable element Fig. 39 in place of the tissue bulk.

[0046] It will be appreciated that the system may be reversed with a hollow coil delivered over a solid delivery element.

[0047] In some cases the delivery device comprises a rail for the tapered coil. The rail and the coil may have interengagable features. Some examples are illustrated in Figs. 42 to 44.

[0048] The rail system Fig. 44 consists of an outer implantable coil element Fig. 42, and an inner support rail element Fig. 43. The two elements interlock. The system Fig. 44 is rotated (most commonly in a clockwise direction) to the desired tissue depth. Upon the system Fig. 44 reaching the desired tissue depth, the elements are uncoupled Fig. 42 and the inner support rail is reversed out of the tissue bulk by rotation opposite in direction to insertion (commonly counter clockwise), leaving behind the outer implantable coil element Fig. 42 in place surrounding, compressing and closing the fistula tract.

[0049] It will be appreciated that the system may be reversed with an inner implantable coil delivered over an outer support rail.

Ball attachment Figure 48:

[0050] The centre feature may have a ball feature along the shaft to aid in anchoring a seton that may be tied or looped around the centre feature. The ball provides a back stop where the knotted or looped seton will not detach from the centre feature.

Hook attachment Figure 49:

[0051] The centre feature may have a hook feature along the shaft to aid in anchoring a seton that may be tied or looped around the centre feature. The hook provides a back stop where the knotted or looped seton will not detach from the centre feature.

Cleat attachment Figure 50:

[0052] The centre feature may have a cleat feature along the shaft to aid in anchoring a seton that may be tied or looped around the waist of the cleat feature. The

cleat provides a back stop where the knotted or looped seton will not detach from the centre feature.

Internal to Centre feature Figure 51 and 52

[0053] The centre feature may be hollowed as in Figure 51 and the seton may be placed in the hollowed portion. It may be glued or heat staked as shown in Figure 52 or crimped as shown in Fig. 53.

Butt Joint Figure 54:

[0054] The seton may be attached by a butt joint as shown in Figure 55. The centre feature and seton are inserted into a tubular element with opposite ends facing each other as in Figure 55. The three components may be joined by heating, glue as shown in Fig. 55, or by crimping/swaging as shown in Fig. 54. The join may have multiple crimp points along the tubular element to securely attach the seton and centre feature.

Thermal bond Figure 56

[0055] The seton and centre feature may be thermally bonded / joined together as in Fig. 56, where both materials are made of a material with similar glass transition temperatures (Tg) and brought to their Tg and allowed to flow together creating a secure junction.

[0056] It will be appreciated that the embodiments of this system may also incorporate features such as previously described, including, but not limited to, a centre feature, a seton attachment feature, an integrated drainage seton and an integrated sharp tip located on the drive rail.

[0057] The seton 12 is used as a guidance and positioning mechanism and once the device is implanted serves as a means of fistula tract drainage. The seton 12 may be constructed of bioabsorbable materials, tissue healing enhancement properties, infection control agents and be constructed of part or composite of these materials.

[0058] After the fistula tract preparation, the seton 12 is attached using standard surgical technique to the existing surgical probe, suture, or seton already in place in the fistula tract. Once the seton 12 is attached, the system is pulled through the fistula tract proximally (towards the physician) until the coil device is adjacent to the tissue wall (rectal wall). The seton 12 ensures that the outer leading coil is centred around the outside of the fistula tract. Tension may be applied to the seton 12 as the coil is advanced into the tissue to aid in advancement and to maintain a centred position around the fistula tract.

[0059] The seton 12 is attached to the central portion of the coil 11. With the coil knitting together the sphincteric muscle and closing the fistula tract's internal opening the seton 12 maintains the proximal portion of the fistula tract's patency to facilitate drainage of any abscess, pus, and new accumulation of bodily fluids to prevent infection

occurrence. The seton 12 prevents the tract from closing in on itself proximal of any fluid accumulation and acts as a conduit allowing material drainage between the wall of the tract and the outer wall of the seton 12. The seton 12 may also have a central lumen with tangential drainage holes entering from the external wall of the seton 12. The seton 12 may be constructed with a multi surface external wall to create channels and optimize the fluid drainage and prevent the fistula tract wall from occluding drainage around the seton. The seton 12 may be constructed of part or all elements as described and illustrated in Figs. 24 to 33.

[0060] The seton 12 is constructed of materials that are strong enough to allow for surgical placement in the fistula tract. The seton 12 may be constructed of materials that are non-absorbable and meant to be removed at a later time. Alternatively, the seton 12 may be made of materials that bioabsorb throughout and upon completion of the fistula tract healing processes (examples include magnesium, PLA, PLGA). The seton 12 may be constructed of or include anti-infection agents to prevent infection of the fistula tract (silver ions, antibacterial agents). The seton 12 may be constructed of materials that aid in tissue growth (stem cell, collagen matrix). The seton 12 may be constructed of part or all elements as described.

[0061] The seton may be of any suitable shape in cross section such as round, oval, cross shape, star or braid as illustrated in Figs. 24 to 26 and Figs. 30, 32, 33. In all cases the seton may be hollow as illustrated in Figs. 27, 28, 29 and 31 to further enhance drainage. The seton may have peripheral holes as illustrated in Figs. 28 and 31 to provide for increased drainage effectivity. The holes allow additional surfaces of drainage, by increasing drainage surface area/channels the fluid drains more quickly and reduces the chance that any of the channels will become occluded and prevent fluid drainage at the same moment in time.

[0062] Fig. 46 illustrates the delivery of the system through the fistula tract prior to deployment of the coil. The seton, attached to the centre feature allows the coil to be drawn into apposition against the mucosal wall, and located concentric to the fistula tract internal opening.

[0063] Fig. 47 illustrates the position of the coil prior to deployment and demonstrates the effect of the centering feature in combination with the seton in positioning the coil concentrically around the fistula tract internal opening. (Dimensions 'x' being equal).

[0064] As noted above, one or other or both of the coil and seton may comprise bioabsorbable materials.

Typical materials for the coil include:

[0065]

- Bioabsorbable magnesium (including MgFe and other magnesium alloys) is one material of choice because it offers the strength of stainless steel and sim-

ilar metals, yet is bioabsorbable. MgFe alloys are well studied and have been used in medical products.

[0066] Synthetic bioabsorbable materials may include PLA and PLGA (poly (lactic-co-glycolic acid)) (PLGA, PCL, Polyorthoesters, Poly(dioxanone), Poly(anhydrides), Poly(trimethylene carbonate), Polyphosphazenes), and or natural bioabsorbable materials may include fibrin, collagen, chitosan, gelatin, Hyaluronan are bioabsorbable polymers and would be a material of choice as they are commonly used bioabsorbable materials and have been well studied and used in medical products for over 70 years.

[0067] For example, companies such as Ethicon market a number of such products with different absorption rates such as <http://www.ethicon.com/healthcare-professional/s/products1>. Absorbable polymer materials are also available from medical material companies such as Zeus, see <http://www.zeusinc.com/advanced-products/absorv-bioabsorbables>.

Typical materials for the seton include:

[0068]

- Bioabsorbable magnesium (including MgFe and other magnesium alloys) is one material of choice because it offers the strength of stainless steel and similar metals, yet is bioabsorbable. MgFe alloys are well studied and have been used in medical products.
- Synthetic bioabsorbable materials may include PLA and PLGA (poly(lactic-co-glycolic acid)) (PLGA, PCL, Polyorthoesters, Poly(dioxanone), Poly(anhydrides), Poly(trimethylene carbonate), Polyphosphazenes), and or natural bioabsorbable materials may include fibrin, collagen, chitosan, gelatin, Hyaluronan are bioabsorbable polymers and would be a material of choice as they are commonly used bioabsorbable materials and have been well studied and used in medical products for over 70 years.

[0069] In one case both the coil and the seton are bioabsorbable, and the seton degrades prior to the degradation of the coil. This may be achieved in a number of different ways, such as the seton being of a different bioabsorbable material to the coil.

[0070] For example the coil implant may be constructed of PLLA which degrades slowly, typically within 18 to 36 months depending on formulation, cross section, and surface modifications, and the Seton drain may be constructed of PLGA (85L/15G) which typically degrades "faster" in 1 to 2 months depending on formulation, cross section, and surface modifications

[0071] Another method of altering the time of degradation (degradation (absorption) properties) is by providing a reduced cross sectional area, more porosity, less

crystallinity, more reactive hydrolytic groups in the backbone, more hydrophilic end groups, and/or more hydrophilic backbone.

[0072] In one case, the seton begins to absorb 5 weeks post-surgical implantation. This is variable depending upon the healing time of the patient, with full healing usually occurring within a 5 to 10 week period. By way of example the coil implant may remain for a period of at least 10 weeks after healing and may degrade over a 6 to 18 month time period from the date of implantation.

[0073] Advantageously, the closure mechanism of the device is maintained during the entire healing process. In some cases the coil remains in situ to withstand rectal pressures and maintain closure of internal tract opening for at least 10 weeks to prevent re-opening of the tract.

[0074] The coil implant may remain in place longer to allow full healing of the internal opening of the fistula tract. The seton drain may degrade at a faster rate compared to the coil implant so long as the seton drain is in place for a long enough time for all remaining abscess and infection, to drain from the fistula tract and any side branches. It is advantageous that the seton drain absorbs faster than the coil so that the patient does not have any visually remnant feature of the device or thoughts of fistula. The seton is not needed for as long a period as the coil implant, with the seton drain absorbing faster than the implant, the patient will not have to return to the surgeon for removal during the internal opening healing process.

[0075] Also, the implant remains in place for a long enough period of time (e.g. greater than 1 week) to allow remodelling of the defect in the mucosa and formation of a mucosal layer. This mucosal layer acts as a bacterial seal preventing reinfection of the tract from entering of fascies. The re-formation of the muscular layer in conjunction with the sphincter muscle closure mechanism prevents fascies entering the tract.

[0076] The implant coil and draining seton may be doped or loaded with healing and antimicrobial agents (such as stem cell, silver ions, silver particles, antibiotics, antibacterial agents and the like).

[0077] The seton may be of differential bioabsorption wherein the seton is absorbed at a different rate along its length.

[0078] The seton may be of differential bioabsorption wherein the distal portion of the drain absorbs more quickly than the proximal portion. This differential absorption of the seton results in the seton remaining attached to the coil via the proximate portion until fully absorbed. Advantageously, this allows for the external opening to close and remove the chance of the seton being pulled out through the external opening.

[0079] The seton may also be of differential bioabsorption wherein the proximal portion of the seton absorbs more quickly - in this case the anchoring mechanism of the closure device with relation to the seton could be broken at an earlier time than the full seton absorption allowing the seton to be removed (by the patient or doctor

or naturally fall out) through the external opening.

[0080] In both differential absorption embodiments, the entire seton would have to remain in place for full healing (and drainage) time of the tract (e.g. 10 weeks).

[0081] The bioabsorbable materials used in the construction of the implant coil, or drainage seton, or both, can be both natural or synthetic polymers such as those listed below.

10 Natural polymers

[0082]

- Fibrin
- Collagen
- Chitosan
- Gelatin
- Hyaluronan

Synthetic polymers

[0083]

- PLA, PGA, PLGA, PCL, Polyorthoesters
- Poly(dioxanone)
- Poly(anhydrides)
- Poly(trimethylene carbonate)
- Polyphosphazenes

[0084] The selection of the material used can be made whilst taking the following factors into account.

Factors that accelerate polymer degradation:

[0085]

- More hydrophilic backbone.
- More hydrophilic endgroups.
- More reactive hydrolytic groups in the backbone.
- Less crystallinity.
- More porosity.
- Smaller device size.

[0086] The implant coil of the invention may be delivered by a number of techniques. In one case the coil is delivered by a coil delivery mechanism. In this case, the implant coil may have an interface region for interfacing with the delivery mechanism.

[0087] A perianal fistula treatment device may comprise an implant coil having a tapered portion which is configured for insertion into bulk tissue surrounding a fistula. The implant coil may have a driver interface portion which is configured for engagement with a driver implement for rotation of the coil to draw tissue surrounding a

fistula inwardly. The advantages of such an implant coil are:

- Ability to be delivered deep into the sphincter muscle complex allowing for greater anchoring and sphincter muscle apposition at the muscle defect
- Ability to disengage from the delivery mechanism in a spiral nature, allowing reversing of the delivery mechanism through the same tract as delivery preventing further damage to the tissue
- Prevents the mucosa of the rectum being pulled down towards the sphincter muscle complex
- Ability to be delivered through and past the anoderm resulting in lower pain due to interference with the nerve endings of the anoderm
- Prevention of bacterial tracking by delivering deep sub mucosally allowing a new mucosal lining to form at the fistula internal opening

[0088] One such implant coil 200 is illustrated in Fig. 57 and comprises a tapered section 202 and a driver interface portion which in this case is provided by straight coil section 201 which has a substantially uniform lateral extent along a length thereof. The implant coil 200 has a leading end 220, a transition region 203 and a trailing end 221. The tapered portion 202 of the coil extends from the leading end 220 to the transition region 203 and the driver interface portion 201 extends from the transition region 203 to the trailing end 221. It will be noted that, as described in other embodiments, the tapered portion of the coil decreases in lateral extent between the leading end 220 and the transition region 203. The leading end 220 may have a pointed tissue insertion tip as illustrated, for example, in Figs. 14 to 17.

[0089] The implant is a coiled body structure. The leading end of the implant is the largest coil and initially surrounds the tissue defect with appropriate margin. As the implant is advanced the leading end provides a large surface area to effectively anchor the implant. Each subsequent coil provides (adds to) the anchoring and compression function. The smallest coil towards the trailing end provides the highest amount of tissue compression. As the implant is turned into the tissue each coil further compresses the captured tissue toward the centre of the tissue defect, thus effectively completely compressing the surrounding tissue inwardly. The close approximation of tissue allows for the tissue to heal together. This compression provides an effective seal against the pressures generated in the rectum and prevents entering of passing faeces into the fistula tract thus preventing re-infection. The smaller diameters of the implant coils retain the captured tissue from separating and prevents the breakdown of the healing process or foreign material from entering the tissue defect. This is a major advantage over sutures and suture based surgical techniques such as the advancement flap (dermal flap) and the LIFT procedures.

[0090] The compression ensures close approximation of tissue throughout the centre of the implant. At the most

proximal surface the close approximation of tissue provides support to the healing mucosal lining of the rectum over the implant and tissue defect. Thus the healing tissue is fully supported by the implant during the healing process and is capable of surviving pressures of 150mmHg and upwards of 200mmHg which can be generated in the rectum.

[0091] The coil is delivered submucosal (at a predetermined depth) below the surface of the mucosa. This ensures that there is a full mucosal seal at the rectal mucosa surface to provide for a bacterial seal barrier. With the implant just below the surface the tissue is drawn inwards for complete compression and supports the mucosa healing process.

[0092] As the implant is turned into the tissue the compression becomes greater along the depth of the coil (progressive compression) and the length of the tract captured internal of the implant is compressed completely. This close approximation of tissue aids in the healing process.

[0093] In this and other embodiments the implant body is in the form of an open tapered coil body (for example, without a cross bar or other centering feature) in which the leading edge, (into the muscle) is of a larger diameter than the trailing edge, (rectum surface). The trailing portion is of smaller diameter than the leading portion. The coil is of open form, therefore there is no inward protrusion at either the proximal nor distal end of the body. This open form factor enables the implant to be driven into the tissue body to a pre-determined depth (depending on the taper) which results in progressive tissue compression.

[0094] At least the driver interface portion of the implant coil is solid and in some cases all of the implant coil is solid. Alternatively, as described above and below, the implant coil or at least part thereof may be hollow.

[0095] In this embodiment, preferably the treatment device also includes a seton of the type described above. In some cases the seton is not mounted or attached to the implant coil during delivery but may be attached so as to extend from the coil when the coil is in situ. In some cases the seton may be embedded in the sphincter muscle complex and lead so that the end of the seton protrudes through the external opening of the fistula tract.

[0096] The implant is delivered using any suitable delivery device as described. In one case the delivery device comprises a driver implement which interfaces with the implant coil and is used to rotate the coil to draw tissue surrounding a fistula inwardly. The driver implement preferably interfaces with the driver interface of the implant coil.

[0097] In some cases the driver implement comprises a driver coil which is configured for engagement with the driver interface of the implant coil. The driver coil may have a substantially uniform lateral extent along a length thereof for engagement with the corresponding driver interface portion of the implant coil.

[0098] In one embodiment as illustrated in Figs. 58 and

59 a driver coil 205 is hollow for interfacing with the interface portion 201 of the implant coil.

[0099] Figs. 58 and 59 illustrate an assembly 204 in which a solid implant coil 206 is delivered by a straight hollow delivery coil 205. The coil implant 206 has a straight profile section 207 and a tapered section 208. The straight profile section 207 fits within the internal channel of the delivery coil 205 up to the interface 209, whereby the hollow coil 205 is rotated which in turn rotates the implant coil 206 for delivery.

[0100] The hollow sections of the delivery coil in all cases may comprise a single turn, multiple turns or part thereof or the entire construct.

[0101] Figs. 60 and 61 illustrate an assembly 210 in which a hollow implant coil 211 is delivered by a straight solid delivery coil 212. The coil implant 211 has a straight profile section 213 and a tapered section 214. The straight solid delivery coil 212 fits within the internal channel of the hollow coil implant 211 up to the interface 215, whereby the solid delivery coil 212 is rotated which in turn rotates the hollow coil implant 211 for delivery.

[0102] The straight sections of the coil in all cases may comprise a single turn, multiple turns or part thereof.

[0103] The hollow sections of the implant coil in all cases may comprise a single turn, multiple turns or part thereof or the entire construct.

[0104] The delivery system has the following advantages:

- Ability to follow the tract of the implant coil allowing deep delivery to the sphincter muscle complex allowing for greater anchoring and sphincter muscle apposition at the muscle defect
- Ability to disengage and retract in a spiral nature, reversing through the same tract as delivery preventing further damage to the tissue
- Prevents the mucosa of the rectum being pulled down towards the sphincter muscle complex
- Enables the implant to be delivered through and past the anoderm resulting in lower pain due to interference with the nerve endings of the anoderm
- Prevention of bacterial tracking by delivering deep sub mucosally

[0105] These delivery mechanisms may be coupled to a manually operated, trigger operated user interface or similar.

[0106] In current techniques for treating a fistula a surgeon identifies the external opening of the fistula tract and carefully inserts a probe through the external opening, through the fistula tract and through the internal opening of the fistula. The probe is then extended back through the rectum and a localisation seton or suture is attached to the end of the probe which is then drawn back through the rectum and the fistula tract until it exits through the external opening of the fistula tract. The localisation seton loop is then tied off.

[0107] The implant and delivery system of the invention

is compatible with this known current technique. In the invention the probe or the localisation seton may be used to guide the leading end of the implant coil and/or the drainage seton.

[0108] The implant body in some cases is in the form of an "open" tapered coil body in which the distal edge (leading edge, into the muscle) is of a larger diameter than the proximal edge (trailing edge, rectum surface), the proximal portion is of smaller diameter than the distal portion. The coil is of open form, therefore there is no inward protrusion at either the proximal nor distal end of the body. The open form factor enables the implant to be driven into the tissue body to a pre-determined depth (depending on the taper which results in progressive tissue compression).

[0109] The open coil design allows for the mucosal layer to heal over the top of the implant, and the implant supports the healing of the mucosal layer, by preventing the pressure from opening the tract, and compromise freshly healed mucosa layer. With the implant below the mucosa it does not interfere with external rectal surface and interact with faeces that may drag the implant out of its purchase or lend to tract infection along its body. Thus, the implant is suitable for submucosal delivery which facilitates the formation of a continuous mucosal surface over the site of implantation.

[0110] The implant in some cases has anti-movement (anti-rewind) features to prevent the rotational movement of the implant in the counter-clockwise motion. Typically, the implant is driven into the tissue body in a clockwise motion consistent with the usual direction of driving fixation medical devices. However, it will be appreciated that the implant may also be driven into the tissue in the counter clock-wise direction. The anti-rewind features facilitate the forward driving motion into the tissue body in a clock-wise motion to be effortless during delivery but provide resistance to prevent the implant from working itself out or unwinding during the course of natural wound healing and normal physiological forces experienced day to day of the patient's life.

[0111] The anti-rewind features may include one or more of:

- Positive feature such as a barb, fishhook, arrowhead or the like (such as features 302 of the implant illustrated in Figs 62 to 65). Such positive barb type features may be added in the X, Y, or Z plane to enhance the fixation of the implant;
- Negative features such as trough features along the body of the implant, such trough features may be one or more of a square trough, a lead in trough, and/or a square back trough;
- V-Lock type, quills may be incorporated along the body of the implant. The quills may be shaped to facilitate ease of entry into tissue but does not allow the implant to move in the opposite direction. The

quill may lay flat upon insertion and then become exposed if moved in the opposite direction. A multiple of such quills increases the surface area (friction) of the implant body and prevents the implant from re-winding;

- Surface modification/surface area enhancing. The surface of the implant body may be modified to increase the surface area to increase the friction interaction between the implant and the tissue it is implanted in.

- Surface roughening mechanical:
May include sandblasting, micro stamping (impression on material)
- Surface treatment chemical:

May include soaking (being exposed to) in a chemical agent that roughens the implant body surface

May include chemical photo etching

- Surface treatment in manufacturing process:
The tooling of a moulded implant design may have positive features that when the implant is removed from the mould, rough features are left on the body of the implant
- Surface "pillar" like gecko feet (Setae) Biomimicry:

[0112] As described above, a driver coil may be used to insert the implant. The driver coil (such as the coil 404 illustrated in Fig 66) may have advantageous pitch 402 and diameter 403 dimensions to minimise tissue binding during the delivery of the implant coil.

[0113] In addition, the driver coil surface 405 may be constructed so as to have a lubricious nature (e.g. by means of a coating or surface treatment or other) in order to minimise the torque requirement associated with the tissue friction during delivery of the implant coil and during retraction of the delivery coil.

[0114] The coiled section of the delivery coil may include features to temporarily lock or fasten to the implant prior to and during implant delivery. This provides a positive interface between the implant and the delivery mechanism, to prevent premature implant detachment and related delivery issues.

[0115] When the implant has been delivered to the correct location and depth the delivery mechanism detaches / disengages from the implant and is removed from the anatomy.

[0116] The driver coil may have an interface to the implant which allows positive (interlocking) when the driver coil is turned in a clockwise direction and negative (i.e. disengagement) interaction when the driver coil is turned in an anti-clockwise direction (or vice versa). Thus when the implant has been delivered to the tissue by means of a clockwise driver coil motion, the driver coil may then

turn in an anti-clockwise direction, disengage from the implant, and exit (or 'back out') from the tissue.

[0117] The implant may be attached to the delivery coil by a mechanism that prevents the implant becoming dislodged from the delivery coil prior to complete delivery. Thus, the implant coil is prevented from prematurely detaching from delivery coil.

[0118] The internal support structure of the implant coil may have a positive feature (peak) that locks into a negative (valley) feature on the implant. There may be several features of this type to enhance the locking grip.

[0119] The inverse of this arrangement may also be implemented in which a positive feature is provided on the implant and a negative feature is a part of the driving mechanism.

[0120] Alternatively or additionally, the implant may be attached to the internal opening of the implant driver by friction / interference fit / surface roughness. The driver coil may be hollow and accept a solid implant or the driver may be solid and inserted into the hollow portion of the implant.

[0121] The cross section of the driver coil may be a channel or slot rather than closed circular. A coil with such a cross section may be more easily manufacturable. It may also allow the incorporation of internal (to the driver coil) locking features to interface with the implant.

[0122] The implant is interfaced to the driving mechanism such as a driver coil. In one case the interface comprises a flare or step that abuts against the driving mechanism. One such flare or step 301 is illustrated in Figs 62 to 65. Such a flare provides the push point of the implant and transfer of force to drive the implant into the tissue body.

[0123] The flare may also act as a barb or anti-rewind feature allowing only one way (e.g. clockwise) motion which in one case is forward motion (clockwise motion driven into the tissue body) and prevents the implant from moving in a backwards motion (unwinding/counter clockwise).

[0124] Such a barb feature may be achieved by having the flare surface area greater than the driving coil interface surface area.

[0125] The flare may be positioned anywhere along the implant body that is optimal for the implant driving force, driver attachment coupling, and/or anti motion control (anti-rewind can be clockwise or anti clockwise).

[0126] It will be appreciated that as an alternative to such locking features on the implant coil similar features may be provided on the engagement surfaces of the delivery coil.

[0127] The implant is in some cases in the form of a coiled body structure. The distal end of the implant is the largest coil, and the distal end initially surrounds the tissue defect with appropriate margin. As the implant is advanced the distal portion provides a large surface area to effectively anchor the implant (each subsequent coil provides (adds to) the anchoring and compression function). The smallest proximal coil provides the highest

amount of tissue compression. As the implant is turned into the tissue each coil further compresses the captured tissue toward the centre of the tissue defect, thus effectively completely compressing the surrounding tissue inwardly. The close approximation of tissue allows for the tissue to heal together. This compression provides an effective seal against the pressures generated in the rectum and prevents entering of passing faeces into the fistula tract thus preventing re-infection. The smaller diameters of the implant coils retain the captured tissue from separating and prevents the breakdown of the healing process or foreign material from entering the tissue defect. This is the advantage over sutures and suture based surgical techniques such as the advancement flap (dermal flap) and the LIFT procedures.

[0128] The compression ensures close approximation of tissue throughout the centre of the implant. At the most proximal surface the close approximation of tissue provides support to the healing mucosal lining of the rectum over the implant and tissue defect. Thus the healing tissue is fully supported by the implant during the healing process and is capable of surviving pressures of 150mmHg and upwards of 200mmHg which are generated in the rectum.

[0129] Preferably, the coil is delivered submucosal (at a predetermined depth) below the surface of the mucosa. This ensures there is a full mucosal seal at the rectal mucosa surface to provide for a bacterial seal barrier. With the implant just below the surface the tissue is drawn inwards for complete compression and supports the mucosa healing process.

[0130] As the implant is turned into the tissue the compression becomes greater along the depth of the coil (progressive compression) and the length of the tract captured internal of the implant is compressed completely, the close approximation of tissue aids in the healing process.

[0131] The implant and delivery system is compatible with current surgical technique.

[0132] Upon completion of the surgeon preparing the tissue tract, the device drain is attached to the rectal end of the fistula probe or seton/suture that was used to localize the tract.

[0133] The probe /seton is pulled toward the surgeon through the fistula tract out of the external opening until the large distal portion of the implant is abutted against the rectal wall. The Implant coil is aligned to be concentric to the internal tract opening.

[0134] The device drain is tied to the fistula probe or localization seton.

[0135] In one embodiment the drain seton runs distal of the implant and through the length of the handle and may be anchored in the proximal portion of the drive shaft or handle.

[0136] At the interface of the implant and driver a cutting mechanism (such as a snip, guillotine or the like) may be provided to automatically cut the drainage seton once the implant is delivered. The handle/delivery system

may then be readily removed from the surgical field.

[0137] In another embodiment the drain seton is locked to the handle/driver mechanism during implantation (delivery of implant) to maintain traction. Once the implant is fully implanted the handle is decoupled (automatically or manually) from the drain seton. The excess drain seton material may be trimmed at the external surface of the closed tissue tract site at the surface of the rectum.

[0138] Referring to Figs 72 and 73, a seton 905 is held in a fixed position along the length of the tissue tract 901 due to the compression at the internal opening 902. The implant opening 903 compresses the tissue opening 904 around (onto) the drain seton 905, locking it into place. The drain seton may have a specialty designed / located compression zone and may have corresponding features to facilitate the anchoring of the seton in this zone 906.

[0139] The drain is fixed in place due to the compression forces of the internal tissue tract being compressed inwardly by the radial forces applied by the implant.

[0140] To further enhance fixation of the drain seton and prevent the drain seton from moving out of the tract distally or proximally the drain seton may be constructed with locking features 906 along the entire length, partial length, and defined/predetermined compression zone at the site of the implant tissue compression, or any combination of these.

[0141] Referring to Fig. 68, knots 501 may be implemented along the length of the drain seton 502 or at a specific location such as that of the implant compression zone.

[0142] Referring to Fig. 69, spheres, cylinders, triangles and other multifaceted shapes 602 may be provided such as by moulded over along the length of the drain seton 601 or at a specific location such as that of the implant compression zone.

[0143] Referring to Fig. 70, enhance the anchoring of the drain seton barbs 703, 704 may be incorporated along the length of a drain seton 702 or at a specific location such as that of the implant compression zone. The barbs may face in both the external 703 and internal opening directions 704 to prevent motion in either direction.

[0144] To enhance the anchoring of the drain seton quills such as 801, 802, 804 (Fig. 71) may be incorporated along the length of the drain seton 803 or at a specific location such as that of the implant compression zone. The quills may face in both the external 802 and internal opening direction 801 to prevent motion in either direction.

[0145] The drain seton maybe be constructed to act purely as a drain and/or as a scaffold to enhance tissue healing.

[0146] To provide enhanced drainage, the seton may have a plurality of peripheral holes and may include (pores). The shape of the seton in cross section may be selected from one or more of round, oval, star and cross. The drain/seton is constructed to be bioabsorbable.

[0147] An example of potential materials include: PLA and PLGA (poly(lactic-co-glycolic acid)) (PLGA, PCL,

Polyorthoesters, Poly(dioxanone), Poly(anhydrides), Poly(trimethylene carbonate), Polyphosphazenes), and or natural bioabsorbable materials may include fibrin, collagen, chitosan, gelatin, Hyaluronan are bioabsorbable polymers and would be a material of choice as they are commonly used bioabsorbable materials.

[0148] The shape is designed to enhance the drainage of the residual tract. The shape may also act as a scaffold to improve/enhance the healing of the tract.

[0149] The plurality of peripheral holes / pores enhance drainage of the tract to prevent the drain/seton from blockage.

[0150] To enhance scaffolding, the plurality of peripheral holes / pores may serve as a structure of a scaffold that enhances tissue integration and improves wound healing of the tract.

[0151] A variety of materials may be used as a tissue scaffold that enhance and improve tissue wound healing. Many of these materials are bioabsorbable polymers or natural tissue materials. An example of potential materials include: PLA and PLGA (poly(lactic-co-glycolic acid)) (PLGA, PCL, Polyorthoesters, Poly(dioxanone), Poly(anhydrides), Poly(trimethylene carbonate), Polyphosphazenes), and or natural bioabsorbable materials may include fibrin, collagen, chitosan, gelatin, Hyaluronan are bioabsorbable polymers and would be a material of choice as they are commonly used bioabsorbable materials.

[0152] The invention also provides a mechanism to stabilise the tissue during the delivery of the implant to prevent bunching and twisting of the mucosal layer during delivery of the implant. By preventing such tissue interaction, the delivery forces may be reduced and a more reliable and repeatable depth of delivery may be achieved.

[0153] One mechanism of stabilising the mucosal tissue is achieved by utilising a hollow 'trumpet, cone, shield or pyramid' type element that is attached to the delivery mechanism and surrounds the undelivered implant. One such stabiliser 952 is illustrated in Figs. 74 and 75.

[0154] The 'trumpet' interfaces onto the surface of the mucosal lining and may stabilise the tissue prior to and during the delivery of the implant using one or more of the following mechanisms:

- Pressure - the trumpet may be spring loaded (953) or otherwise to apply pressure to the mucosal surface. The pressure may be manual force from the user's application of the delivery mechanism while abutting to the mucosal surface
- Spike type features. The surface of the trumpet that interfaces to the mucosal surface (954) may contain features that penetrate into the mucosal surface and hence prevent rotation or twisting of the mucosal lining. These features may be in the form of:
 - Needles
 - Microneedles

- Micro-spikes (951)
- Castellated features (similar to the features of a rook in a chess set)

- 5 - The features may be incorporated into the trumpet by means of:

- Overmoulding
- Injection moulding
- 10 ◦ Press fit

- Surface treatment

- 15 ◦ Rubberised surface
- Surface modification
- Surface roughening (sand blasting etc.).

[0155] Referring to Figs. 76 to 79 there is illustrated a system comprising a guide or driver 1101 which in this case is in the form of a coil, and an implant element 1102. In this case the guide coil 1101 is hollow and is made of a rigid material and contains the implantable element 1102. The implantable element 1102 may be made of a malleable material and may also be bioabsorbable. The guide coil 1101 has a sharp tip 1103 to facilitate penetration into tissue. The sharp tip 1103 may be solely part of the guide 1101, or a part of the guide 1101 and implantable element 1102 or solely the implantable element 1102.

[0156] The guide coil 1101 has a distal diameter that is larger than the tissue defect such that, in use, the guide 1101 surrounds the internal opening of the fistula track Fig. 78. The guide coil 1101 is driven into the tissue, surrounding the internal opening of the fistula tract 1104 to a depth to below the tissue mucosa 1105 to capture the appropriate amount of sphincter muscle tissue. Once at depth, the guide 1101 is unwound from the tissue leaving the implantable element 1102 anchored in the tissue and surrounding the fistula tract (Fig. 79).

[0157] With the guide 1101 removed from the tissue and the implantable element 1102 anchored in the tissue, the implantable element 1102 is activated in this case by pulling in the direction of the arrow 1106. The implant 1102 is anchored distally in the tissue and collapses and compresses the tissue tract closed (like a purse string or boa constrictor snake) Fig. 79.

[0158] The guide coil 1101 may be a straight or tapered coil. The coil may be hollow or a rail type support or an internal support (such as a removable wire internal to a hollow implant element).

[0159] The implant element 1102 may be anchored in various ways. A single, (or multiple), barb 1107 or locking feature may be located at the distal end of the implant element 1102. The barb(s) 1107 allow the implant element 1102 to penetrate the tissue in one direction Fig. 80, but when pulled in the opposite direction the barbs 1107 catch and lock the implant in place Fig. 81.

[0160] The anchor can be an "umbrella shape" or "par-

achute" shape element 1108 that is attached to the distal end of the implant element 1102. The "parachute" is initially stowed during delivery (Fig. 82) and is unfurled upon the driver element's extraction (Fig. 83). The large surface area of the parachute 1109 captures the tissue at the point of anchorage, locking the implant element 1102 in place.

[0161] Multiples of small "hair" like filaments 1110 may be provided along a length of the distal surface covering the full circumference, specific quadrants, and or intermittently covering the distal surface of the implant element 1102. This quill-like configuration increases the surface area of the distal end and anchors the implant element 1102 in the tissue. The bristles or quills 1110 are initially collapsed/compressed when stowed in the driver guide (Fig. 84). When the guide is removed from the tissue the bristles are exposed and lock into the surrounding tissue (Fig. 85).

[0162] In some cases the implant element 1102 does not have an anchor. In this case the implant element 1102 may be positioned by a pusher 1111 during removal of the guide mechanism after delivery to the desired location (Fig. 87).

[0163] The implantable element 1102 may be at least partially bioabsorbable. The element may comprise a suture which is anchored distally into tissue. When the guide 1101 is removed, the suture can be pulled proximally and will then cinch the tract closed, similar to a purse string.

[0164] The implant element can be made of a shape memory material such as Nitinol or a shape memory polymer. It can be active (requires a stimulus such as electrical, mechanical, light, magnetism or the like) or passive (heat set).

[0165] The implant element 1102 may be stowed in the guide element 1101 for delivery into the tissue. Once the guide/driver element reaches the desired depth, the guide element is unwound from the tissue. As the guide is unwound from the tissue the anchored implant is no longer supported by the guide and the exposed portion(s) of the implant is free to compress the tissue tract. The passive shape set implantable element compresses the tissue tract as the guide element 1101 is unwound from the tissue. The implantable element 1102 may be preset in shape before stowage in the guide element 1101. For example, a Nitinol coil is shape set into the compressed state and is then inserted into the guide 1101.

[0166] The implantable element 1102 may be stowed in the driver/guide element 1101 for delivery into the tissue. Once the guide element reaches the appropriate depth the guide 1101 is unwound from the tissue leaving the implant element 1102 anchored in tissue. With the guide element 1101 removed from the tissue the implantable element 1102 is then activated by any suitable means such as heat, light, electrical signal, changing the state of the implantable element and activating the implantable element to be transformed to the compression state, thus compressing the tissue tract closed. The patient's body heat may passively activate the implant ele-

ment to transform to the compressive state.

[0167] A sharp tip may be provided at the distal tip to penetrate into the tissue as the guide/delivery mechanism is advanced into the tissue.

[0168] In one configuration the distal tip and leading edge of the coil guide/driver element 1101 has a sharp tip that facilitates the penetration of tissue upon insertion and during advancement throughout the tissue Fig. 76, 1103. The implant element 1102 can pass through the sharp tip when correctly located in the tissue.

[0169] In another configuration (Fig. 88) the implant element may have a sharp tip 1112 at the distal end that facilitates the penetration of tissue upon insertion and during advancement throughout the tissue

[0170] A sharp tip in some cases may be incorporated into both the driver element and the implant element.

[0171] In some cases the implant element is an activatable element which may have a collapsed delivery configuration, a deployed configuration, and an activated configuration. The activatable implant element in some cases is an expansile element such as a balloon.

[0172] Figs. 90 and 91 illustrate a coiled balloon 1201 used for closing the internal opening of a fistula tract. The balloon 1201 is delivered in a coiled manner around the fistula tract 1104 (Fig. 90).

[0173] The balloon 1201 may be mounted in a rail of memory alloy or similar which assists in forming the spiral balloon shape, on deployment.

[0174] In one embodiment the balloon 1201 forms a straight coiled structure after delivery around the fistula tract.

[0175] In another embodiment the balloon 1201 forms a tapered coiled structure after delivery whereby the larger coil of the balloon is positioned deeper in the tissue than the narrow end.

[0176] The balloon 1201 may be delivered using a hollow delivery coil which locates the balloon in place. The balloon is then pushed out of the delivery coil and left in place.

[0177] Once in place, the balloon 1201 is inflated with saline, or other liquid or gas 1203 (Fig. 91). The effect of inflation is to compress the tissue surrounding the fistula tract 1202 thereby closing the internal opening of the fistula tract. This compression provides an effective seal against the pressures generated in the rectum and prevents passing faeces entering into the fistula tract, thus preventing re-infection.

[0178] The balloon may be comprised of a bioabsorbable material or similar. After a period of time corresponding to the healing of the fistula tract, the balloon material may degrade to a sufficient extent that the fluid with which it is filled (e.g. saline) is exposed to the tissue and is also absorbed. In time the entire balloon is absorbed.

[0179] The delivery mechanism may have a sharp tip to facilitate progression through the tissue.

[0180] The balloon may be dragged behind a coiled solid needle type delivery mechanism and detached to deploy the balloon.

[0181] In another embodiment the balloon is made from a non-bioabsorbable material, and is removed at an appropriate time frame post healing of the fistula tract.

[0182] The pressure to which the balloon is inflated may be variable. The balloon may be inflated to a pressure that corresponds to sufficient closing of the tract opening thereby overcoming the variability in delivery, anatomy and tract diameter.

[0183] A programmable electronic controller may be used to automatically inflate the balloon to the appropriate pressure.

[0184] Alternatively an analog or digital pressure gauge may be provided to indicate the balloon pressure to the clinician.

[0185] The activatable compressive element (balloon) may similarly be formed from a foam, pre formed structure (e.g. Nitinol cage or stent-like structure), or collapsible coil or other similar structure.

[0186] Referring to Figs. 92 and 93 the implant element 1301 can be made from a shape memory material (Nitinol, shape memory polymer composite) activated by heat, light, electrical current or other energy source.

[0187] Once the implant element 1301 is delivered to the desired depth by an appropriate delivery/guide element 1302 (Fig. 92) the implant 1301 is activated by heat, light, electrical signal or other method, changing the state of the implant 1301 and activating the implant to be transformed to the compression state, thus compressing the tissue tract closed 1303 (Fig. 93). The patient's body heat may passively activate the implant to transform to the compressive state.

[0188] A compression coil may be delivered by placing a delivery tube 1401 a specified distance from the internal opening of the tissue tract (Fig. 94). Inside the tube an implant element 1402 is stowed. The delivery tube is inserted to the desired depth and the implant coil is forced out of the tube. As the implant coil exits the tube opening (Fig. 95) the successive diameters of the coil surround the tissue tract and compress the tissue resulting in closure of the tract.

[0189] In another embodiment (Figs. 96, 97) each additional coil of the implant element 1403 is smaller in diameter aiding in compressing the tract and achieving closure.

[0190] The coil can be made of a shape memory material. It is delivered as a straight coil and upon activation it compress the tissue tract.

[0191] In another method, the implant material is not shape set and not of a shape memory material but is formed by a die built into the delivery tube (Fig. 98). As the coil exits the delivery tube and passes through the die 1404 the implant coil is formed on demand. The coils produced surround the tissue tract and compress the tract.

[0192] Referring to Figs. 99 to 102 the implant element 1406 may also be delivered through a delivery mechanism 1405 located at the mucosal surface resulting in a 'winding' around the fistula tract tending to create a com-

pression zone 1407 and resulting in closure of the tract. The implant may be preformed in a straight or tapered configuration. The implant element may have a sharp tip 1408 to facilitate progression through the tissue.

[0193] In some cases the implant may comprise a plurality of elements 1500. One such implant is illustrated in Figs. 103 and 104. The multiple elements be delivered individually surrounding the fistula tract.

[0194] Each element may be preformed, or formed on delivery, or be activatable as previously described. The elements may be the same size in the preformed, or activated state. Alternatively the leading element may be larger in diameter and the following elements progressively smaller.

[0195] The clinician may determine the number of elements to deploy to attain adequate closure of the tract.

[0196] The device is capable of one or more of the following:

- accommodating varied fistula tract physiology;
- occluding and sealing the internal opening of the tract;
- preventing faecal matter re-infecting the tract;
- preserving sphincteric function;
- enhancing fistula tract healing; and
- facilitating drainage during healing.

[0197] The perianal fistula treatment device ensures sparing of the sphincter, occluding of the fistula tract internal opening, and promotion of drainage and tissue healing.

[0198] The anchoring and sealing mechanism of the device may consist of a tapered coil. The coil geometry is designed to pull tissue together as it is deployed into the sphincter muscle complex, resulting in a strong anchor but also, importantly, an effective compressive seal preventing reinfection of the fistula tract and close tissue approximation to enhance tissue healing.

[0199] The perianal fistula treatment device preserves sphincteric and anatomical conditions and functions, prevents re-fistulisation, and improves healing time over the current treatment methods. The implant closes the fistula internal opening by compressing the tract's surrounding tissue inwardly such that the tissue is brought within close approximation creating a seal impermeable to foreign materials and promoting tissue growth across the closely approximated fistula tract.

[0200] A drain may be used to provide a conduit to drain any abscess and remaining or newly formed exudate and fluids from the fistula tract throughout the time of the healing process. Such a drain or seton may be any of those described above.

[0201] The implant may be of any suitable shape in transverse cross section. For example, the implant cross-section may be round, oval, triangular, multifaced or rib-bon-like. In some cases the implant may be hollow.

[0202] The implant may be intended for subsequent removal or may be bioabsorbable.

[0203] Typical materials for the implant include

- Bioabsorbable magnesium (including MgFe and other magnesium alloys) would be a material of choice because it offers the strength of stainless steel and similar metals, yet is bioabsorbable. MgFe alloys are well studied and have been used in medical products. 5
- PLA) and PLGA (poly(lactic-co-glycolic acid)) are bioabsorbable polymers and would be a material of choice as they are commonly used bioabsorbable materials and have been well studied and used in medical products for over 70 years. 10
- The implant may also be constructed from other common materials used for suture applications 15

[0204] A bioabsorbable implant would be beneficial to treatment of perianal fistulas due to the body's natural tendency to reject foreign materials.

[0205] The closure implant of the device may be maintained during the entire healing process. In some cases the implant remains in situ to withstand rectal pressures and maintain closure of internal tract opening for at least 10 weeks to prevent re-opening of the tract. 20

[0206] The implant may remain in place longer to allow full healing of the internal opening of the fistula tract. 25

[0207] The implant remains in place for a long enough period of time (e.g. greater than 1 week) to allow remodelling of the defect in the mucosa and formation of a mucosal layer. This mucosal layer acts as a bacterial seal preventing reinfection of the tract from entering of fascies. The re-formation of the muscular layer in conjunction with the sphincter muscle closure mechanism prevents fascies entering the tract. 30

[0208] The implant may be doped or loaded with healing and antimicrobial agents (such as stem cell, silver ions, silver particles, antibiotics, antibacterial agents and the like). 35

[0209] Modifications and additions can be made to the embodiments of the invention disclosed without departing from the scope of the invention defined by the claims. For example, while the embodiments described herein refer to particular features, the invention includes embodiments having different combinations of features within the scope of the claims. The invention also includes embodiments that do not include all of the specific features described. 40

[0210] The invention is not limited to the embodiments hereinbefore described, which may be varied in construction and detail within the scope of the claims. 45

Claims

1. An implant for treating a fistula, comprising: 55

a shaft having a proximal end, a distal end, characterized in that, the shaft comprises:

a plurality of coil loops; and
a plurality of barbs (302) positioned on the shaft, wherein each of the plurality of barbs (302) is located distally of a proximal-most coil loop of the plurality of coil loops; and in that the coil loops form a helical coil having a tapered portion.

2. The implant of claim 1, wherein the shaft further includes a non-tapered portion.

3. The implant of claim 2, wherein each of the plurality of barbs (302) is located distally of the non-tapered portion, preferably wherein the non-tapered portion extends along a minority of a length of the shaft between the proximal end and the distal end.

4. The implant of any of claims 1 to 3, wherein each of the plurality of barbs (302) is a preformed, positive, anti-rotation feature. 20

5. A system for treating a fistula, comprising an implant of any preceding claim, wherein:

the implant extends between the proximal end and the distal end, the plurality of barbs (302) of the implant forms an anti-rewind feature; the system further comprises a driver coil (404) extending between a proximal end and a distal end; and
in a first configuration, a portion of the driver coil (404) is engaged with a portion of the implant, and in a second configuration, the section of the driver coil is disengaged from the portion of the implant. 35

6. The system of claim 5 wherein the driver coil and the helical coil of the implant have a common pitch.

7. The system of claim 5 or claim 6, wherein the implant includes a channel extending along a surface of at least some of plurality of coil loops. 40

8. The system of any of claims 5 to 7, wherein the implant further includes a non-tapered portion. 45

9. The system of any of claims 5 to 8, wherein the implant further includes a driving abutment (301) located along the non-tapered portion.

10. The system of claim 8 or claim 9, wherein the non-tapered portion extends along a minority of a length of the implant between the proximal end and the distal end of the implant. 50

11. The system of any of claims 5 to 10, wherein, in the first configuration, one of the section of the driver coil (404) and the portion of the implant is received within

the other of the section of the driver coil (404) and the portion of the implant, preferably wherein the portion of the implant is the non-tapered portion.

12. The system of any of claims 5 to 11, further including a drainage member having a deployed configuration in which the drainage member is fixed relative to at least one of the implant or the driver coil. 5
13. A system of any of claims 5 to 12 and comprising a tissue stabilising device (952) which is adapted for stabilising tissue (954) for delivery of the implant. 10
14. A system as claimed in claim 13 wherein the stabilising device comprises a hollow element (952) which is adapted to surround the implant prior to delivery. 15
15. A system as claimed in claim 14 wherein the hollow element is adapted to apply pressure to tissue, the hollow element may be spring biased (953). 20
16. A system as claimed in claim 14 or claim 15 wherein a leading surface of the hollow element is configured for interaction with a mucosal surface. 25
17. A system as claimed in any of claims 14 to 16 wherein the hollow element comprises features (951) for penetration of a mucosal surface. 30

Patentansprüche

1. Implantat zur Behandlung einer Fistel, das Folgendes umfasst:

einen Schaft, der ein proximales Ende, ein distales Ende aufweist,
dadurch gekennzeichnet, dass der Schaft Folgendes umfasst:

eine Vielzahl von Spiralschleifen; und
eine Vielzahl von Widerhaken (302), die an dem Schaft positioniert sind, wobei sich jeder der Vielzahl von Widerhaken (302) distal von einer proximalsten Spiralschleife der Vielzahl von Spiralschleifen befindet; und
dadurch, dass
die Spiralschleifen eine helikale Spirale bilden, die einen konischen Teil aufweist. 45
2. Implantat nach Anspruch 1, wobei der Schaft weiter einen nicht-konischen Teil einschließt. 50
3. Implantat nach Anspruch 2, wobei sich jeder der Vielzahl von Widerhaken (302) distal von dem nicht-konischen Teil befindet, bevorzugt wobei sich der nicht-konische Teil entlang einer Minderheit einer Länge des Schafts zwischen dem proximalen Ende und 55

dem distalen Ende erstreckt.

4. Implantat nach einem der Ansprüche 1 bis 3, wobei jeder der Vielzahl von Widerhaken (302) ein vorgeformtes, positives Drehblockierungsmerkmal ist.
5. System zur Behandlung einer Fistel, das ein Implantat nach einem vorstehenden Anspruch umfasst, wobei:

sich das Implantat zwischen dem proximalen Ende und dem distalen Ende erstreckt, wobei die Vielzahl von Widerhaken (302) des Implantats ein Rückdrehblockierungsmerkmal bildet; das System weiter eine Antriebsspirale (404) umfasst, die sich zwischen einem proximalen Ende und einem distalen Ende erstreckt; und in einer ersten Konfiguration ein Teil der Antriebsspirale (404) in einen Teil des Implantats eingreift und in einer zweiten Konfiguration der Abschnitt der Antriebsspirale von dem Teil des Implantats gelöst wird.
6. System nach Anspruch 5, wobei die Antriebsspirale und die helikale Spirale des Implantats eine gemeinsame Steigung aufweisen.
7. System nach Anspruch 5 oder Anspruch 6, wobei das Implantat einen Kanal einschließt, der sich entlang einer Oberfläche von zumindest einigen der Vielzahl von Spiralschleifen erstreckt.
8. System nach einem der Ansprüche 5 bis 7, wobei das Implantat weiter einen nicht-konischen Teil einschließt. 35
9. System nach einem der Ansprüche 5 bis 8, wobei das Implantat weiter einen Antriebsanschlag (301) einschließt, der sich entlang des nicht-konischen Teils befindet. 40
10. System nach Anspruch 8 oder Anspruch 9, wobei sich der nicht-konische Teil entlang einer Minderheit einer Länge des Implantats zwischen dem proximalen Ende und dem distalen Ende des Implantats erstreckt. 45
11. System nach einem der Ansprüche 5 bis 10, wobei in der ersten Konfiguration eines des Abschnitts der Antriebsspirale (404) und des Teils des Implantats innerhalb des anderen des Abschnitts der Antriebsspirale (404) und des Teils des Implantats aufgenommen wird, bevorzugt wobei der Teil des Implantats der nicht-konische Teil ist. 50
12. System nach einem der Ansprüche 5 bis 11, das weiter ein Drainageelement einschließt, das eine eingesetzte Konfiguration aufweist, in der das Drainageelement zwischen dem proximalen Ende und dem distalen Ende des Implantats erstreckt.

nageelement in Bezug auf zumindest eines des Implantats oder der Antriebsspirale fixiert ist.

13. System nach einem der Ansprüche 5 bis 12 und das eine Gewebestabilisierungsvorrichtung (952) umfasst, die zur Stabilisierung von Gewebe (954) für die Abgabe des Implantats geeignet ist. 5
14. System nach Anspruch 13, wobei die Stabilisierungsvorrichtung ein hohles Element (952) umfasst, das zur Umfassung des Implantats vor der Abgabe geeignet ist. 10
15. System nach Anspruch 14, wobei das hohle Element zur Ausübung von Druck auf Gewebe geeignet ist, wobei das hohle Element federvorgespannt (953) sein kann. 15
16. System nach Anspruch 14 oder Anspruch 15, wobei eine vordere Oberfläche des hohlen Elements zur Wechselwirkung mit einer Schleimhautoberfläche konfiguriert ist. 20
17. System nach einem der Ansprüche 14 bis 16, wobei das hohle Element Merkmale (951) zur Durchdringung einer Schleimhautoberfläche umfasst. 25

Revendications

1. Implant destiné à traiter une fistule, comprenant : 30
 - un arbre ayant une extrémité proximale, une extrémité distale,
 - caractérisé en ce que**, l'arbre comprend : 35
 - une pluralité de boucles de bobine ; et
 - une pluralité de picots (302) positionnés sur l'arbre, dans lequel chacun de la pluralité de picots (302) est situé de manière distale par rapport à une boucle de bobine la plus proximale de la pluralité de boucles de bobine ; et **en ce que** 40
 - les boucles de bobines forment une bobine hélicoïdale ayant une partie effilée. 45
2. Implant selon la revendication 1, dans lequel l'arbre inclut en outre une partie non effilée.
3. Implant selon la revendication 2, dans lequel chacun de la pluralité de picots (302) est situé de manière distale par rapport à la partie non effilée, préférablement dans lequel la partie non effilée s'étend le long d'une minorité d'une longueur de l'arbre entre l'extrémité proximale et l'extrémité distale. 50
4. Implant selon l'une quelconque des revendications 1 à 3, dans lequel chacun de la pluralité de picots 55

(302) est un élément anti-rotation, positif, préformé.

5. Système de traitement de fistule, comprenant un implant selon l'une quelconque des revendications précédentes, dans lequel :
 - l'implant s'étend entre l'extrémité proximale et l'extrémité distale, la pluralité de picots (302) de l'implant forme un élément anti-rembobinage ; le système comprend en outre une bobine de commande (404) s'étendant entre une extrémité proximale et une extrémité distale ; et dans une première configuration, une partie de la bobine de commande (404) est entrée en prise avec une partie de l'implant, et dans une deuxième configuration, la section de la bobine de commande est sortie de prise avec la partie de l'implant.
6. Système selon la revendication 5 dans lequel la bobine de commande et la bobine hélicoïdale de l'implant ont un pas commun.
7. Système selon la revendication 5 ou la revendication 6, dans lequel l'implant inclut un canal s'étendant le long d'une surface d'au moins quelques-unes de la pluralité de boucles de bobine.
8. Système selon l'une quelconque des revendications 5 à 7, dans lequel l'implant inclut en outre une partie non effilée. 30
9. Système selon l'une quelconque des revendications 5 à 8, dans lequel l'implant inclut en outre une butée de commande (301) située le long de la partie non effilée. 35
10. Système selon la revendication 8 ou la revendication 9, dans lequel la partie non effilée s'étend le long d'une minorité d'une longueur de l'implant entre l'extrémité proximale et l'extrémité distale de l'implant. 40
11. Système selon l'une quelconque des revendications 5 à 10 dans lequel, dans la première configuration, l'une de la section de la bobine de commande (404) et de la partie de l'implant est reçue au sein de l'autre de la section de la bobine de commande (404) et de la partie de l'implant, préférablement dans lequel la partie de l'implant est la partie non effilée. 45
12. Système selon l'une quelconque des revendications 5 à 11, incluant en outre un élément de drainage ayant une configuration déployée dans laquelle l'élément de drainage est fixe par rapport à au moins un élément parmi l'implant ou la bobine de commande. 50
13. Système selon l'une quelconque des revendications 5 à 12 et comprenant un dispositif de stabilisation 55

de tissu (952) qui est conçu pour stabiliser du tissu (954) pour la délivrance de l'implant.

14. Système selon la revendication 13 dans lequel le dispositif de stabilisation comprend un élément creux (952) qui est conçu pour entourer l'implant avant la délivrance. 5
15. Système selon la revendication 14 dans lequel l'élément creux est conçu pour appliquer de la pression sur le tissu, l'élément creux peut être sollicité par un ressort (953). 10
16. Système selon la revendication 14 ou la revendication 15 dans lequel une surface d'attaque de l'élément creux est configurée pour une interaction avec une surface de muqueuse. 15
17. Système selon l'une quelconque des revendications 14 à 16 dans lequel l'élément creux comprend des éléments (951) destinés à pénétrer dans une surface de muqueuse. 20

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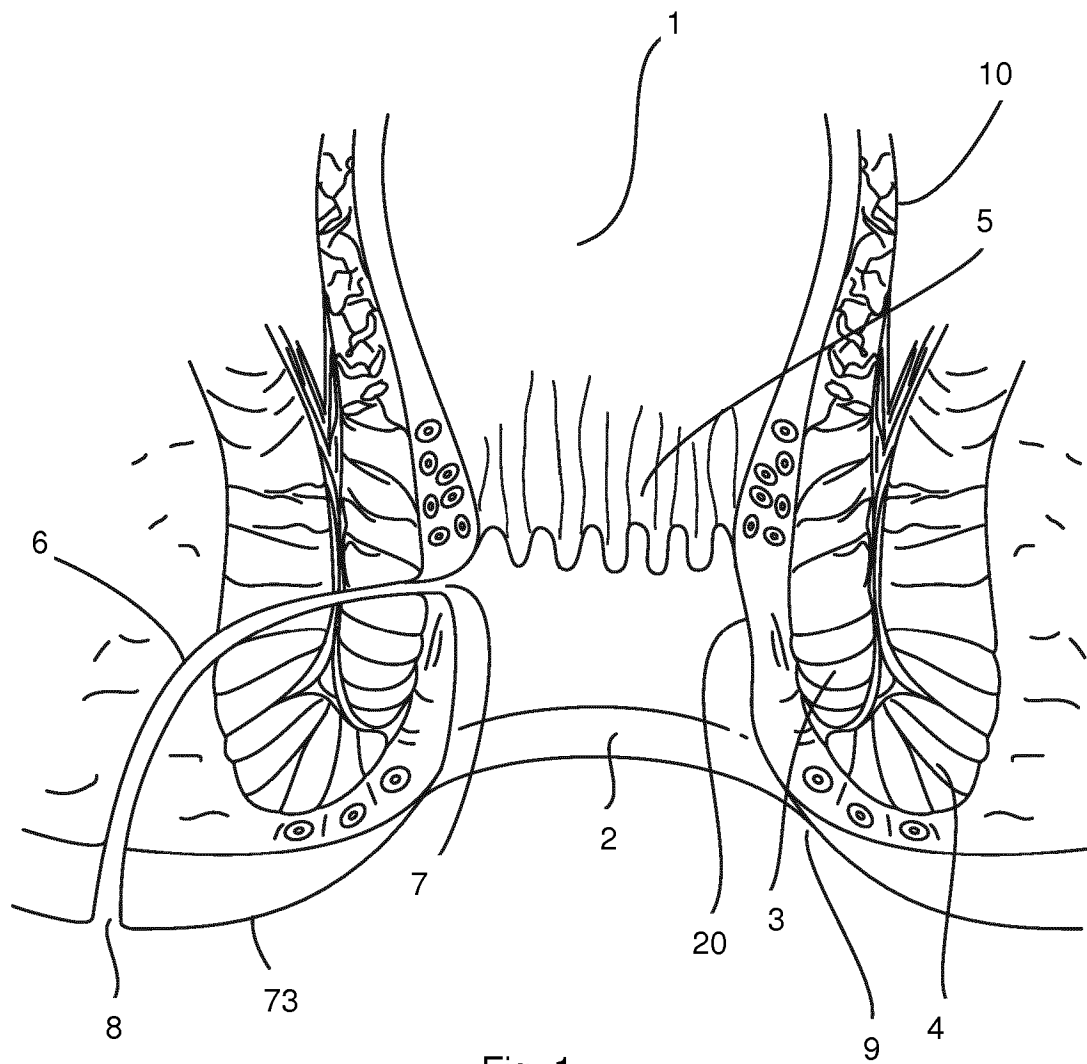
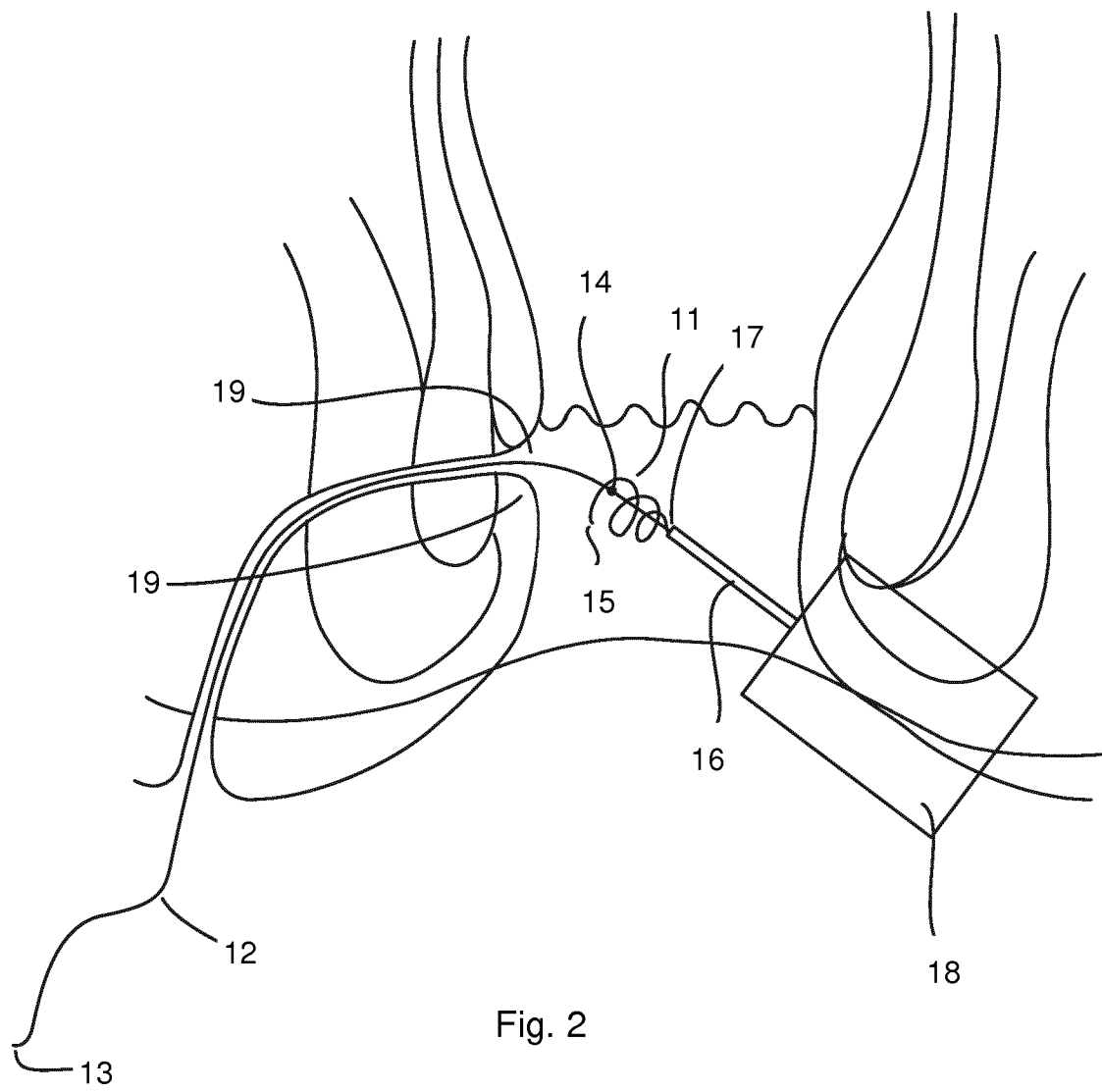


Fig. 1



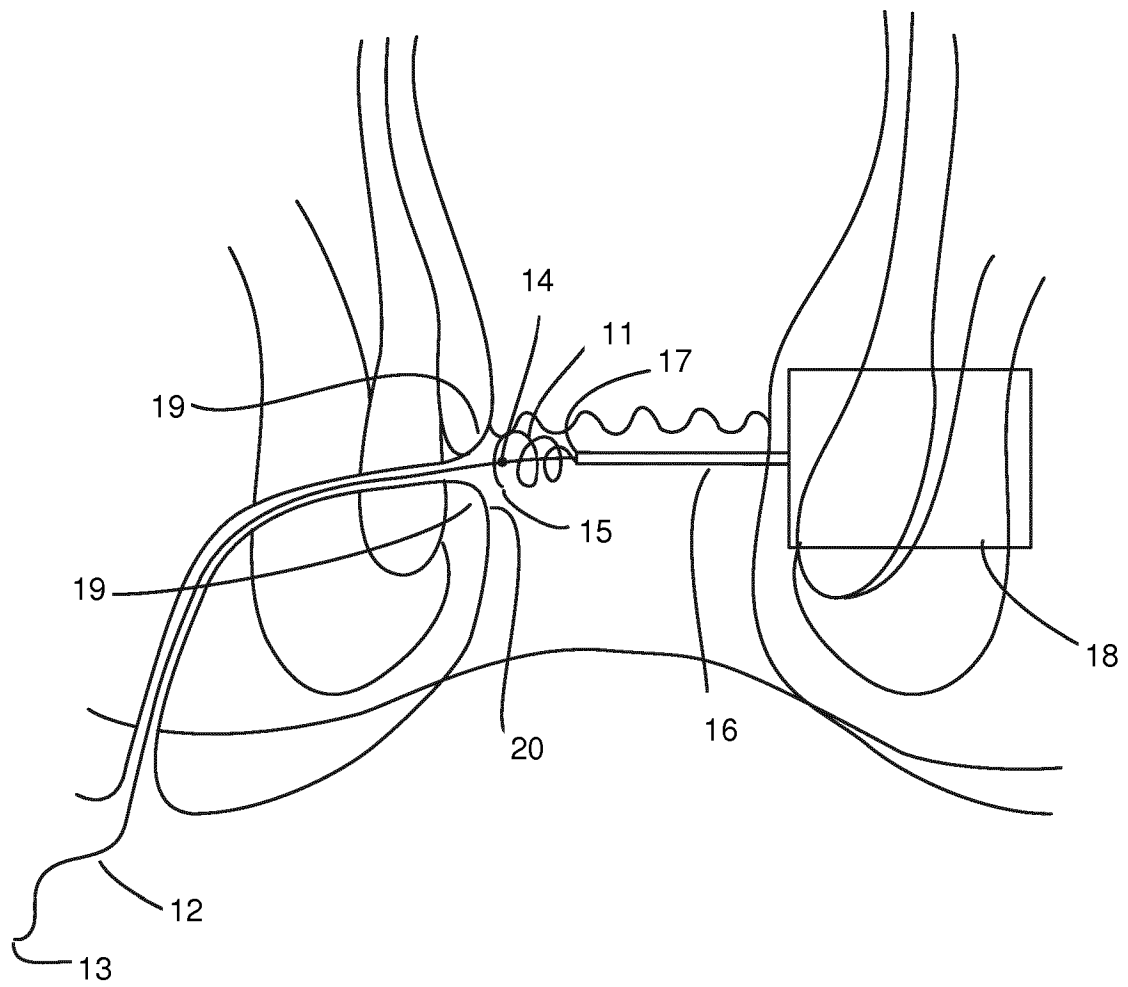


Fig. 3

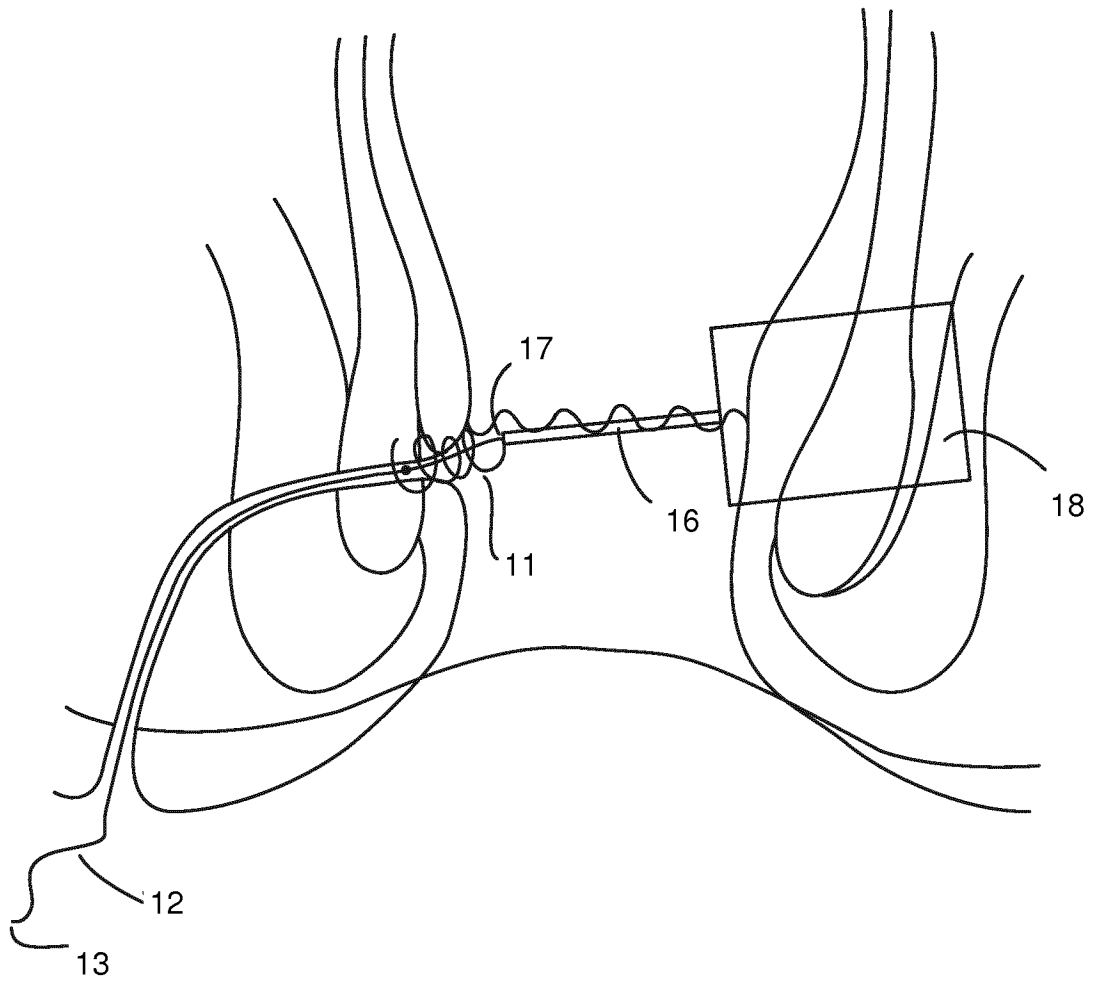


Fig. 4

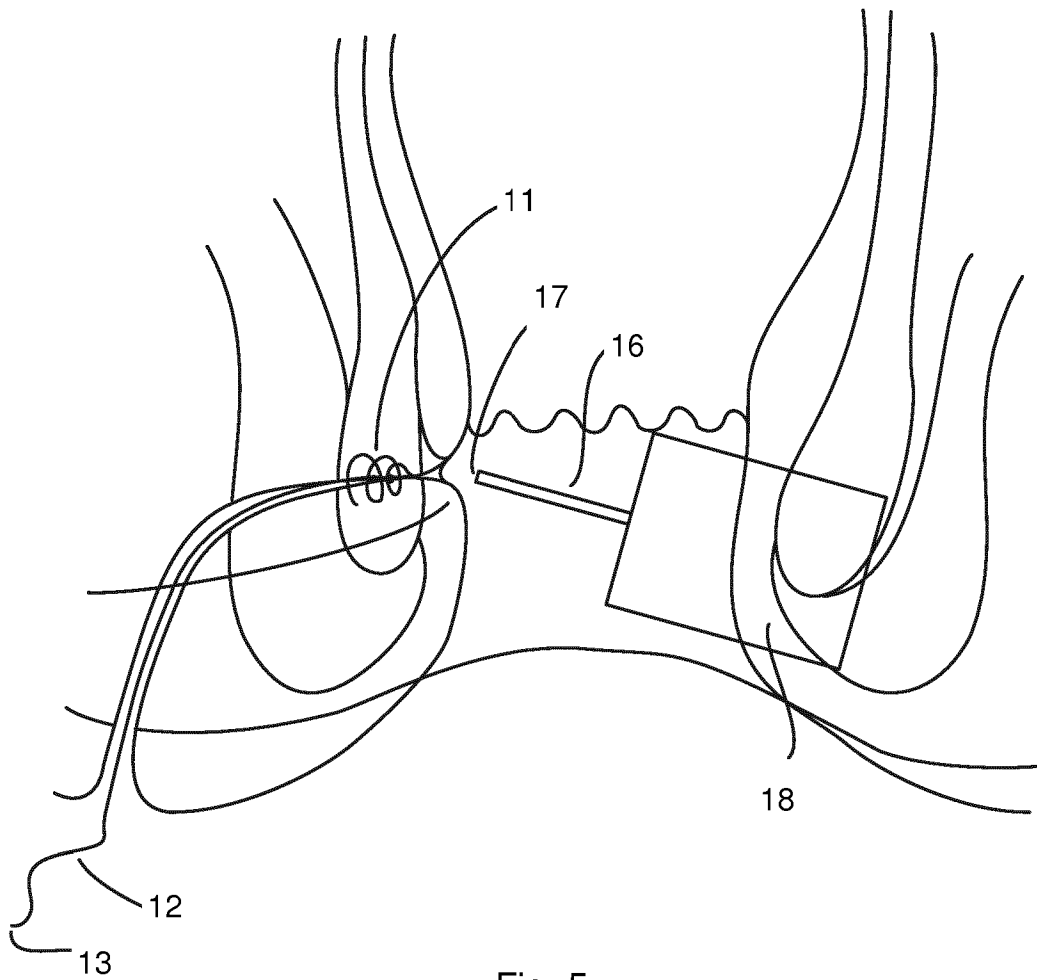


Fig. 5

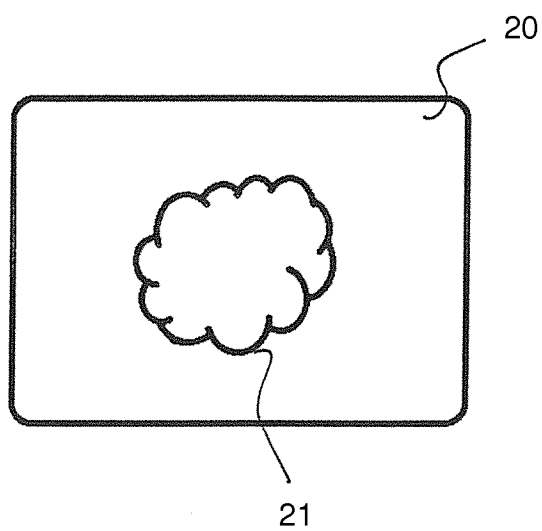


Fig. 6

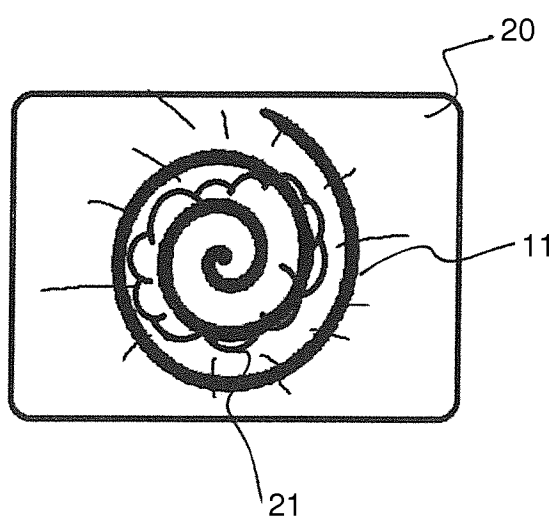


Fig. 7

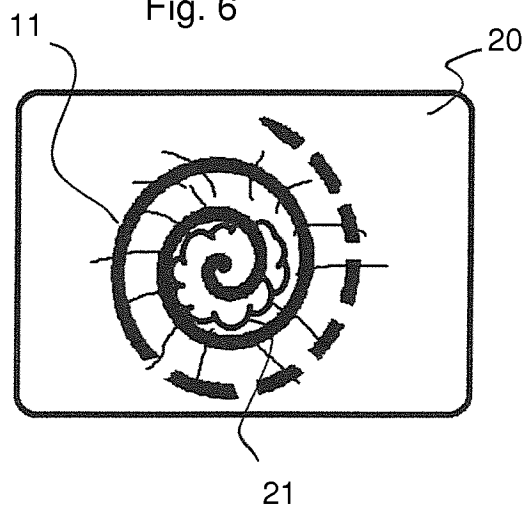


Fig. 8

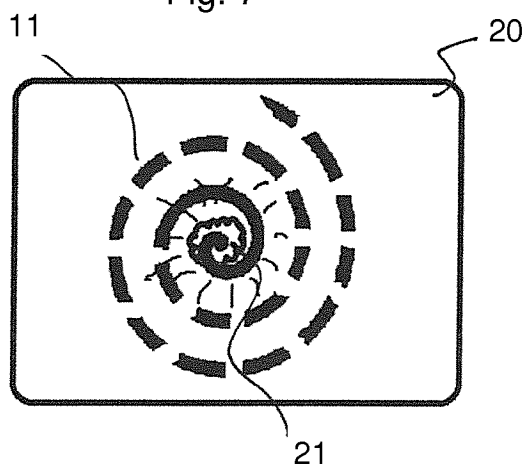


Fig. 9

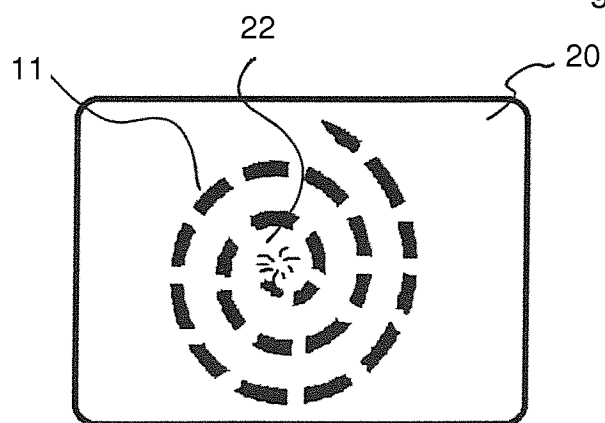


Fig. 10

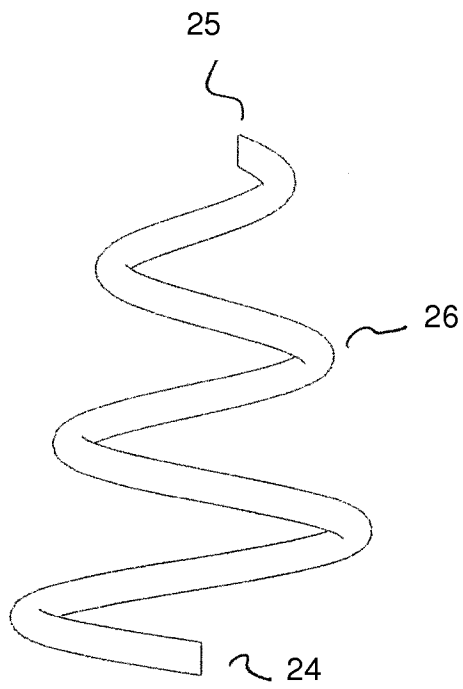


Fig. 11

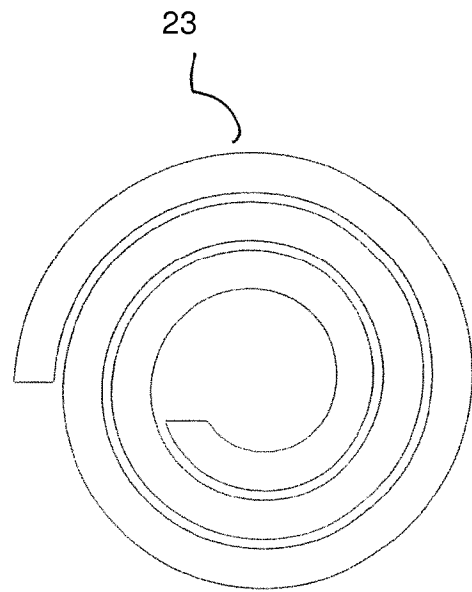


Fig. 12

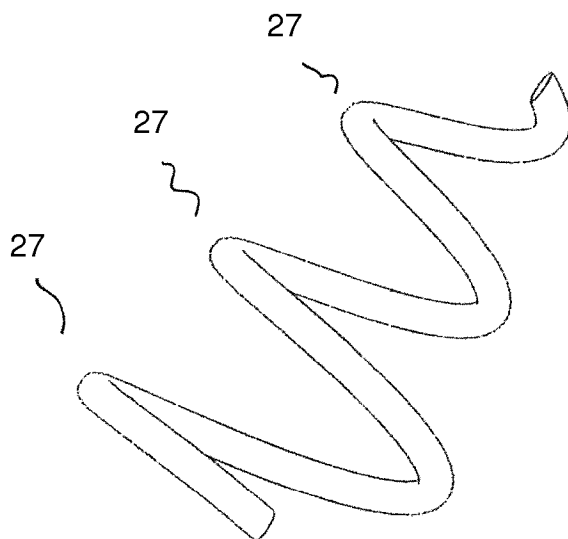
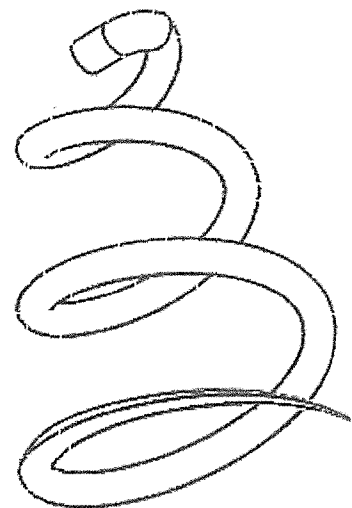
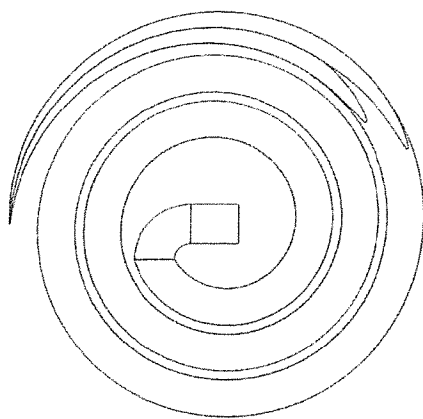
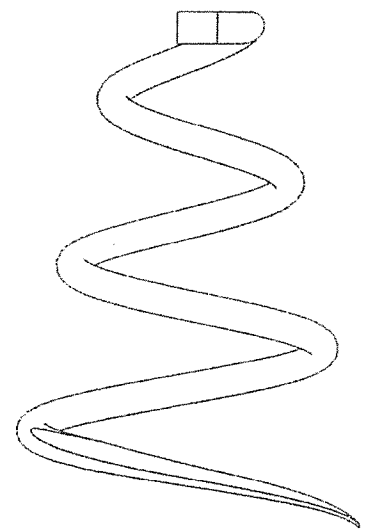
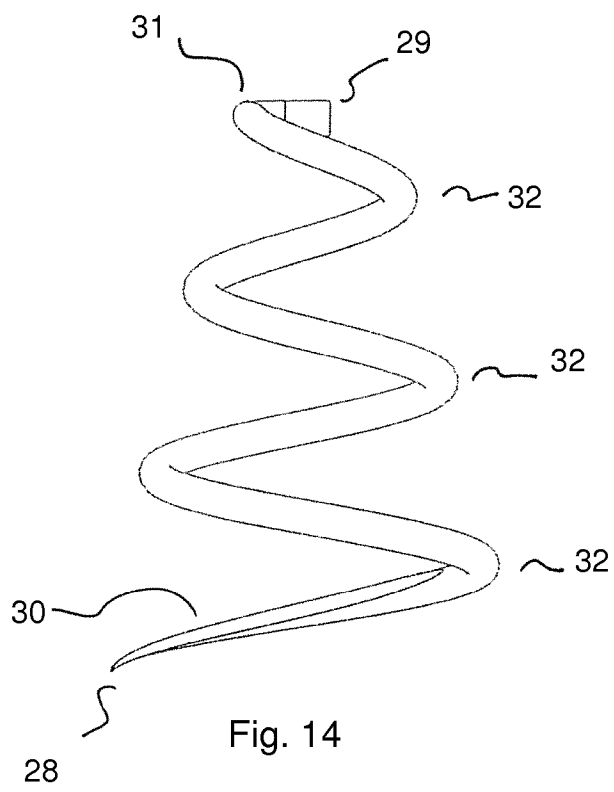


Fig. 13



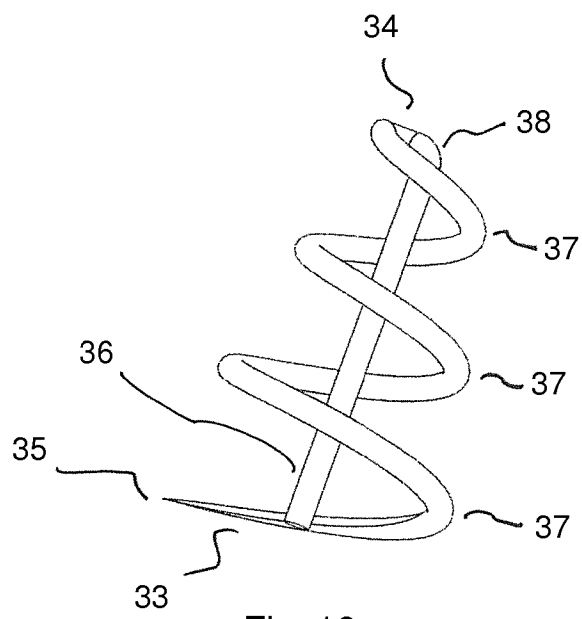


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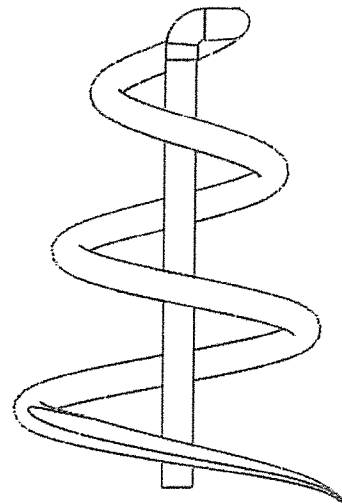


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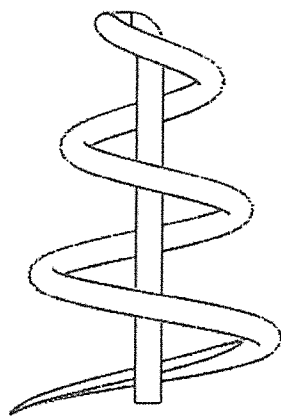


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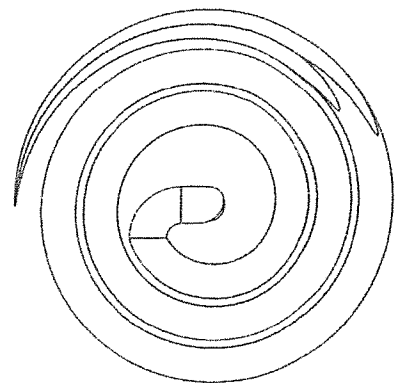


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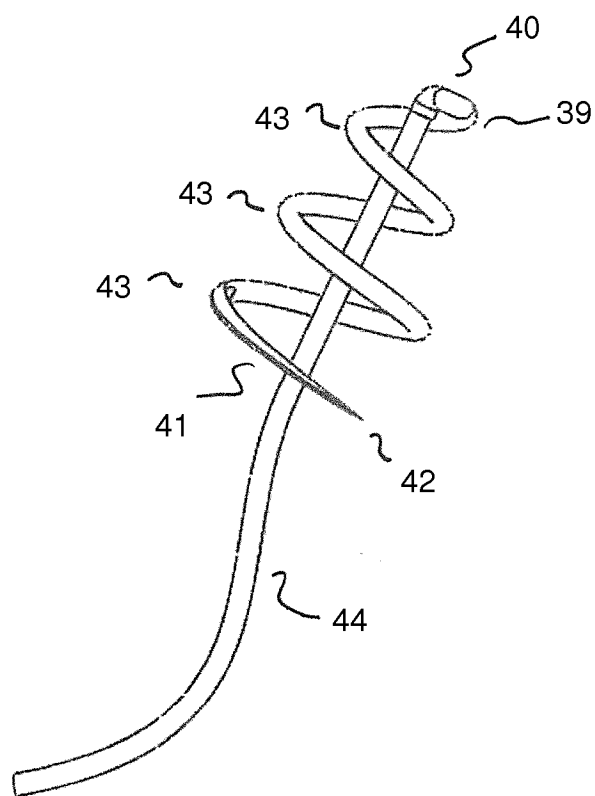


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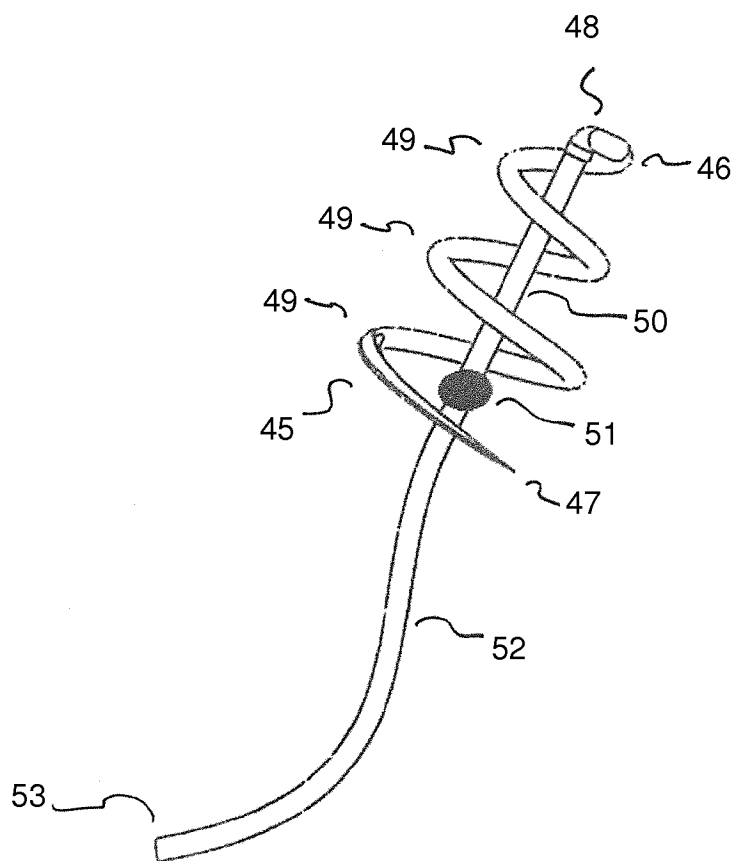


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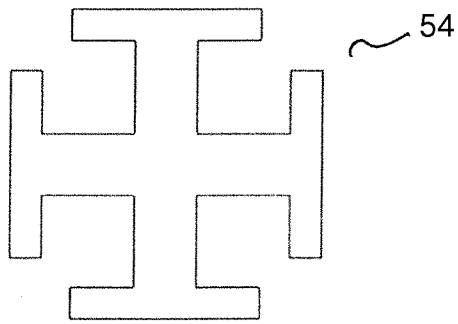


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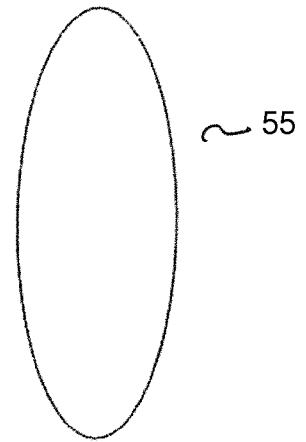


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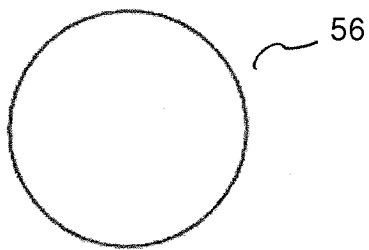


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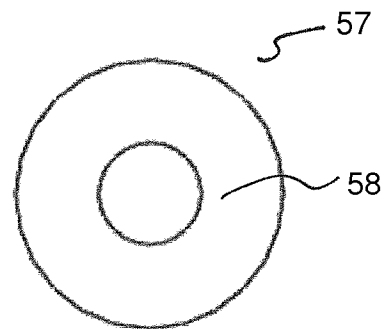


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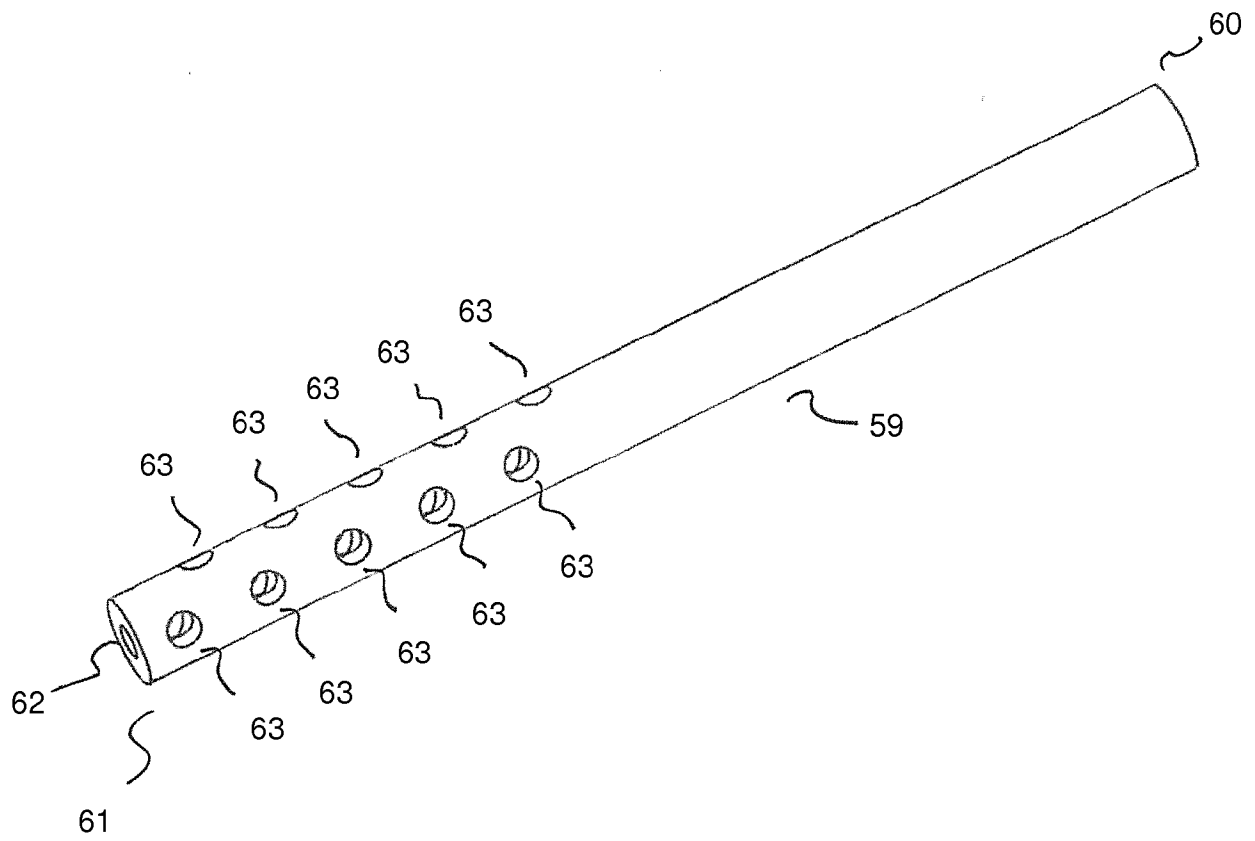


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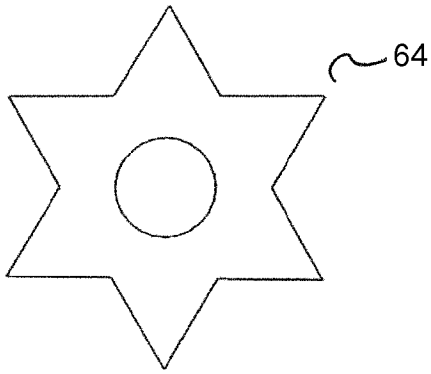


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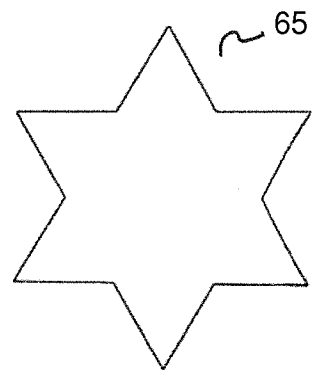


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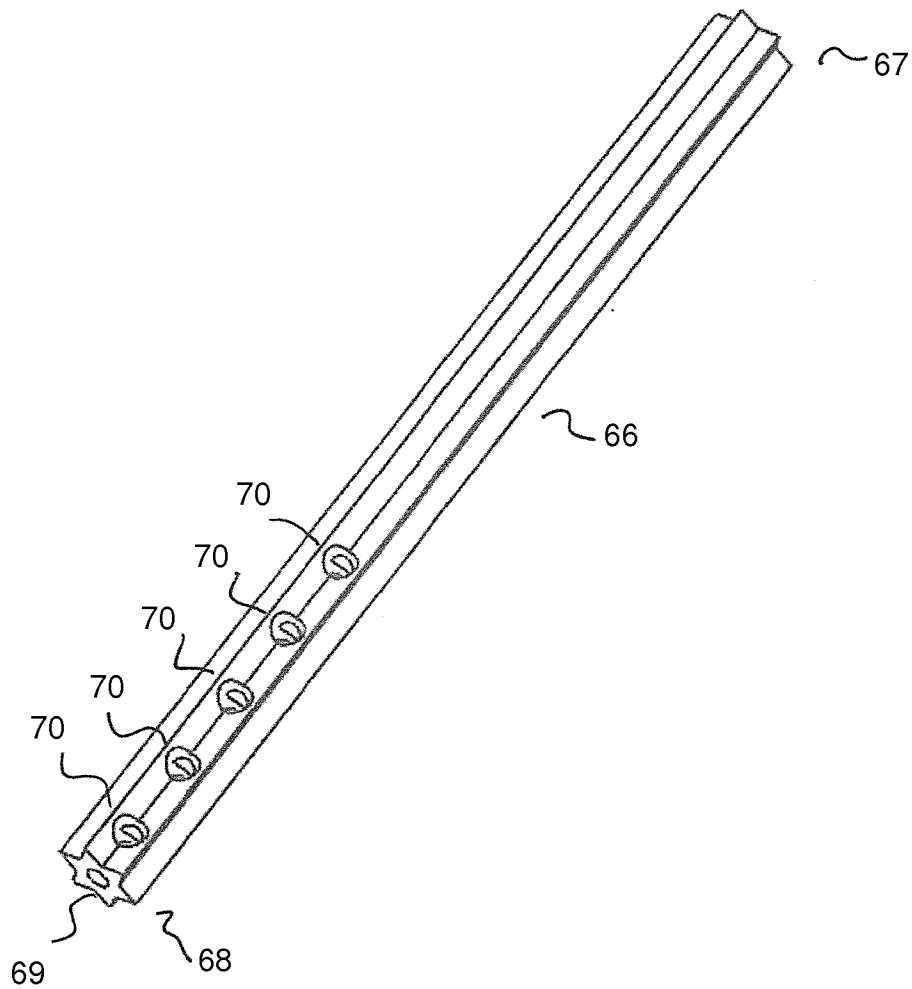


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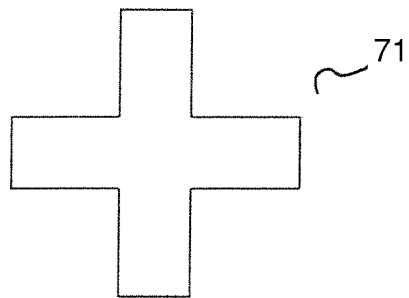


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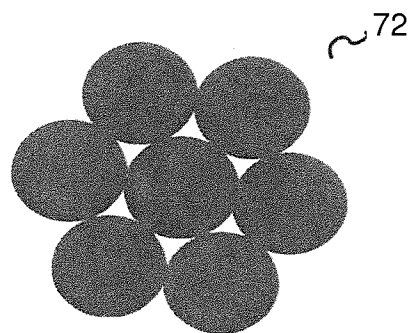


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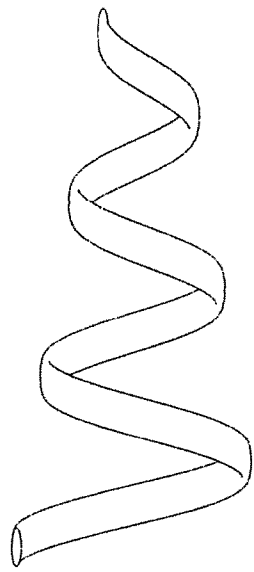


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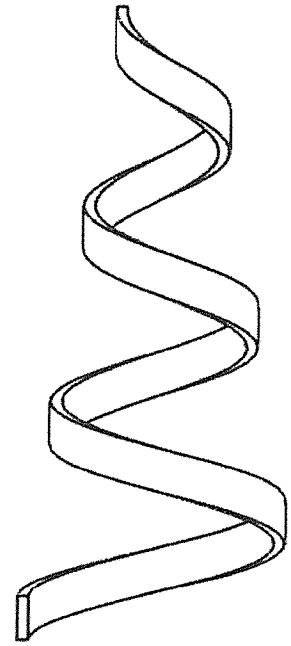


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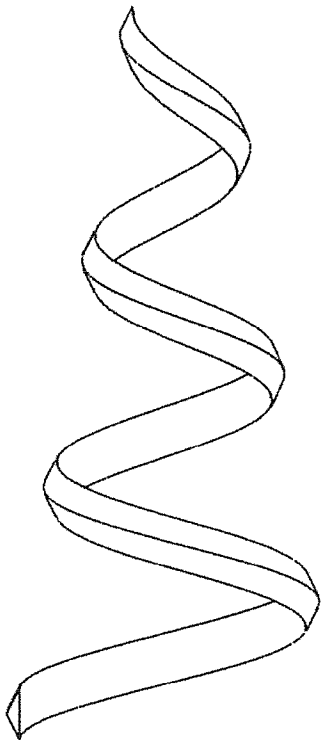


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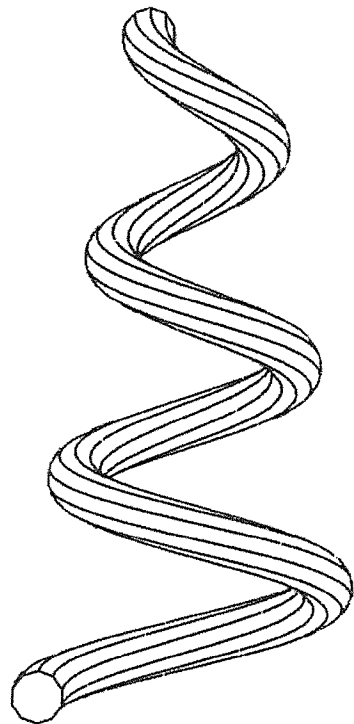


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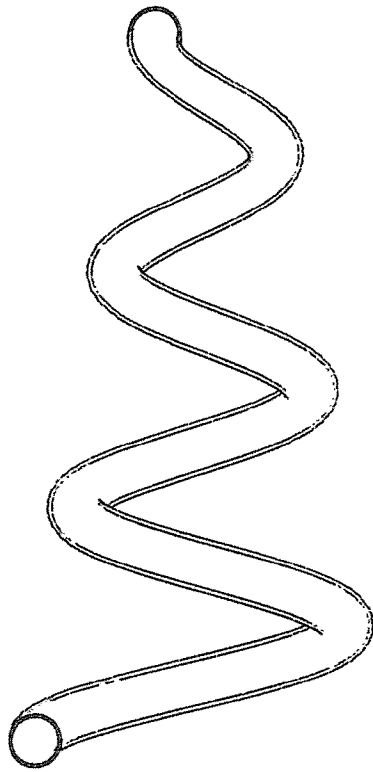


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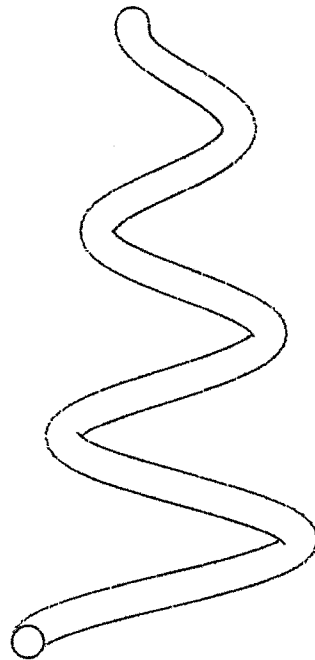


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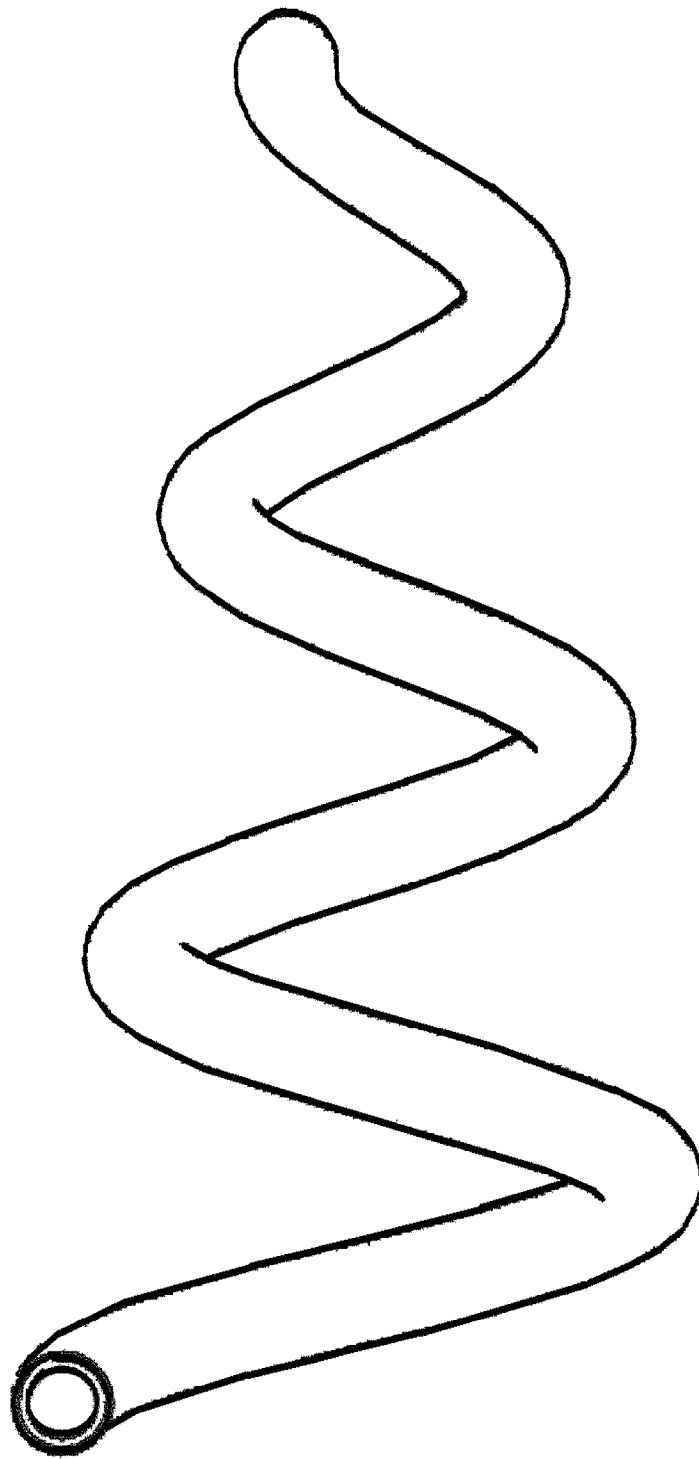


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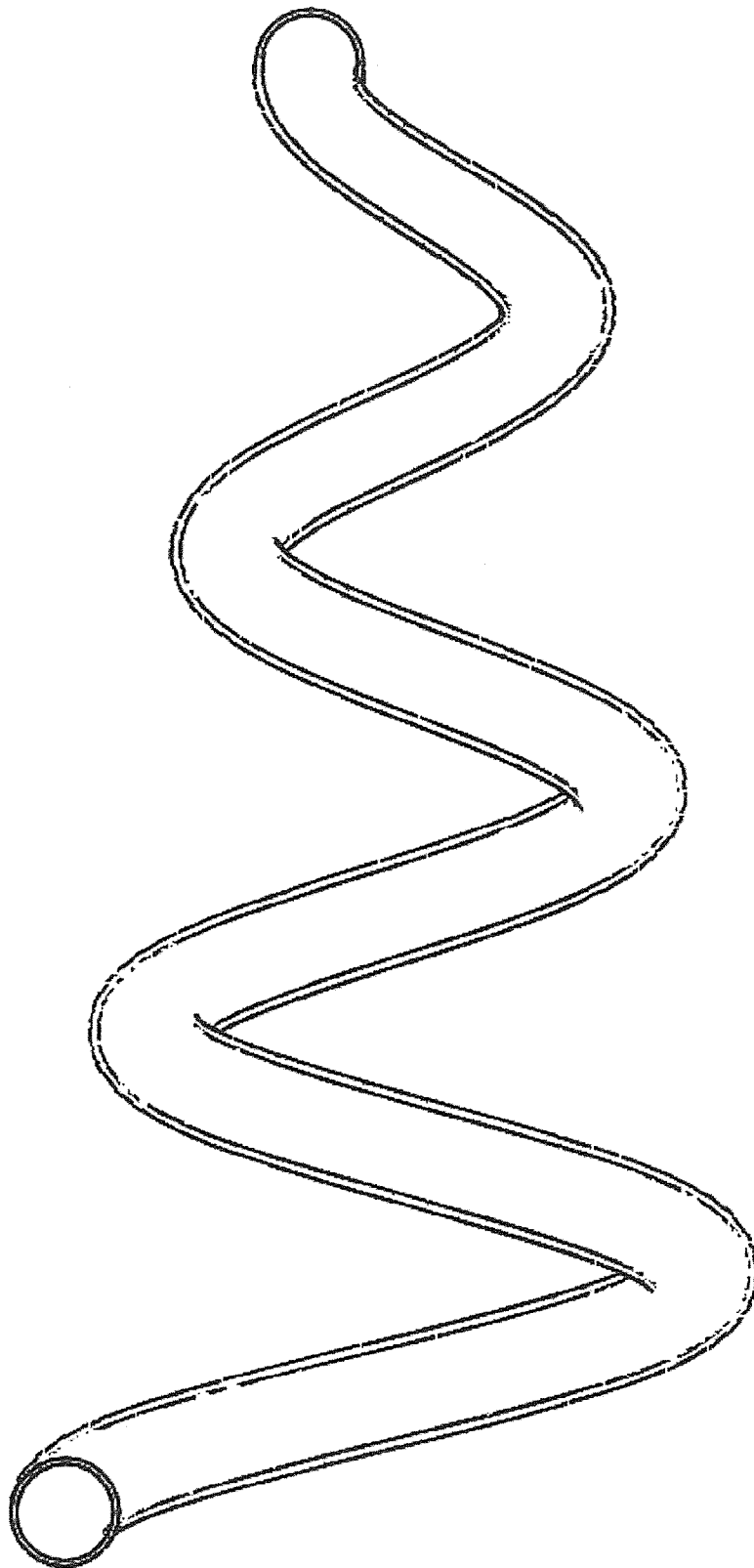


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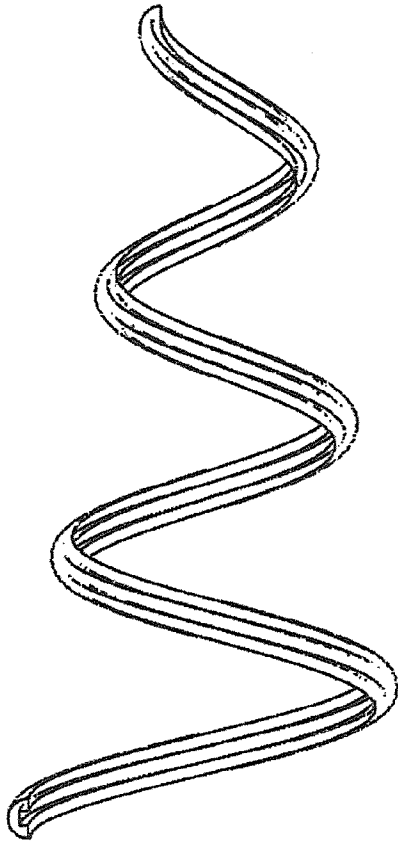


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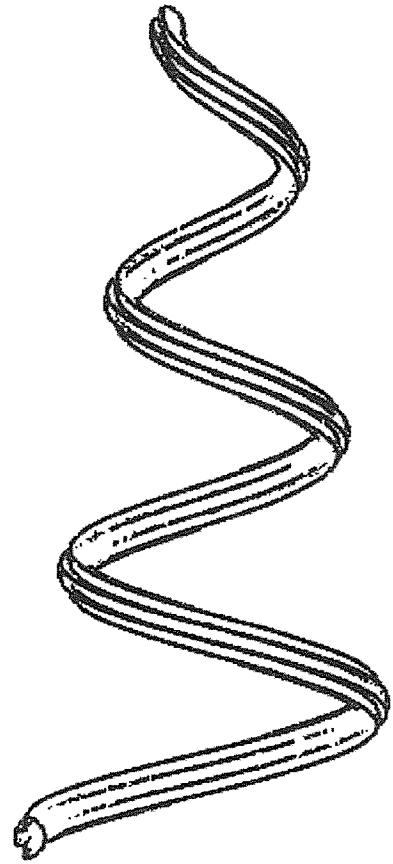


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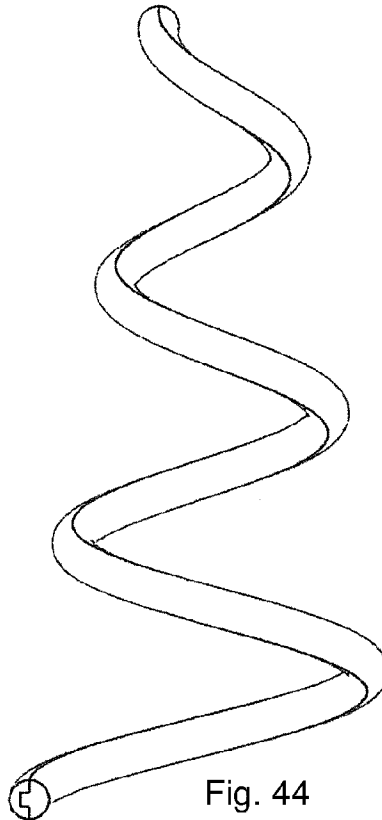


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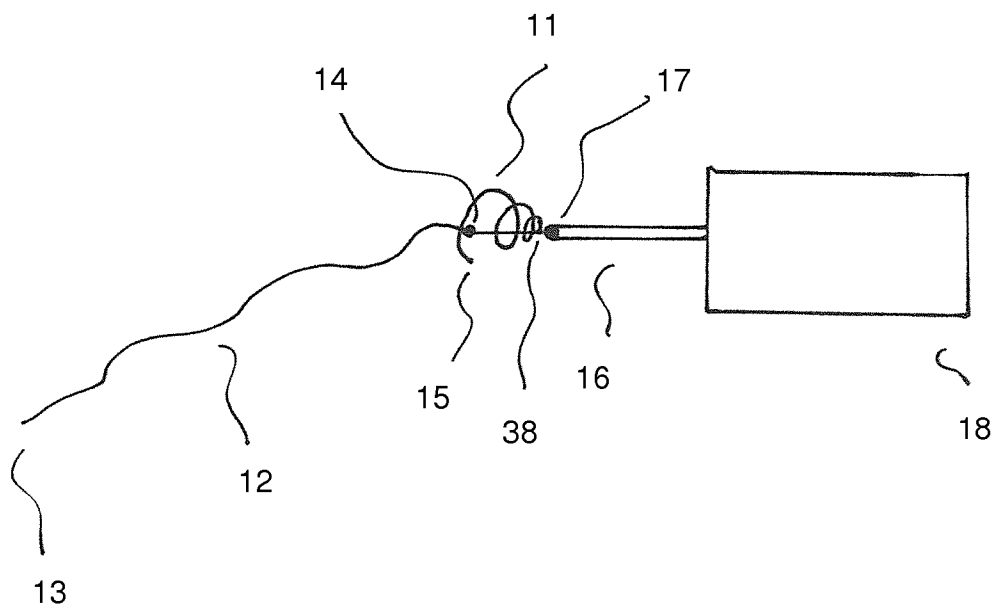


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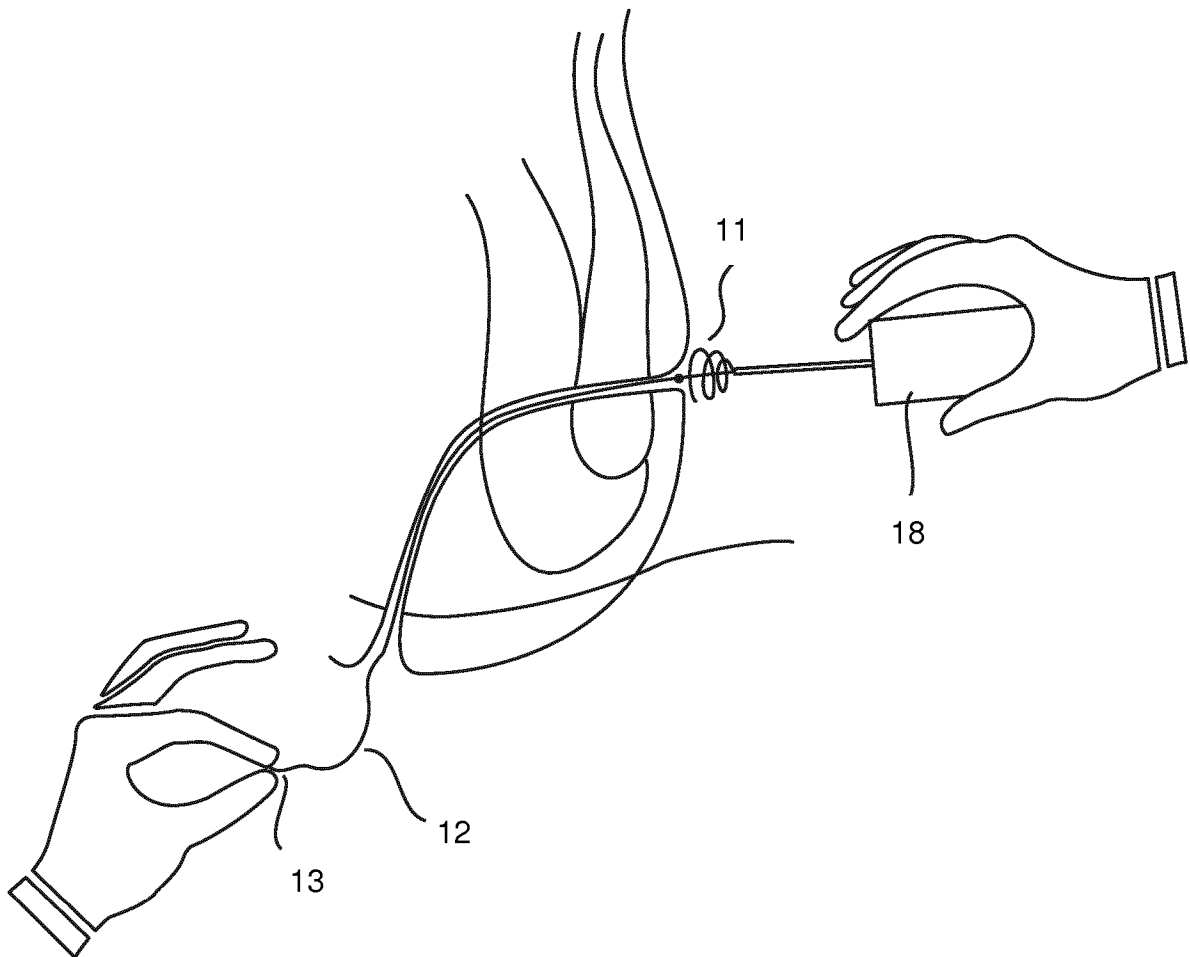


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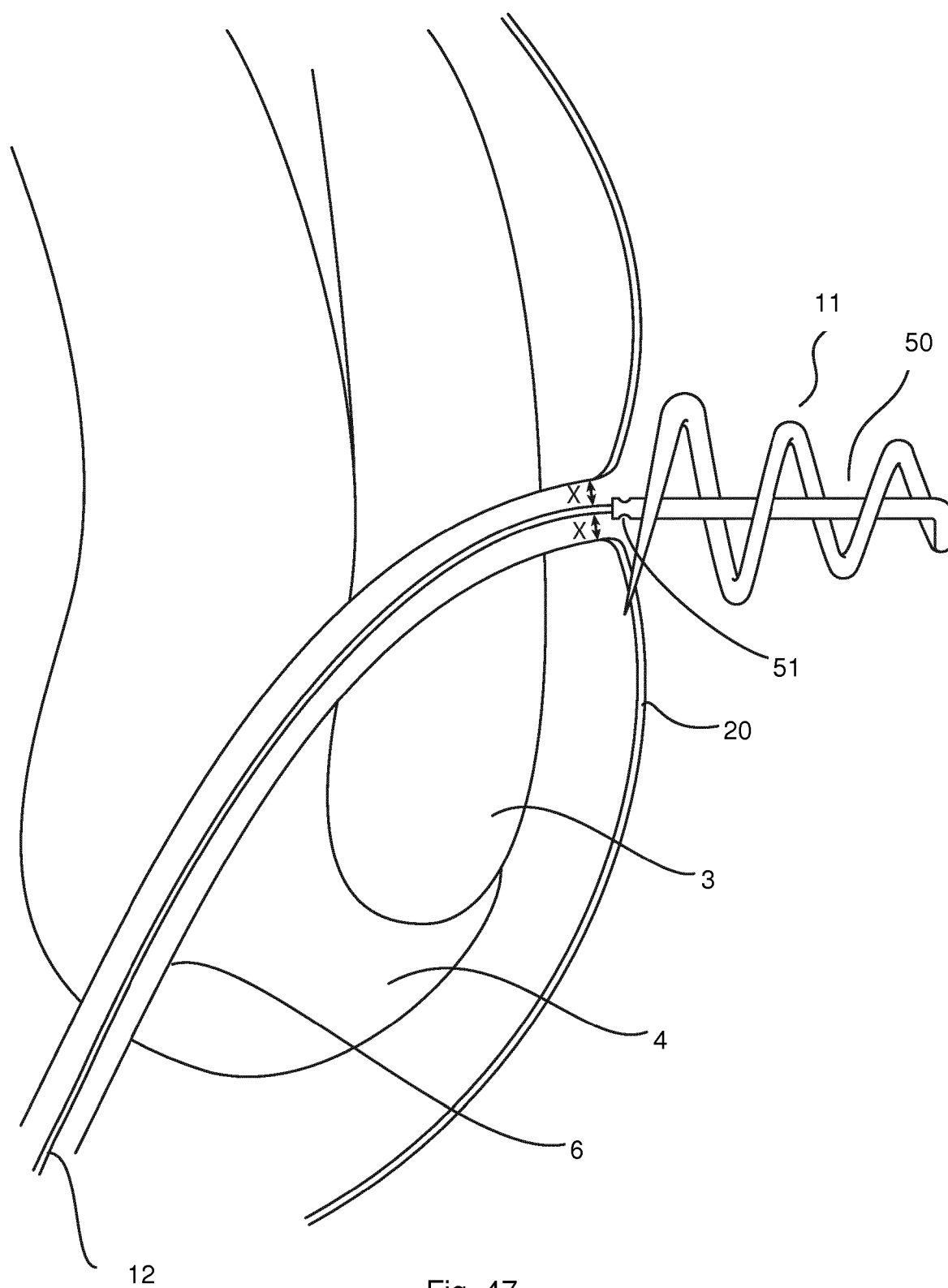


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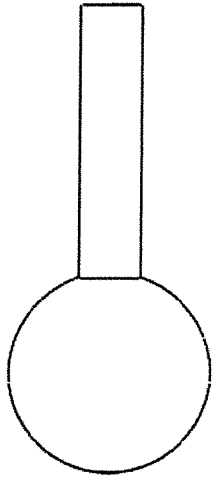


Fig. 48



Fig. 49

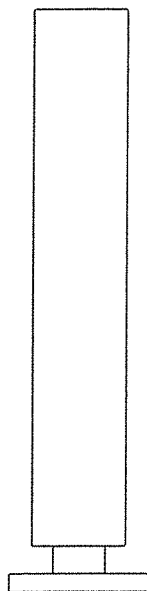


Fig. 50



Fig. 51



Fig. 52



Fig. 53

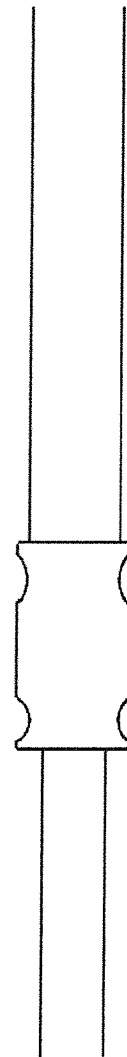


Fig. 54



Fig. 55



Fig. 56

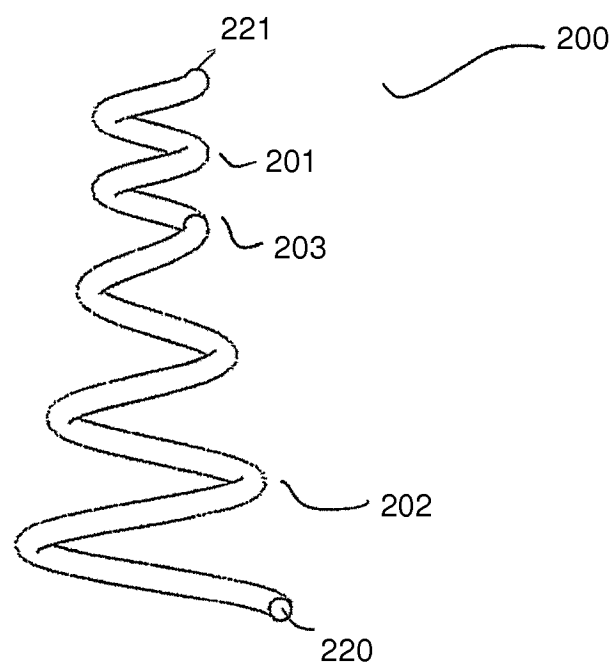
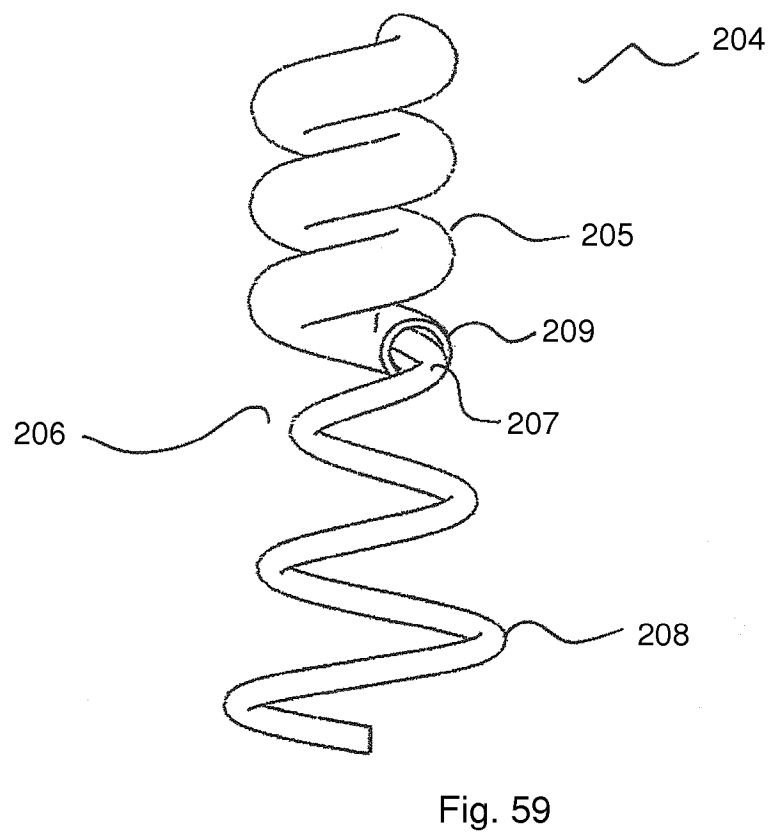
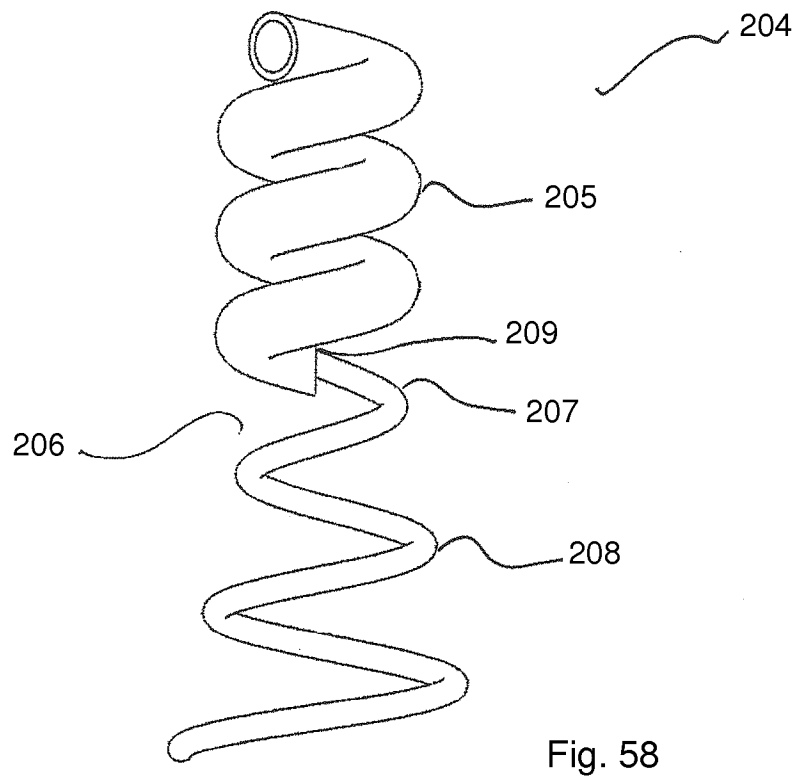


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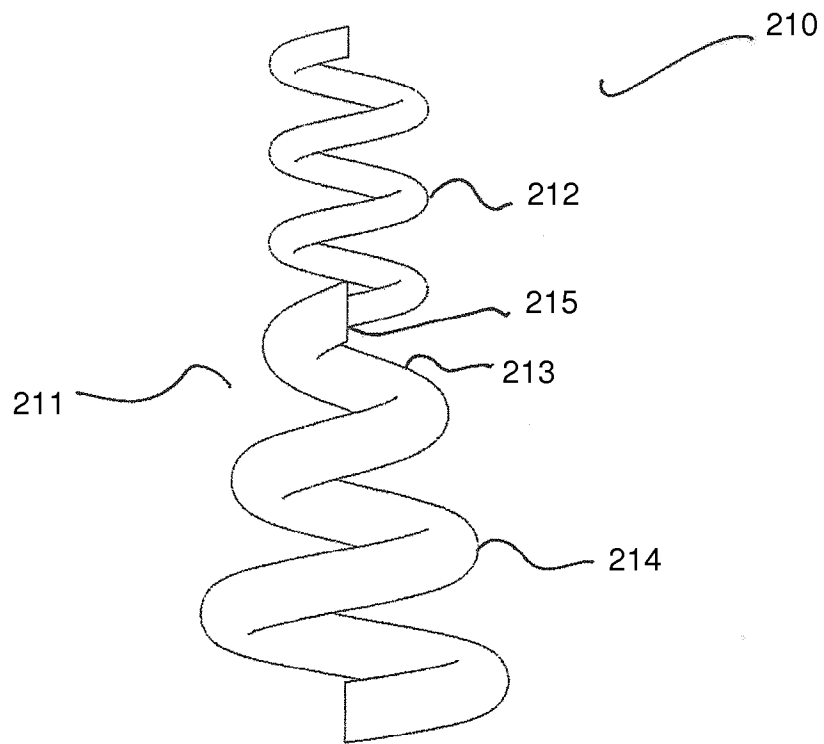


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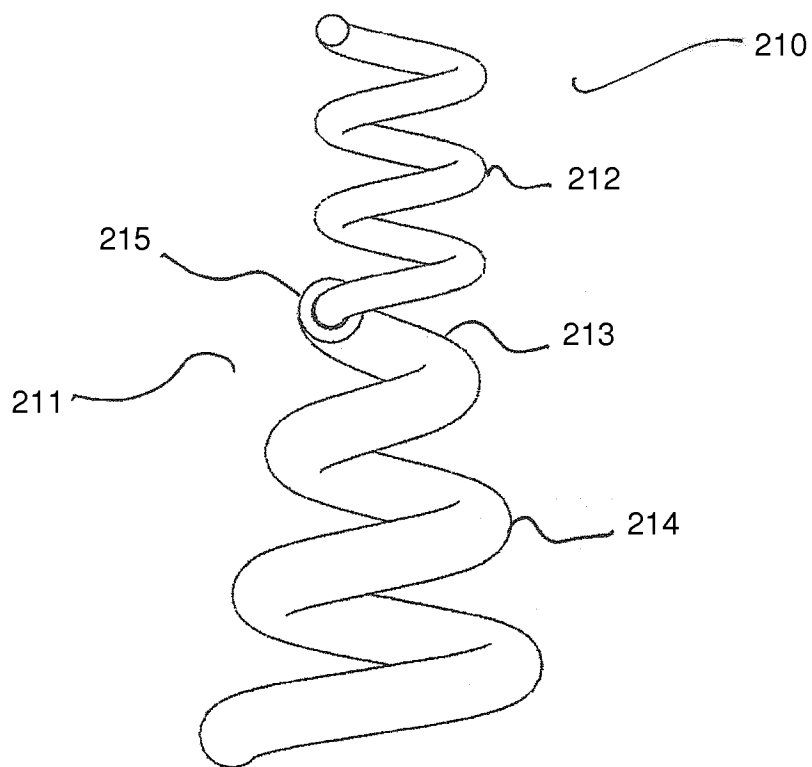


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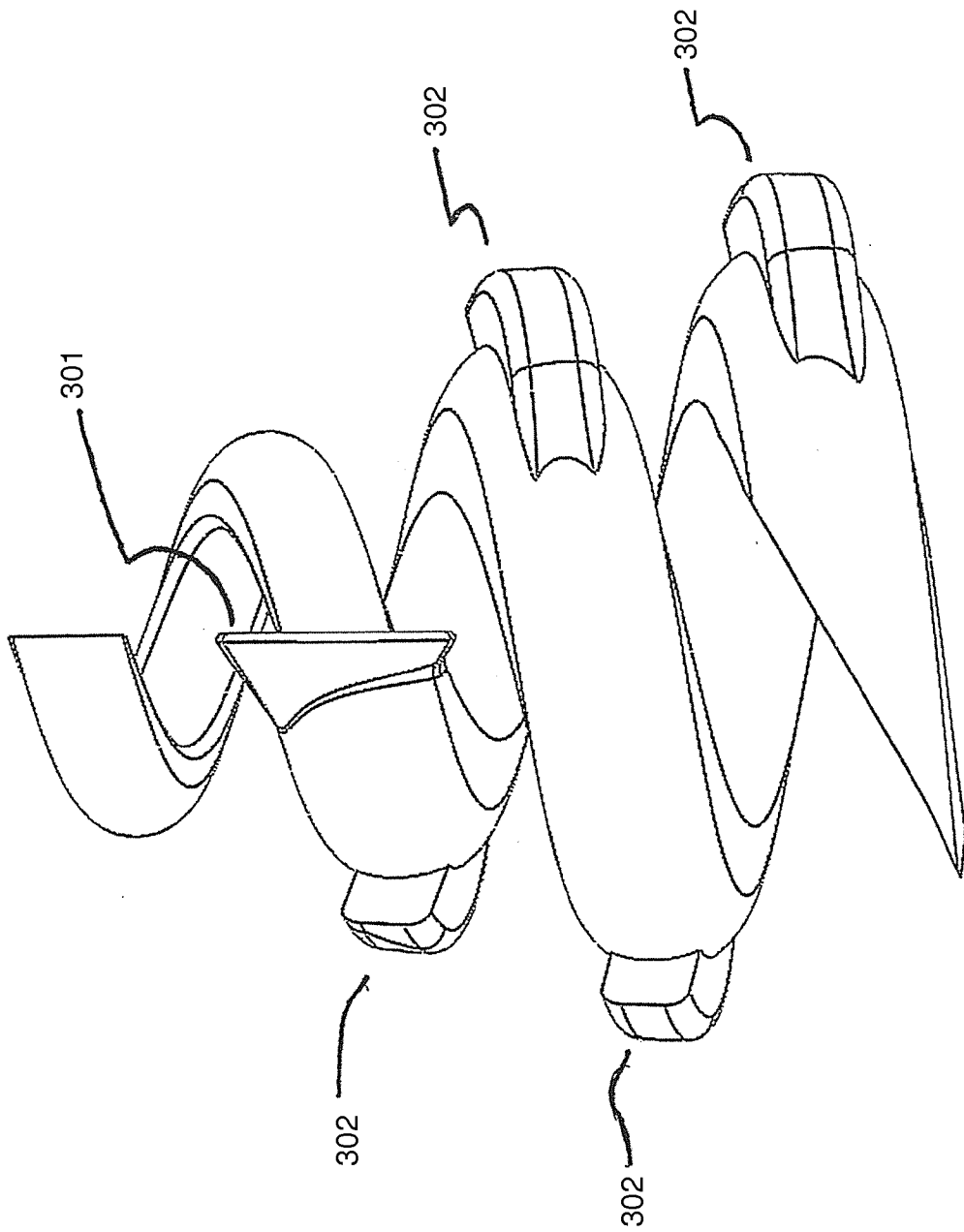


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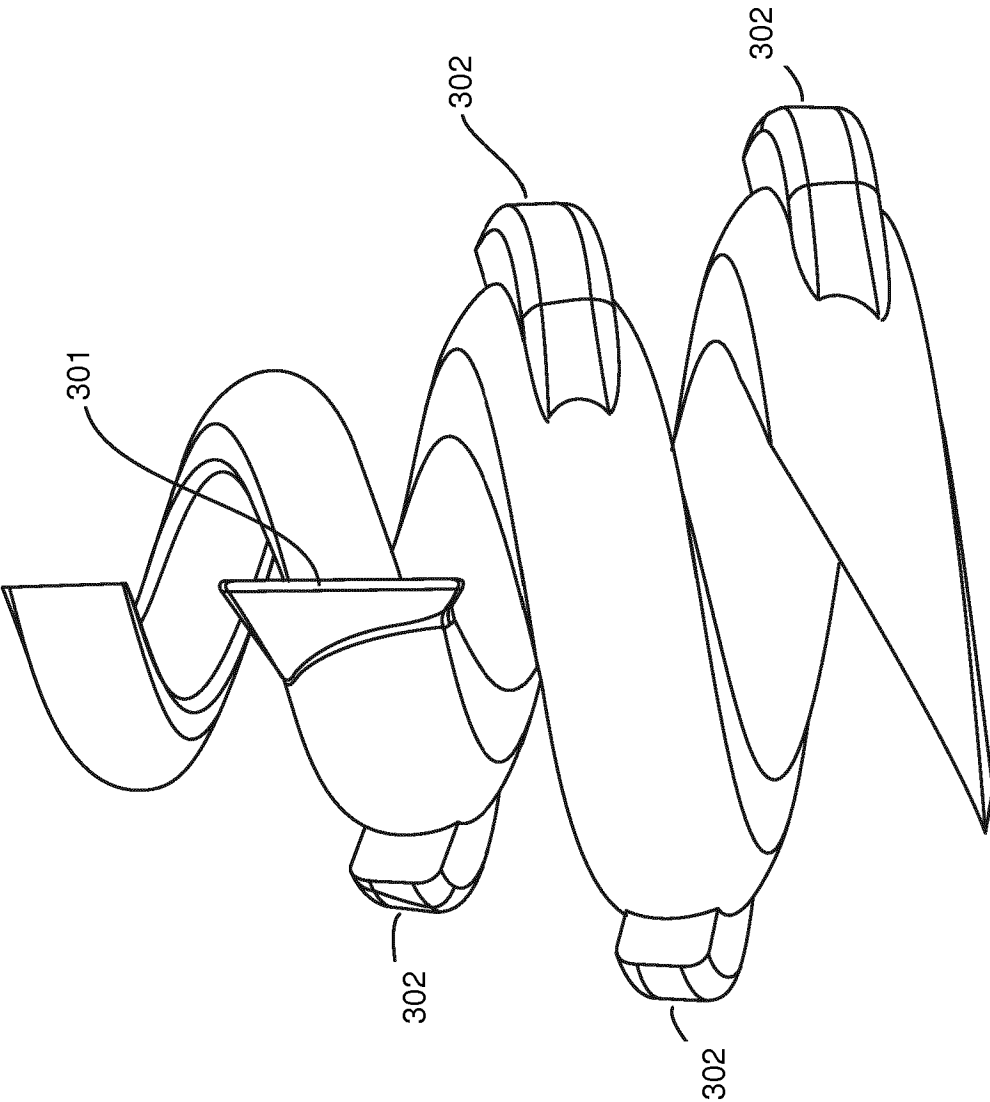


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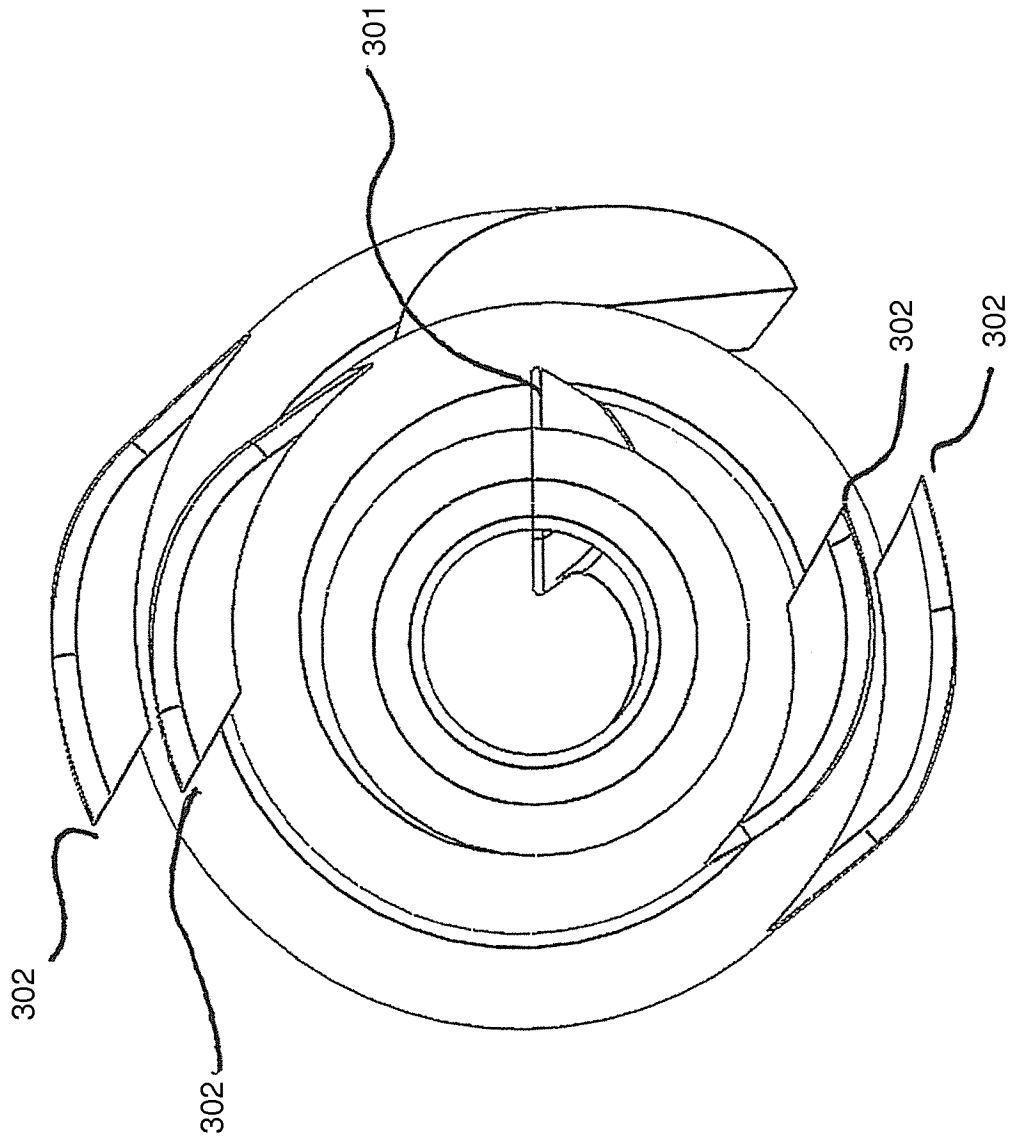


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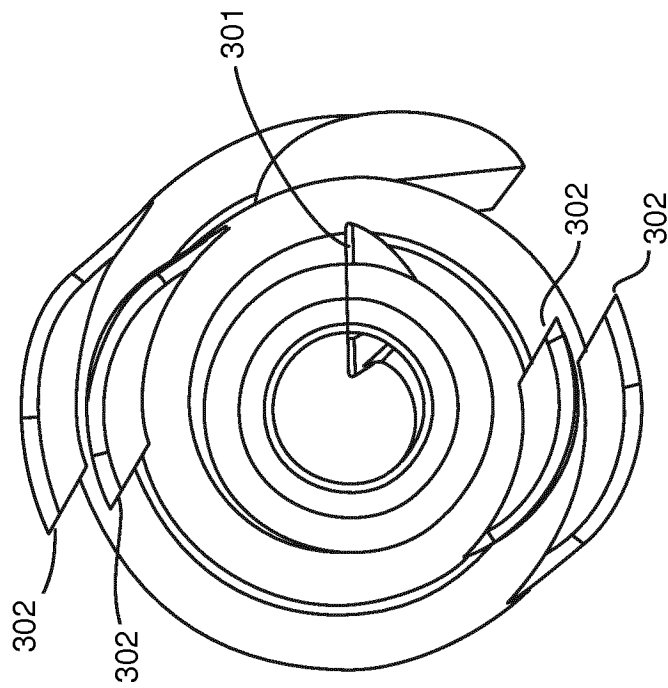


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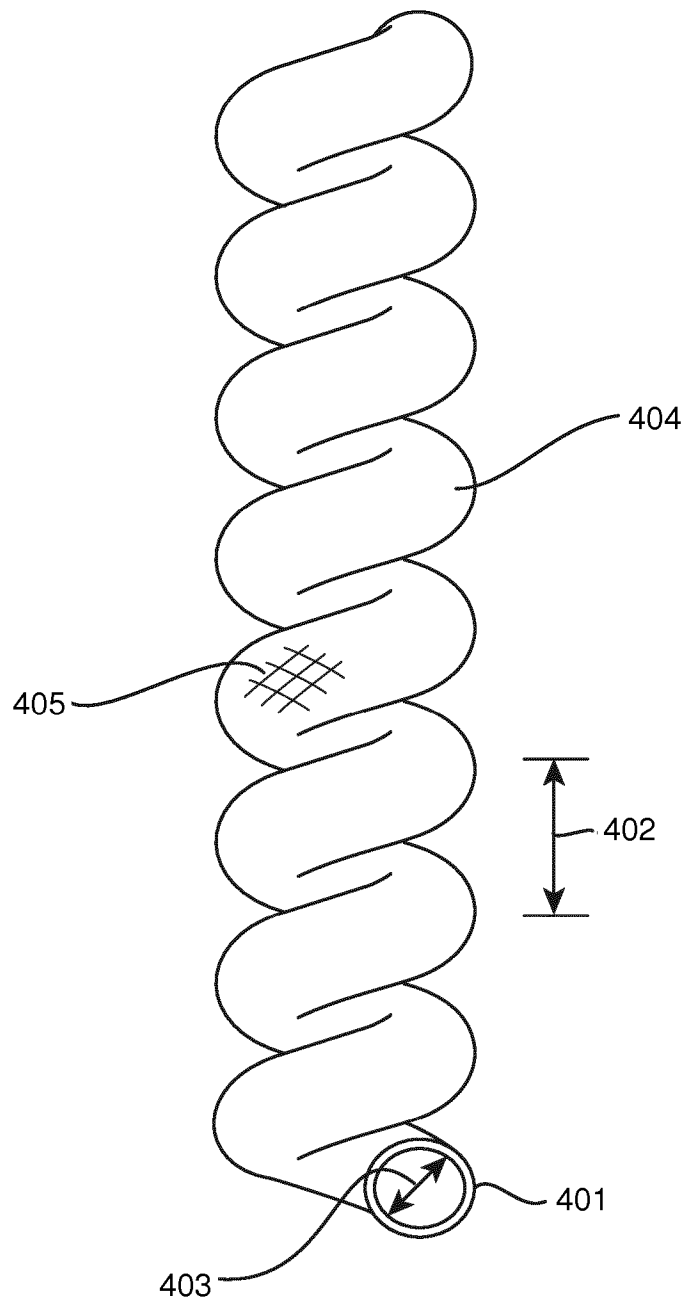
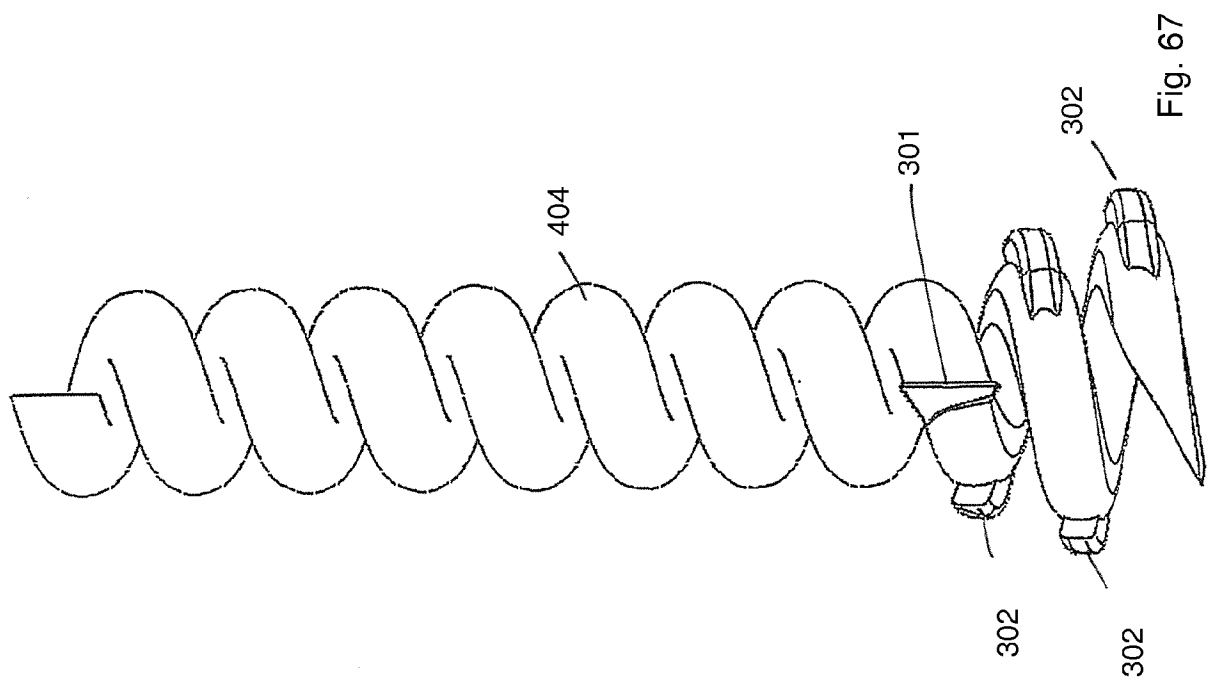


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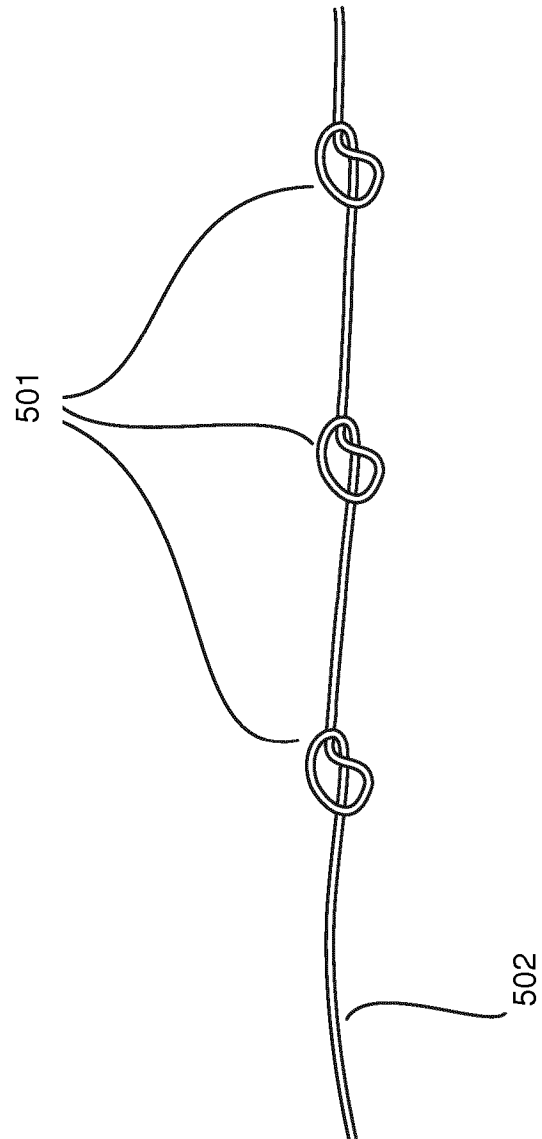


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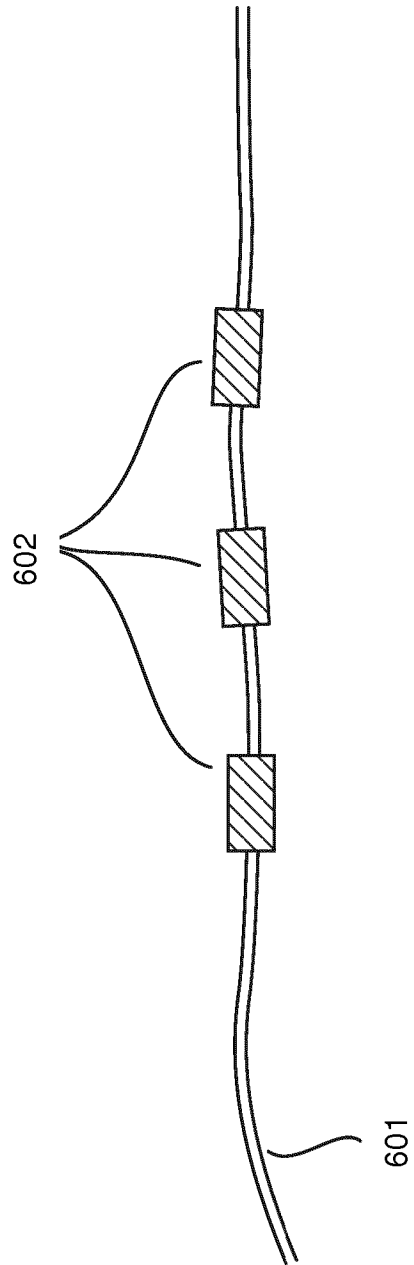


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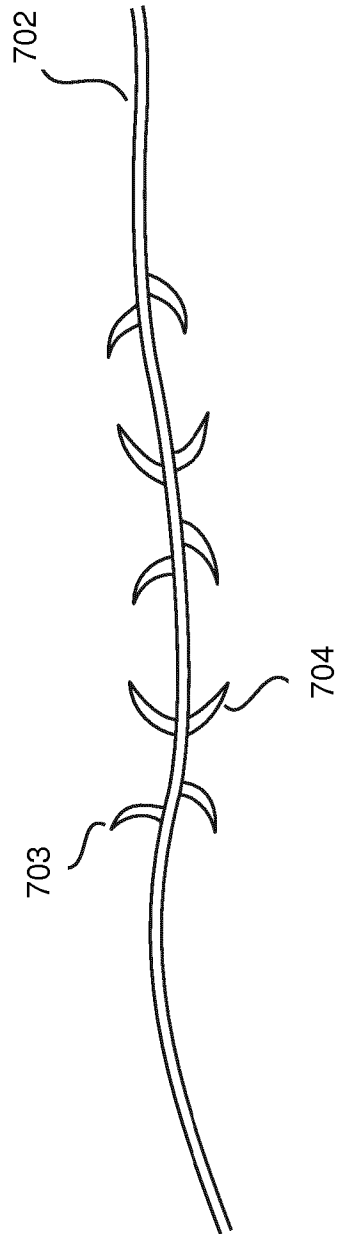


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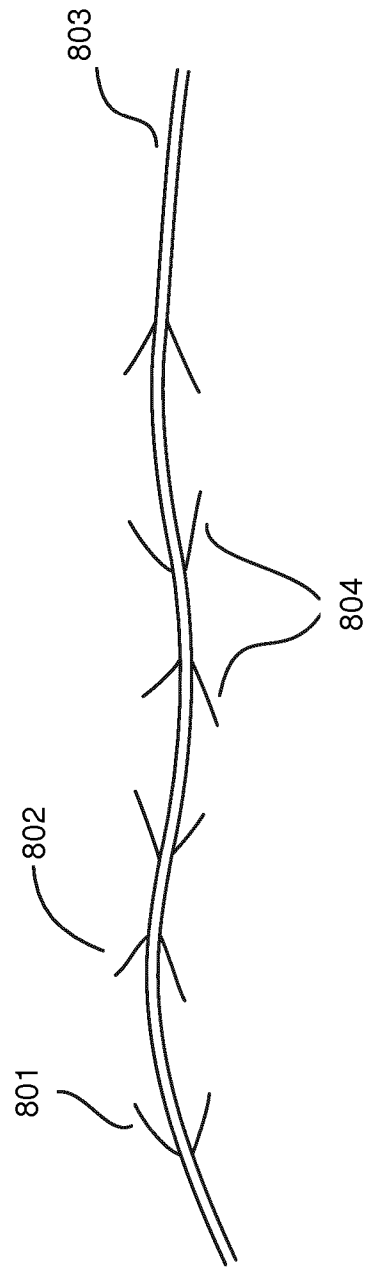


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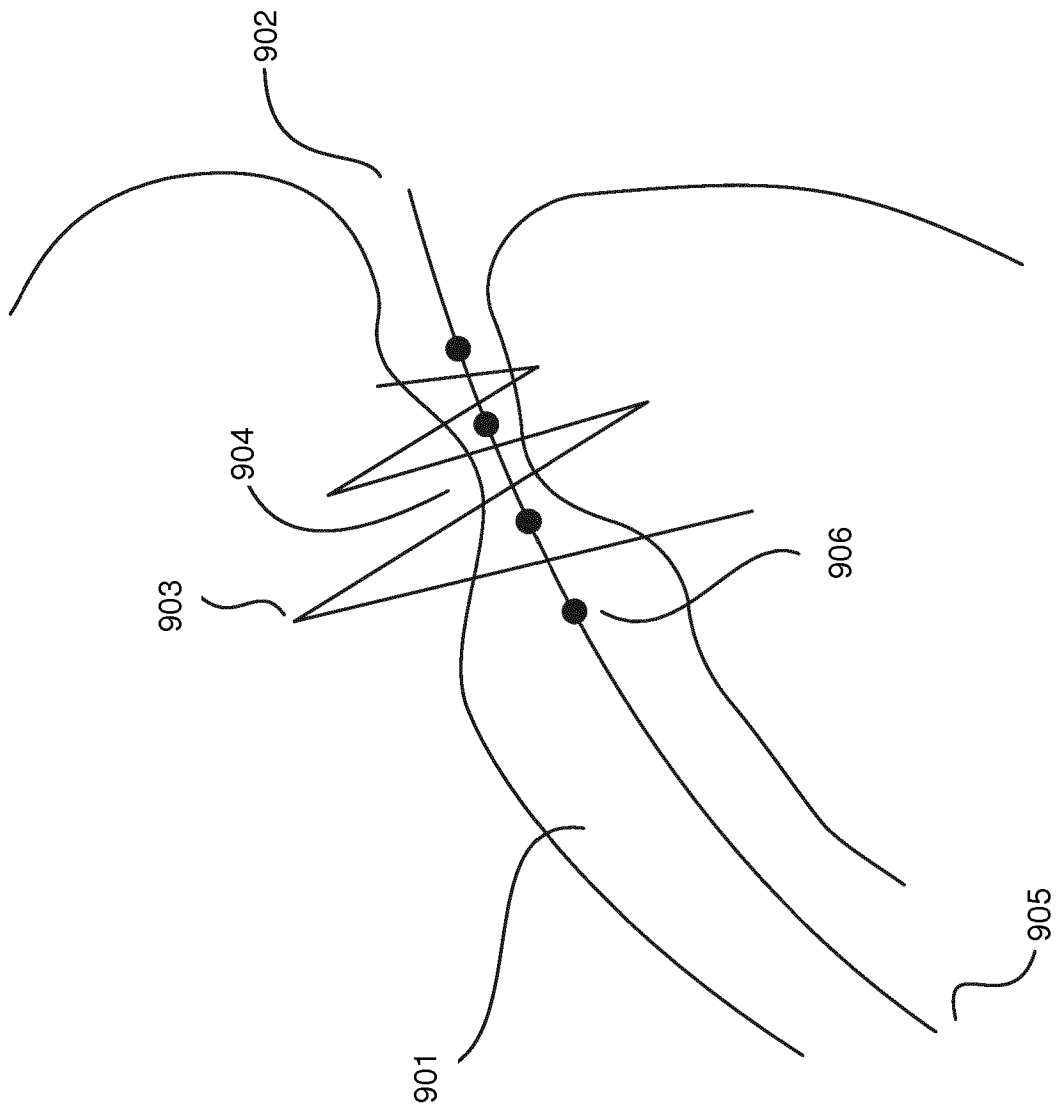


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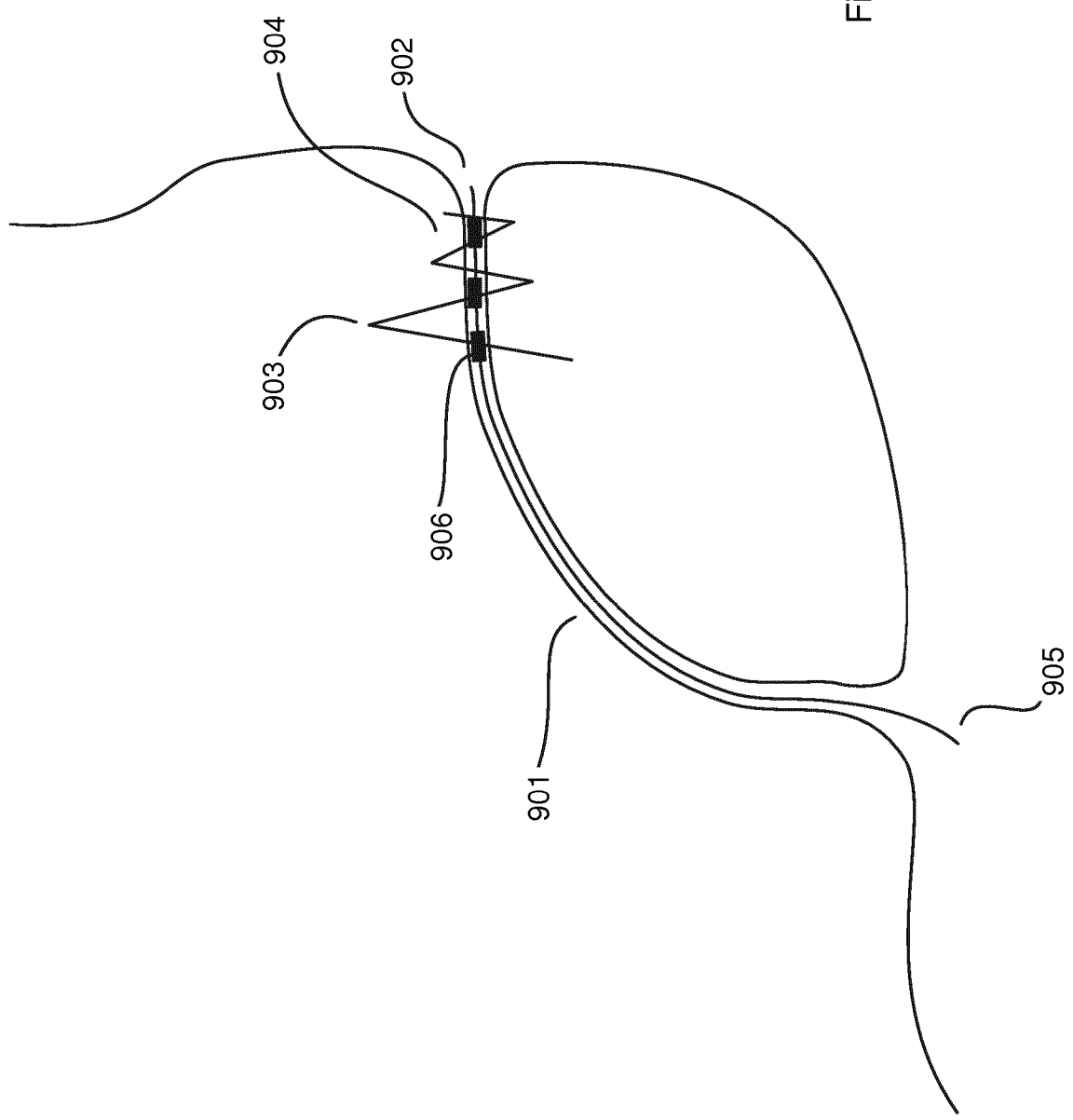


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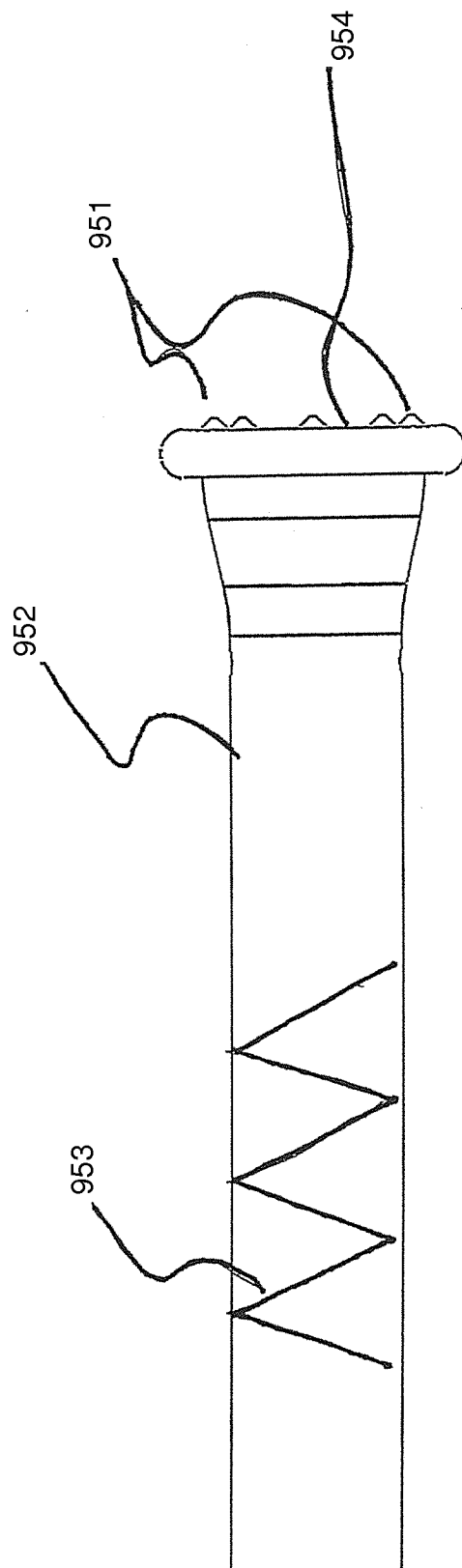


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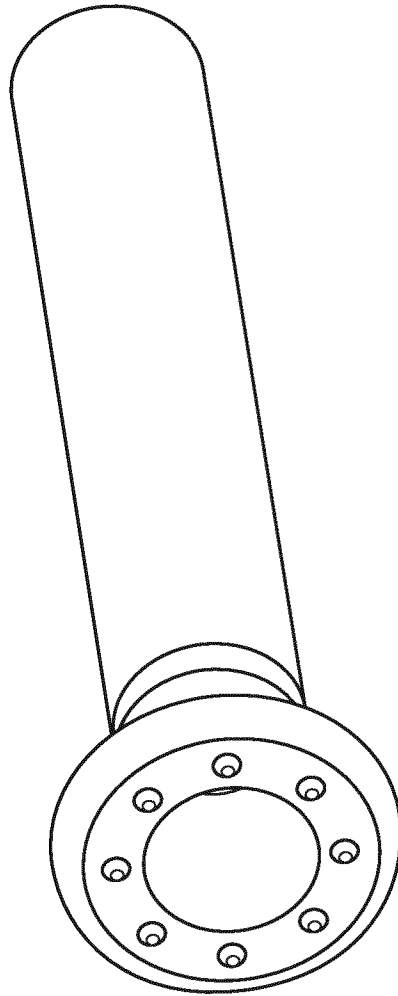


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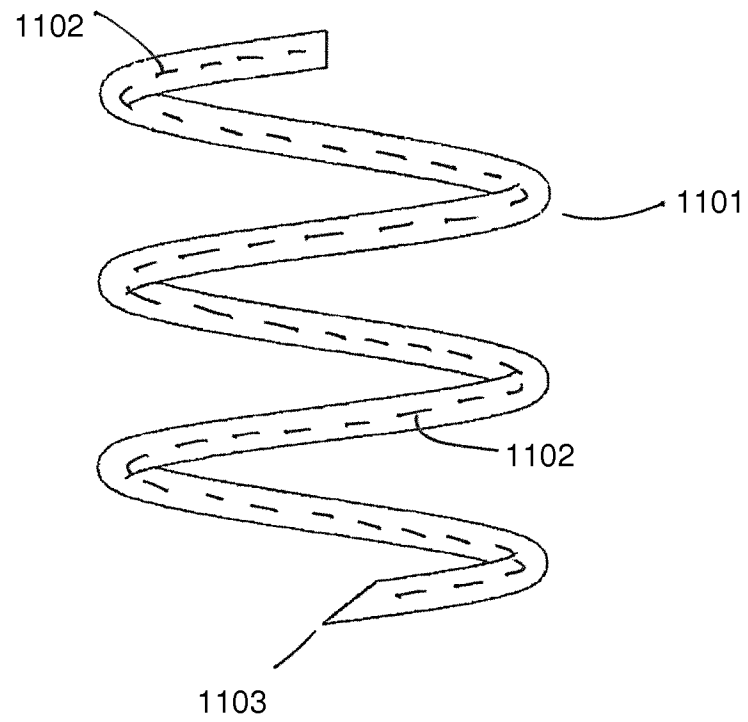


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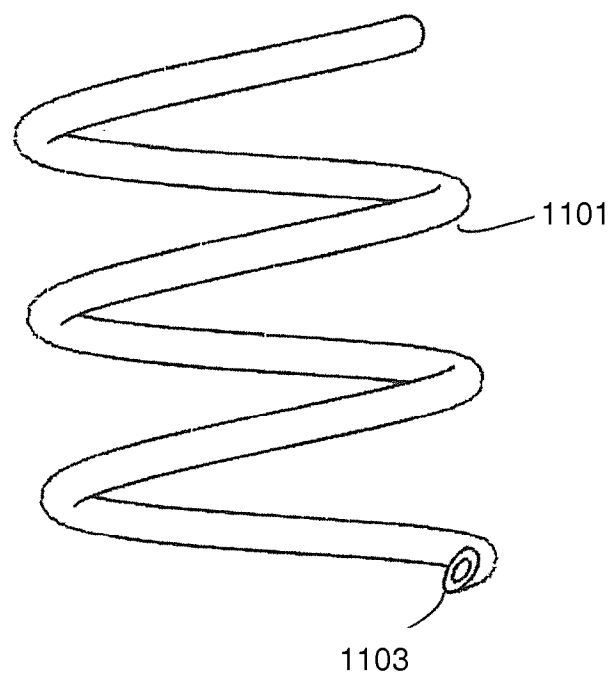


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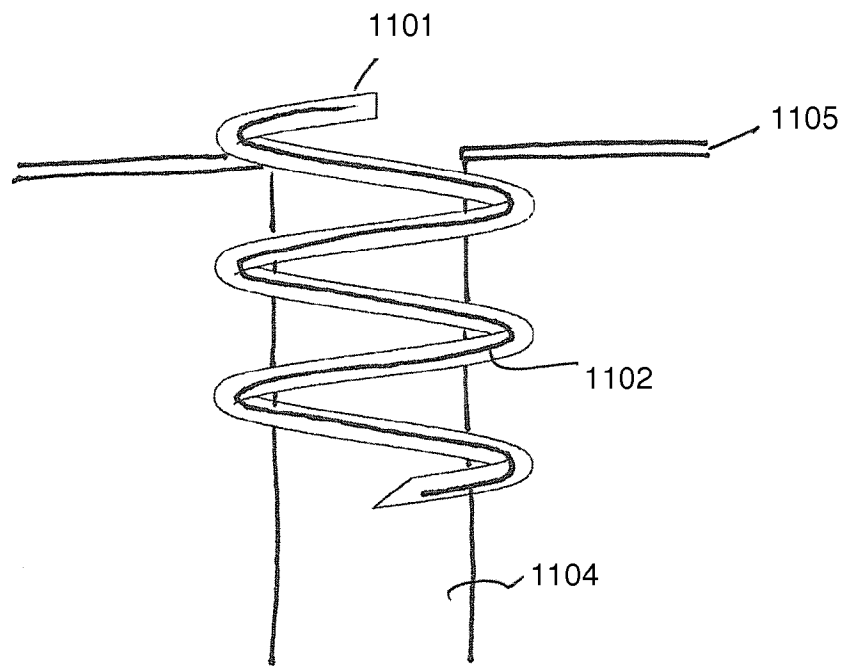


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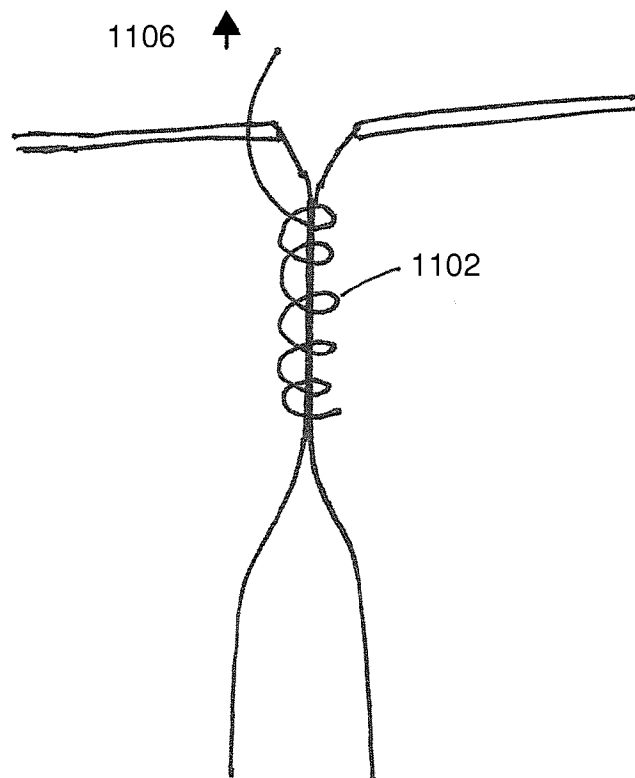


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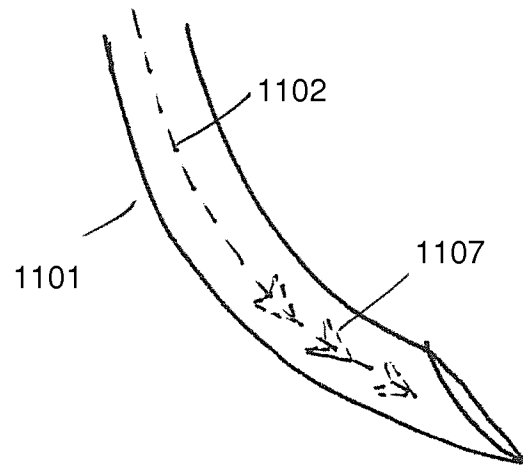


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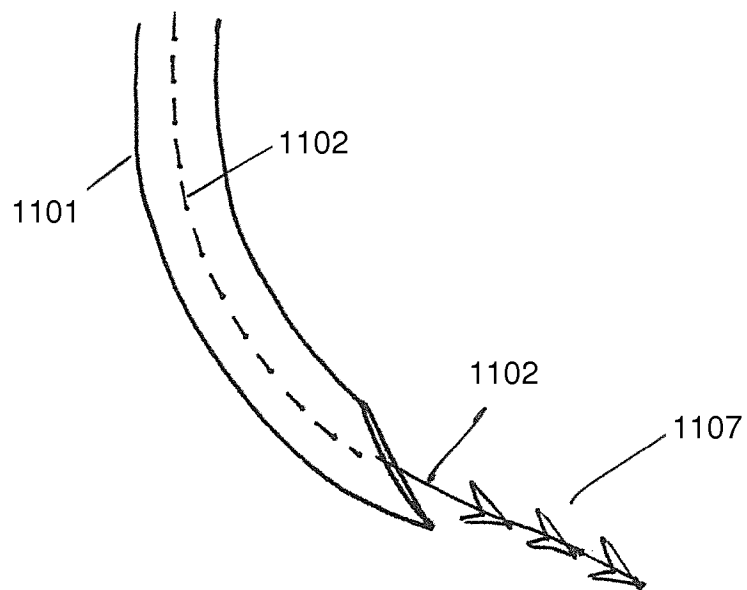


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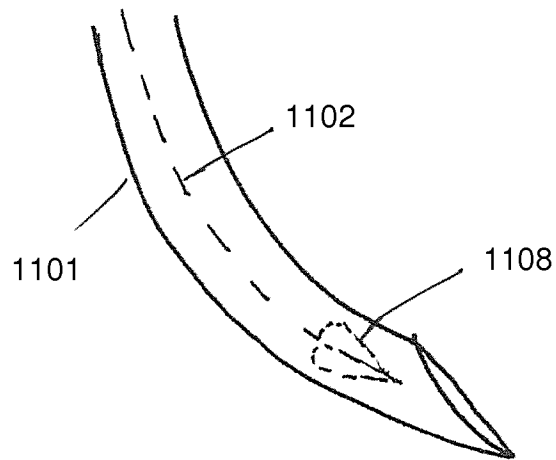


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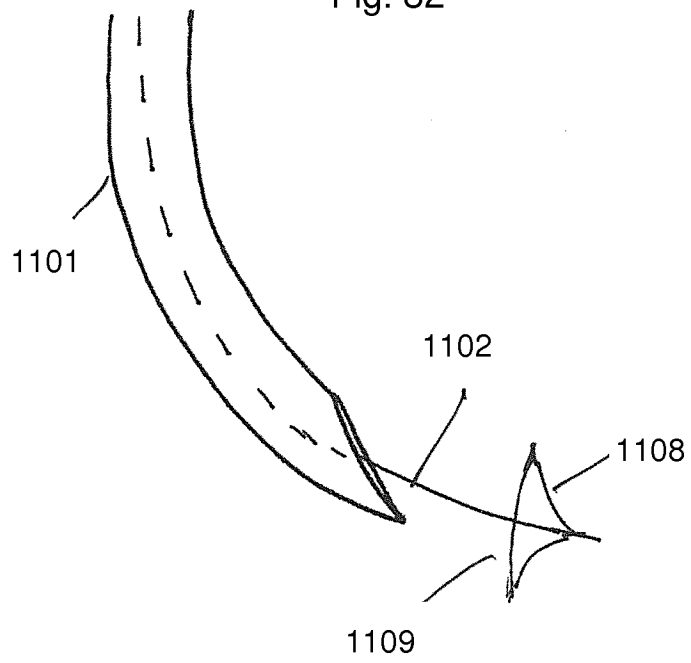


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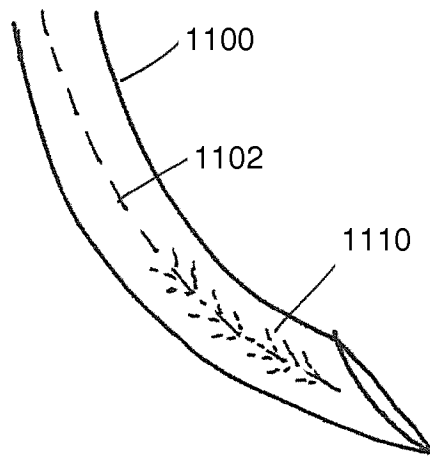


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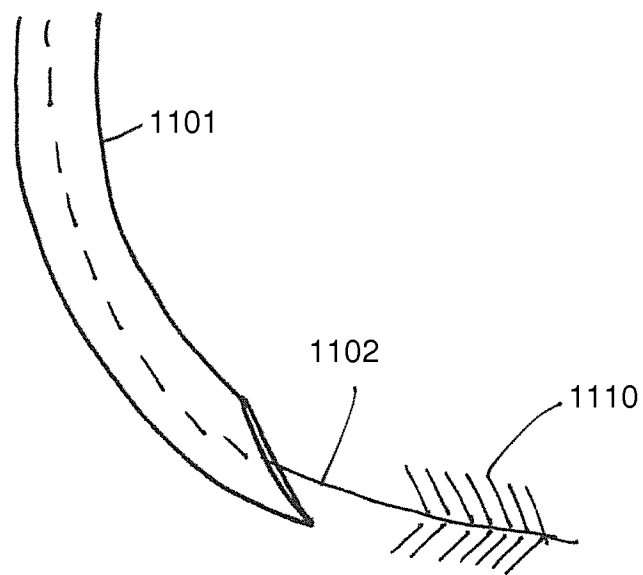


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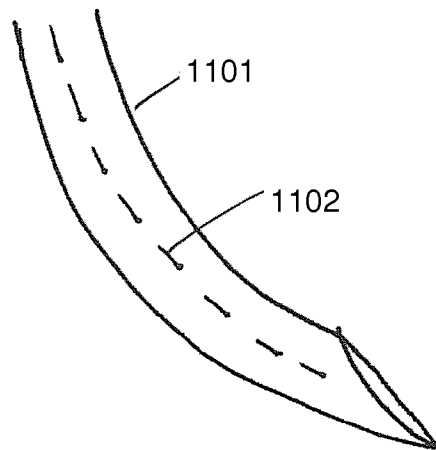


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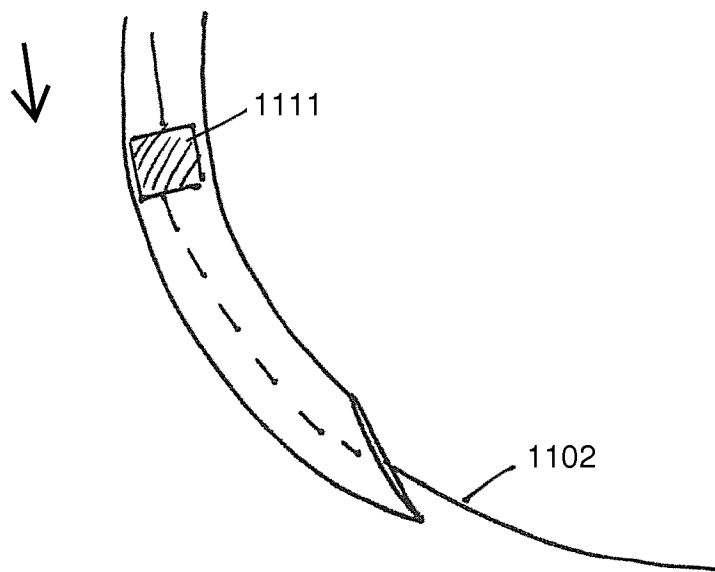


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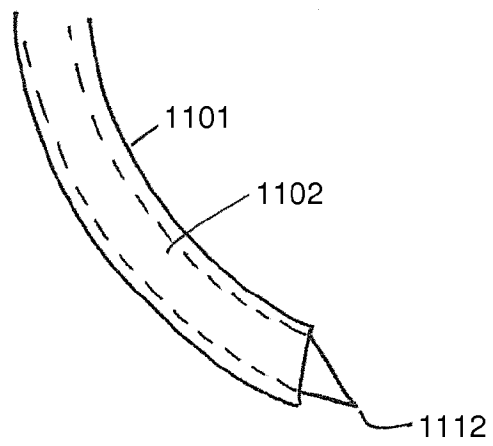


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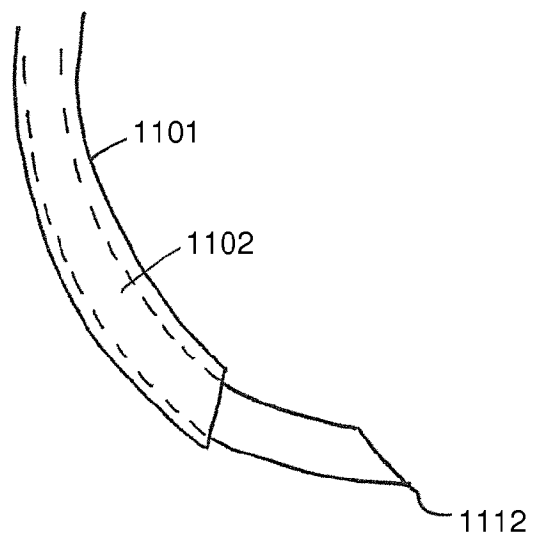


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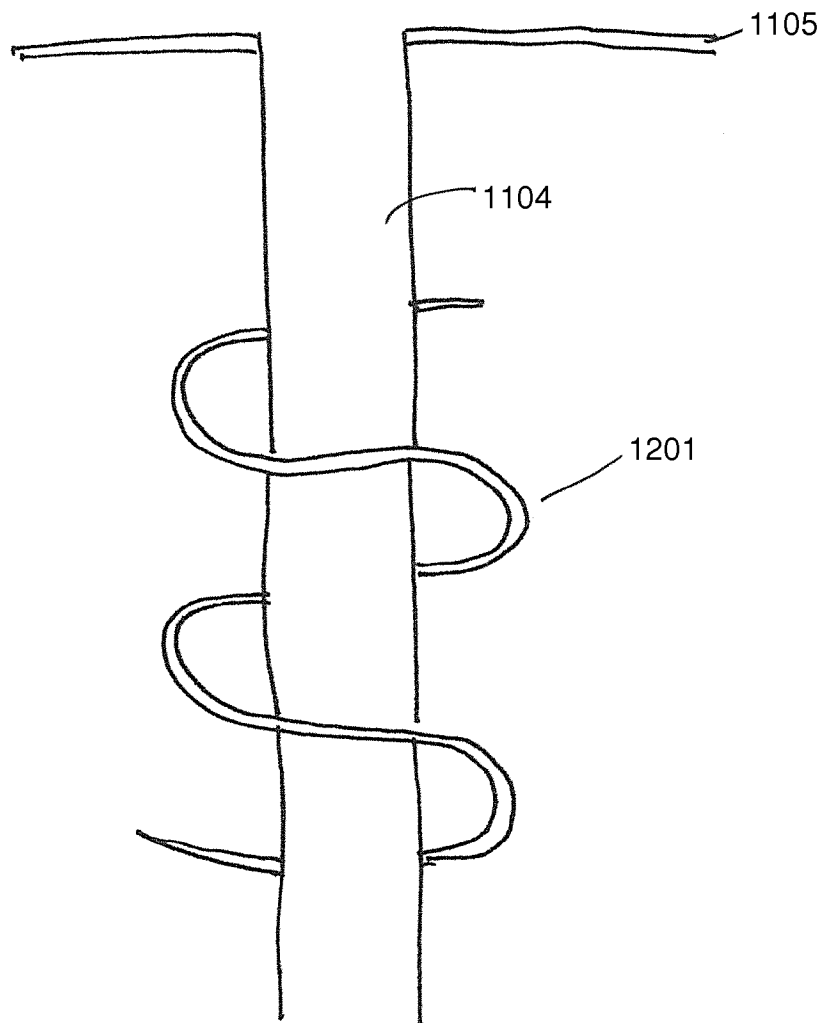
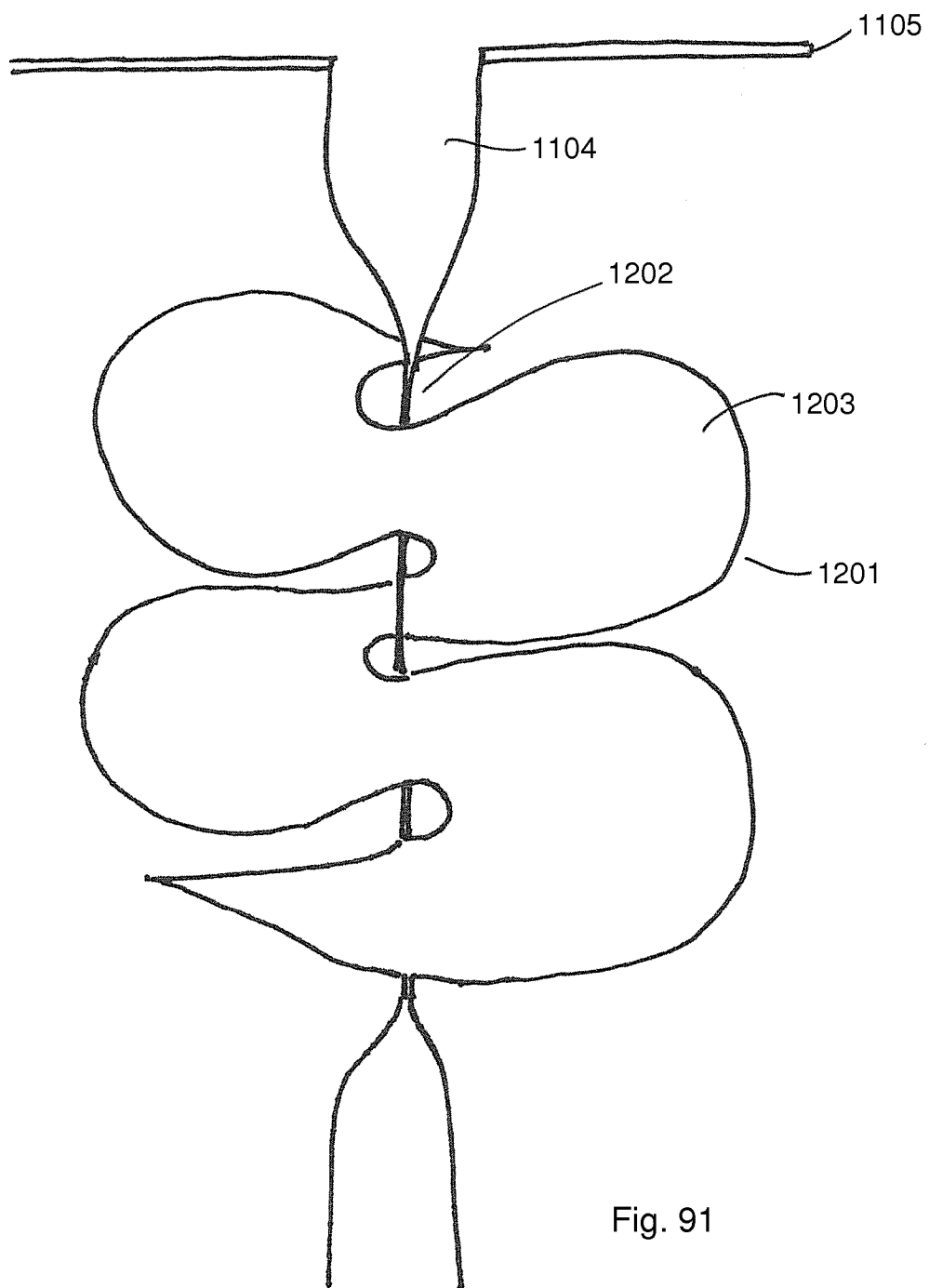
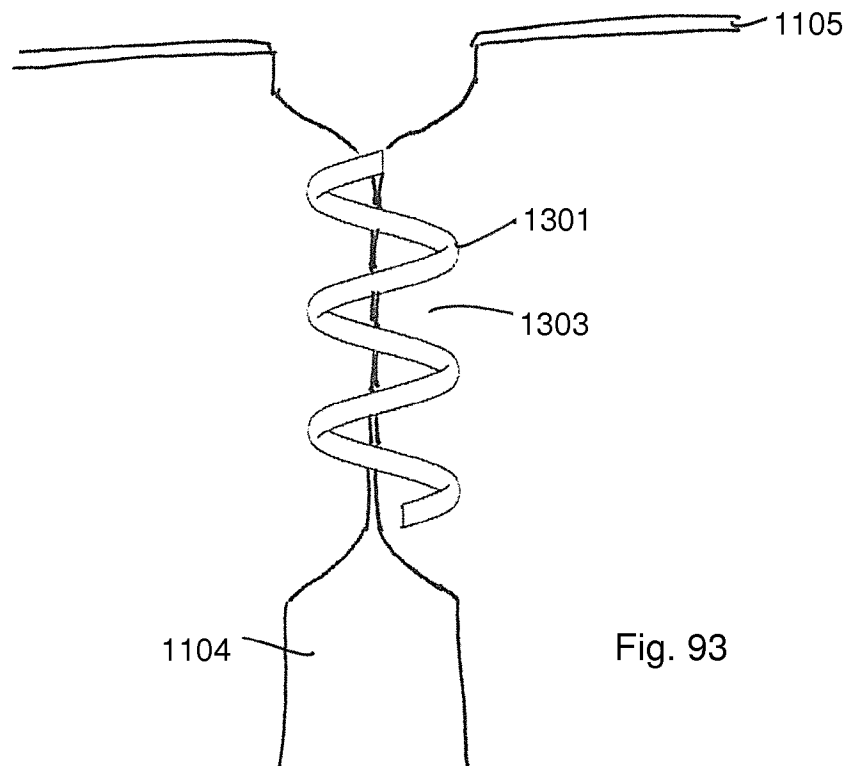
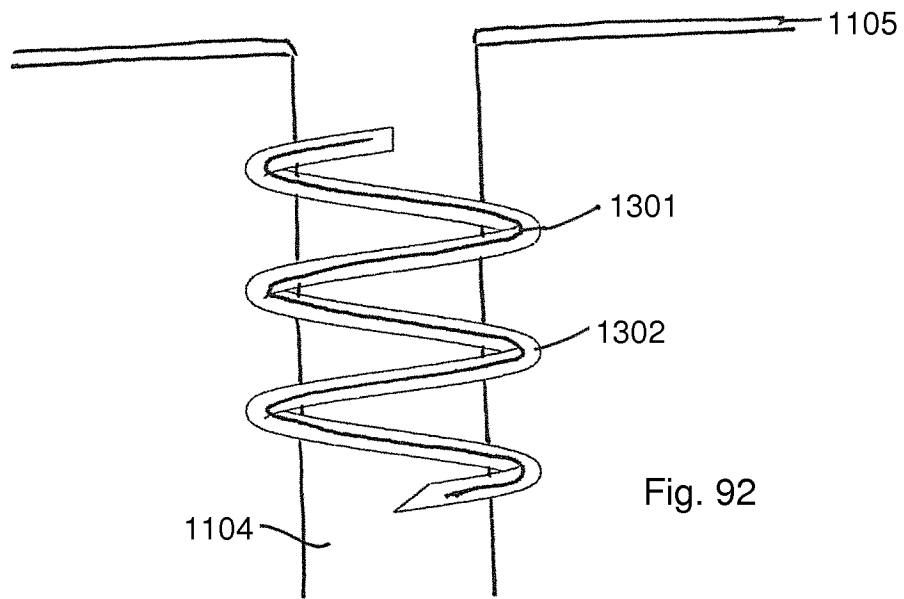


Fig. 90





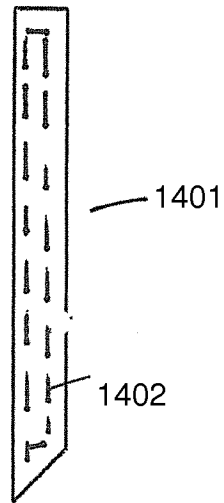


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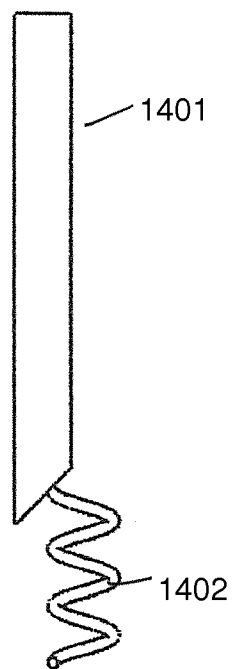


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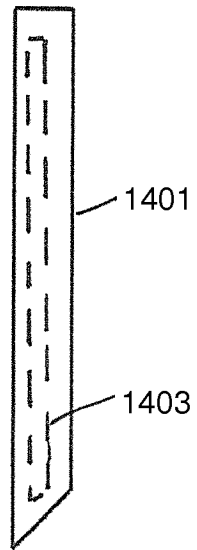


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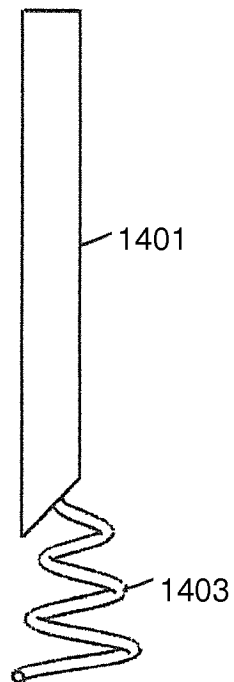


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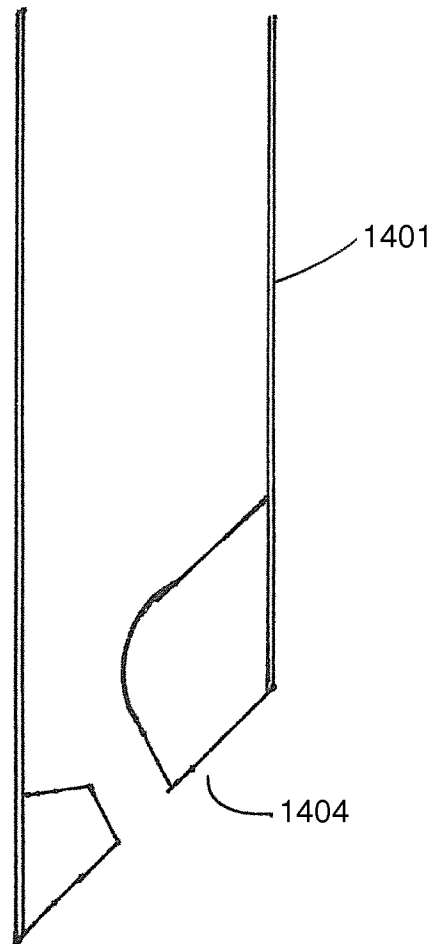


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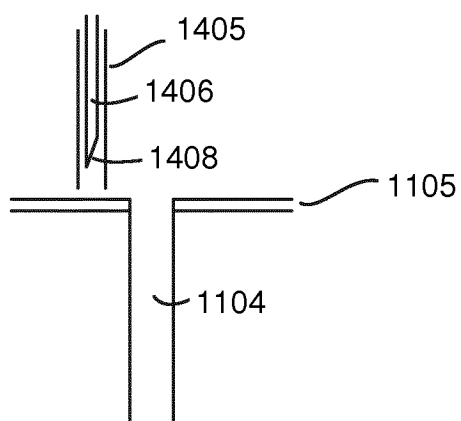


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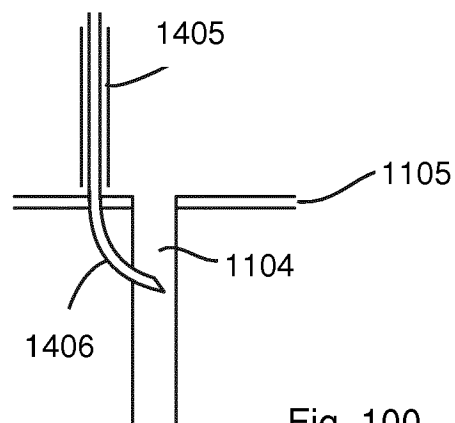


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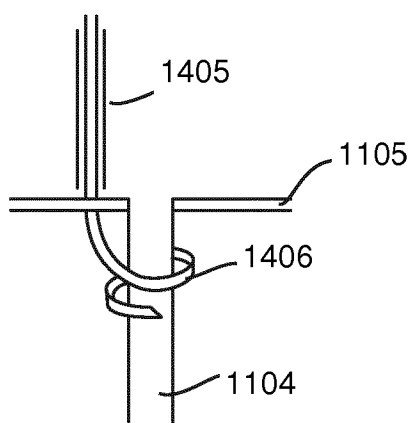


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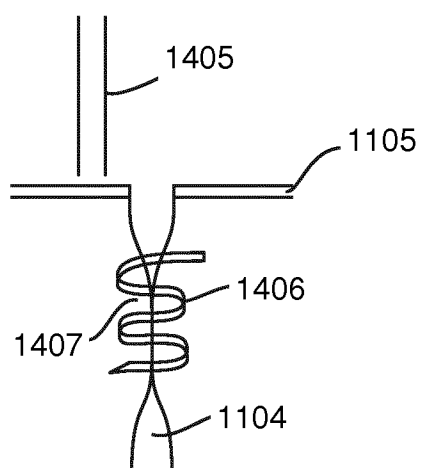


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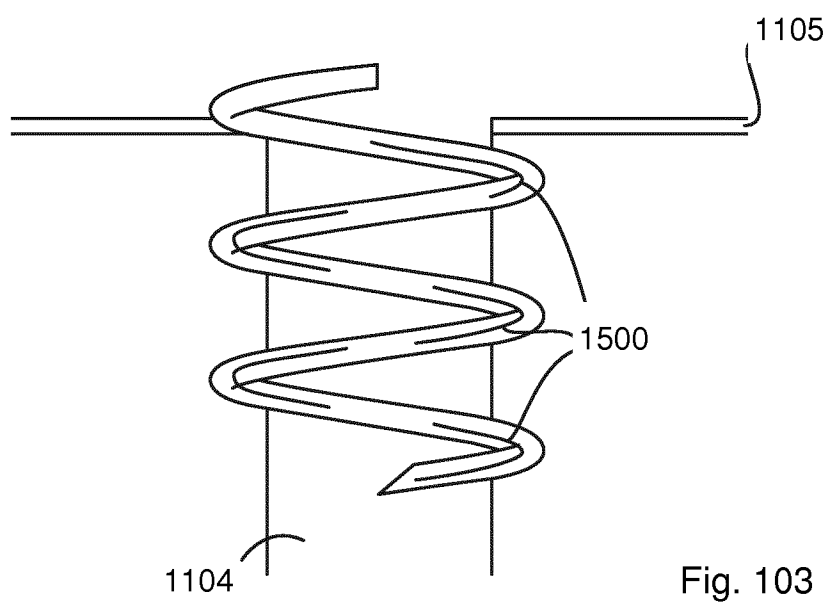


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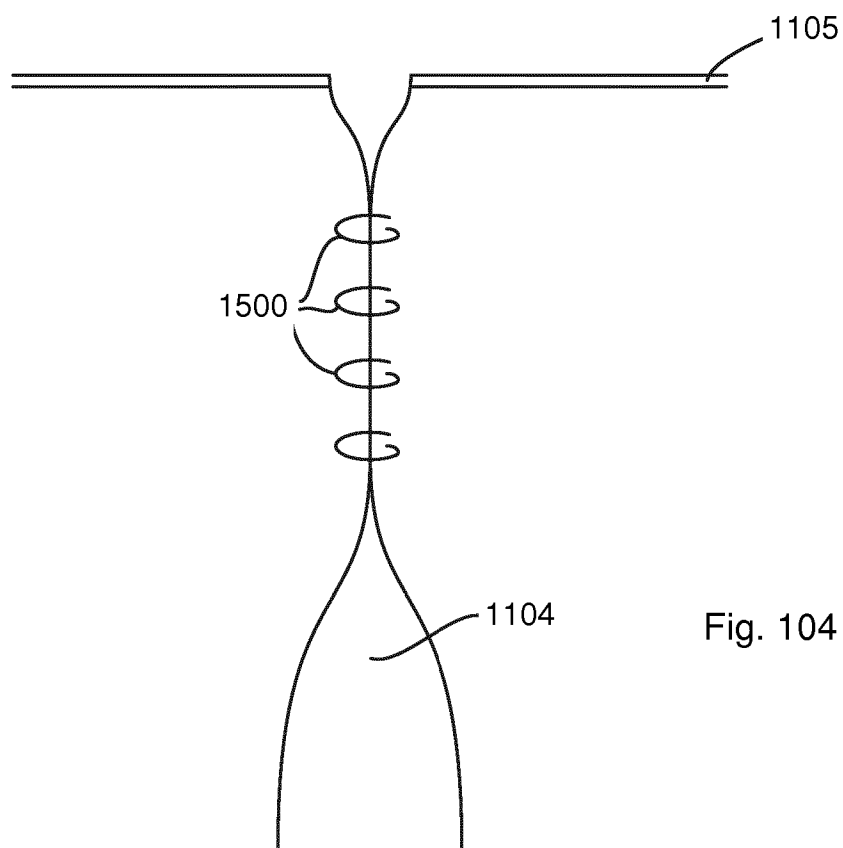


Fig. 104

REFERENCES CITED IN THE DESCRIPTION

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