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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 April 2017 (13.04.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/062850 A2

(51) International Patent Classification:
A61B 17/02 (2006.01) *A61B 17/34* (2006.01)

(21) International Application Number:
PCT/US2016/056109

(22) International Filing Date:
7 October 2016 (07.10.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/238,608 7 October 2015 (07.10.2015) US

(71) Applicant: **APPLIED MEDICAL RESOURCES CORPORATION** [US/US]; 22872 Avenida Empresa, Rancho Santa Margarita, CA 92688 (US).

(72) Inventors: **ALBRECHT, Jeremy, J.**; 22872 Avenida Empresa, Rancho Santa Margarita, CA 92688 (US). **BECERRA, Matthew, M.**; 27052 Springwood Cir, Lake Forest, CA 92630 (US). **NGUYEN, Eric**; 22872 Avenida Empresa, Rancho Santa Margarita, CA 92688 (US).

(74) Agent: **BONNER, Cynthia, A.**; Applied Medical Resources Corporation, 22872 Avenida Empresa, Rancho Santa Margarita, CA 92688 (US).

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

[Continued on next page]

(54) Title: WOUND RETRACTOR WITH MULTI-SEGMENT OUTER RING

(57) Abstract: A retractor/protector suitable for use in a surgical incision or a natural orifice comprises a longitudinal axis defining an instrument access channel extending from a proximal end to a distal end; a flexible outer ring; an inner ring; a flexible sheath extending between the outer ring and the inner ring; and at least one rigid segment adapted to attach to the flexible outer ring to thereby increase the rigidity of the outer ring. Embodiments of the retractor/protector are described that have interlocking and non-interlocking rigid segments. Embodiments are also described that have bases that insert into or under the flexible outer ring in addition to or in lieu of rigid segments to increase rigidity and/or provide support for a detachable cap.

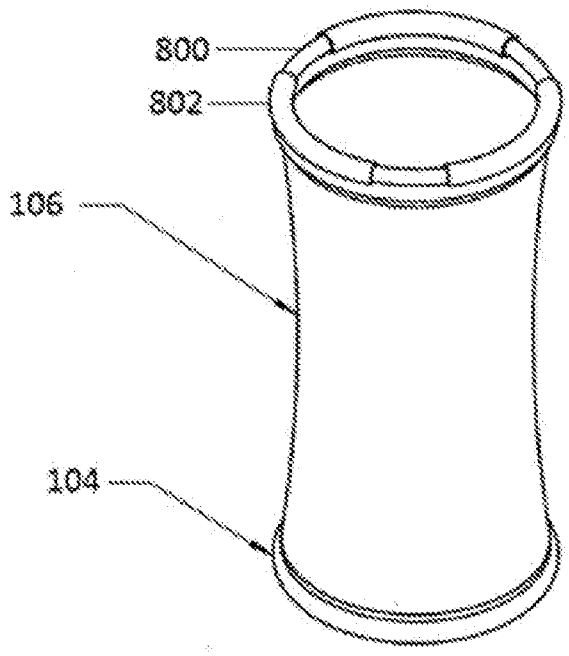

FIG. 3C

WO 2017/062850 A2

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

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WOUND RETRACTOR WITH MULTI-SEGMENT OUTER RING

Cross Reference to Related Applications

[0001] This application claims the benefit of U.S. Application No. 62/238,608, filed October 7, 2015, the entire disclosure of which is incorporated by reference.

Technical Field

[0002] This invention generally relates to medical devices and, more specifically, to a wound retractors having detachable rigid segments attached to the outer rings of the retractor or protector.

Discussion of the Relevant Art

[0003] Wound retractors/protectors have been described in U.S. Patent Nos. 7,650,887; 7,727,146; 7,883,461; 7,913,697; 8,235,054, and 8,267,858, the disclosures of which are hereby incorporated by reference in their entireties. The basic components of such wound retractors include an outer ring or rings, an inner ring, and a flexible sheath or sleeve attached at either end to the outer and inner ring.

[0004] The outer ring or rings of the wound retractor may be flexible or rigid. In general, flexible outer rings are more comfortable and easier to deploy, while rigid outer rings provide better retraction and, optionally, serve as a platform for attachment of a cap or other similar devices. What is needed, therefore, is a retractor having an outer ring that combines the comfort and ease of deployment of a flexible ring with the retraction and functionality of a rigid ring.

Summary

[0005] A retractor/protector suitable for use in a surgical incision or a natural orifice comprises a flexible outer ring, an inner ring, a flexible sheath extending between the outer ring and the inner ring, a longitudinal axis defining an instrument access channel extending through the flexible sheath from the flexible outer ring at a proximal end to the inner ring at a distal end and a rigid segment adapted to detachably connect to the flexible outer ring to thereby increase the rigidity of the outer ring. In some embodiments there are two rigid segments, while in other embodiments there are more than two rigid segments detachably connected to the outer ring. In some embodiments, the rigid segments are interlockable. In some interlockable examples, the rigid segments may have a boss on one end and a recess on the other end, the recess configured to receive the boss of a contiguous rigid segment.

[0006] In another embodiment of the present invention, the rigid attachment is in the form of a ring-shaped rigid base. The ring-shaped rigid base may have an annular groove circumscribed around the outer circumference of the base, the groove configured to receive the outer ring. In this embodiment, the outer ring can be snap fit into the rigid base to provide rigidity when needed.

[0007] In still another embodiment of the present invention, the outer ring is detachable from the flexible sheath. In this embodiment, the outer ring comprises a first magnetic strip. The flexible sheath has a second magnetic strip disposed at the proximal end of the sheath, such that the outer ring is detachably connected to the proximal end of the flexible sheath by magnetic attraction between the first magnetic strip and the second magnetic strip. In alternative embodiments, the outer ring

comprises a first tube and a second tube, wherein a rigid support ring is disposed within the first lumen and the first magnetic strip is disposed within the second lumen. In some embodiments, a cap may be detachably connected to the outer ring.

Brief Description of the Drawings

[0008] FIG. 1 illustrates an isometric view of an adjustable wound retractor.

[0009] FIG. 2 is a cross-sectional view of a wound retractor deployed in an incision.

[0010] FIG. 3A illustrates a front view of a wound retractor having an outer ring system comprising a flexible outer ring with interchangeable rigid segments.

[0011] FIG. 3B illustrates a top view of the wound retractor of FIG. 3A.

[0012] FIG. 3C illustrates a perspective view of the wound retractor of FIG. 3A.

[0013] FIG. 4A illustrates a top view of the outer ring system of FIGs. 3A-C.

[0014] FIG. 4B illustrates a right view of the outer ring system of FIGs. 3A-C.

[0015] FIG. 5A illustrates an alternative embodiment of the wound retractor of FIGs. 3A-C, shown in front view.

[0016] FIG. 5B illustrates a top view of the wound retractor of FIG. 5A.

[0017] FIG. 5C illustrates a perspective view of the wound retractor of FIG. 5A.

[0018] FIG. 6A illustrates the outer ring system of FIGs. 5A-C, shown in top view.

[0019] FIG. 6B illustrates the outer ring system of FIGs. 5A-C, shown in front view.

[0020] FIG. 7A illustrates a wound retractor having a flexible outer ring adapted to mount on a rigid base, shown in top view.

[0021] FIG. 7B illustrates a cross-sectional view of the wound retractor of FIG. 7A.

[0022] FIG. 7C illustrates a perspective view of the wound retractor of FIG. 7A.

[0023] FIG. 8A illustrates the outer ring and rigid base of FIGs. 7A-C, shown in top view.

[0024] FIG. 8B illustrates the outer ring and rigid base of FIGs. 7A-C, shown in cross-sectional view.

[0025] FIG. 8C illustrates the outer ring and rigid base of FIGs. 7A-C, shown in perspective view.

[0026] FIG. 9A illustrates a top view of an alternative embodiment of the wound retractor of FIGs. 7A-C.

[0027] FIG. 9B illustrates a cross-sectional view of the wound retractor of FIG. 9A.

[0028] FIG. 9C illustrates a perspective view of the wound retractor of FIG. 9A.

[0029] FIG. 10A illustrates the outer ring and rigid base of FIG. 9, shown in top view.

[0030] FIG. 10B illustrates the outer ring and rigid base of FIG. 9, shown in cross-sectional view.

[0031] FIG. 10C illustrates the outer ring and rigid base of FIG. 9, shown in perspective view.

[0032] FIG. 11A illustrates a wound retractor having an imbedded magnetic strip, shown in top view.

[0033] FIG. 11B illustrates a wound retractor having an imbedded magnetic strip, shown in front view.

[0034] FIG. 11C illustrates a wound retractor having an imbedded magnetic strip, shown in perspective view.

[0035] FIG. 12A illustrates a front view of the wound retractor of FIG. 11 with broken section lines.

[0036] FIG. 12B illustrates a cross-sectional view of the wound retractor shown in FIG. 12A.

[0037] FIG. 12C illustrates a close-up view of the outer ring of the wound retractor of FIG. 11.

[0038] FIG. 13A illustrates an alternative embodiment of the wound retractor of FIG. 11, shown in top view.

[0039] FIG. 13B illustrates an alternative embodiment of the wound retractor of FIG. 11, shown in front view.

[0040] FIG. 13C illustrates an alternative embodiment of the wound retractor of FIG. 11, shown in perspective view.

[0041] FIG. 14A illustrates a front view of the wound retractor of FIG. 13 with broken section lines.

[0042] FIG. 14B illustrates a cross-sectional view of the wound retractor of FIG. 14A.

[0043] FIG. 14C illustrates a close-up view of the outer rings of the wound retractor of FIG. 13.

Detailed Description

[0044] Wound retractors/protectors have been described in U.S. Patent Nos. 7,650,887; 7,727,146; 7,883,461; 7,913,697; 8,235,054, and 8,267,858, and U.S. Application No. 12/873,115, the disclosures of which are hereby incorporated by reference in their entireties.

[0045] FIG. 1 illustrates an adjustable wound retractor 100 useful in a variety of surgical procedures. The wound retractor **100** includes an outer ring **102**, an inner ring **104**, and a distensible sheath **106** coupling the outer ring and the inner ring. Outer ring

102 is shown as a single ring, but may also be a double ring or triple ring or multiples thereof. In the illustrated embodiment, the outer ring 102 comprises an annular axis around which the outer ring **102** is rotatable or invertible in a process through which the outer ring **102** is rolled through itself.

[0046] To facilitate rolling and to provide for enhanced comfort, the outer ring **102** preferably comprises a flexible material. In some embodiments, the flexible material comprises one or more polymers, for example, flexible engineering plastics. In some embodiments, the flexible material comprises an elastomer, for example, a thermoplastic elastomer. In some embodiments, the outer ring **102** comprises a composite, for example, a polymer and a reinforcing material. Examples of suitable reinforcing materials include fibers, fabrics, and the like, which comprise at least one of polymer, metal, glass, ceramic, and the like. Embodiments of the outer ring **102** are molded and/or extruded as a single piece or as a plurality of pieces that are assembled into the outer ring **102**.

[0047] In the illustrated embodiment, a cross-sectional shape of the outer ring **102** is generally a figure-8, or first circle and a second circle joined by a web extending therebetween. The outer ring may be solid or may have one or more lumens disposed in the ring. Other embodiments of the outer ring have different cross-sectional shapes, for example, generally oval or elliptical; diamond-shaped or rhomboid; hourglass or dog bone shaped; snowman-shaped; radially flat (washer-shaped outer ring), longitudinally flat (cylindrical outer ring), or flat at another angle (frustoconical outer ring); circular (toroidal outer ring), X-shaped, triangular, square, hexagonal, polygonal, and the like. Some embodiments of the outer ring comprise one or more gripping surfaces that facilitate manually rolling the outer ring around the annular axis thereof. Examples of

suitable gripping surfaces include generally flattened surfaces and concave surfaces. Some embodiments of the outer ring **102** have a Möbius configuration in which the outer ring **102** is fabricated with a preloaded circumferential torsional stress, for example, by twisting an elongate member followed by joining the ends.

[0048] In some hollow embodiments of the outer ring **102**, a wire or rod is disposed in at least one first lumen. Some embodiments of the outer ring **102** do not comprise a rod or wire disposed in a lumen thereof. Some embodiments of a non-compliant outer ring **102** facilitate direct coupling of another device to the outer ring **102** for example, a lid, cap, and/or gel cap. Some embodiments of a compliant outer ring **102** conform to a body surface.

[0049] Returning to FIG. 1, the sheath **106** may be coupled to the outer ring **102** and the inner ring **104** by heat seal, adhesive, or other means that are well known in the art. The sheath **106** may be made of a material that is flexible and impermeable to fluids and bacteria.

[0050] Embodiments of the sheath comprise sheets, membranes, fibers, and/or strands of one or more materials that endow the sheath with the abrasion and puncture resistance. Suitable sheets, membranes, fibers, and/or strands comprise at least one of natural polymers, semi-synthetic polymers, synthetic polymers, metal, ceramic, glass, carbon fiber, carbon nanotubes, and the like. Suitable natural polymers include cellulose, silk, and the like. Semi-synthetic fibers include nitrocellulose, cellulose acetate, rayon, and the like. Suitable synthetic fibers include polyester, aromatic polyester, polyamide (NYLON®, DACRON®), aramid (KEVLAR®), polyimide, polyolefin, polyethylene (SPECTRA®), polyurethane, polyurea, polyvinyl chloride (PVC), polyvinylidene chloride, polyether amide (PEBAX®), polyether urethane

(PELLETHANE®), polyacrylate, polyacrylonitrile, acrylic, polyphenylene sulfide (PPS), polylactic acid (PLA), poly(diimidazopyridinylene-dihydroxyphenylene) (M-5); poly(*p*-phenylene-2,6-benzobisoxazole) (ZYLON®), liquid crystal polymer fiber (VECTRAN®), and the like, and blends, copolymers, composites, and mixtures thereof. Suitable metals include stainless steel, spring steel, nitinol, super elastic materials, amorphous metal alloys, and the like.

[0051] Some embodiments of the sheath material comprises a composite comprising a fabric or textile, for example, at least one of a coated fabric, a laminated fabric, and a fabric embedded in a polymer. Coatings and/or laminations are disposed on one face or both faces of the fabric. Suitable coatings and laminating materials include polymers, for example, at least one of polyurethane, polyether, PVC, polyvinylidene chloride, silicone, styrene-butadiene, polyethylene, polypropylene, ethylene-propylene copolymer, polyisoprene, ethylene vinyl acetate (EVA), ethylene-propylene-diene monomer (EPDM), polyamide (MYLAR®), polyether block amide (PEBAX®), polyether urethane (PELLETHANE®), composites, blends, mixtures, and the like. An example of a suitable composite fabric is polyurethane laminated fabric (PUL). Some embodiments of the coating or lamination modify gas and/or moisture permeability through the sheath material, for example, by controlling the size of pores therethrough. For example, decreasing moisture permeability reduces dehydration of the retracted tissue and/or creates a barrier to pathogens such as bacteria. Increasing gas and moisture permeability permits hydrating and/or oxygenating the retracted tissue. Some materials are selectively permeable to certain fluids. For example, some embodiments of PVC are oxygen permeable and moisture impermeable, thereby permitting simultaneously oxygenating tissue while reducing dehydration. Some embodiments of the coating or

lamination comprise an antibacterial or antimicrobial agent. In some embodiments, the antibacterial or antimicrobial agent is a surface agent or is integral to the material. Examples of suitable antibacterial or antimicrobial agents include iodine, antibiotics, silver, triclosan, biocides, and the like. Some embodiments of the coating or lamination provide a smoother and/or lower friction inside surface, which reduces the likelihood of instrument damage to the sheath.

[0052] Some embodiments of the sheath comprise a composite comprising a fiber-reinforced polymer film or membrane. Suitable fibers or strands are discussed above. Suitable polymer film materials include at least one of materials discussed above as coating and laminating materials. In some embodiments, the fibers are sandwiched between polymer film layers. In some embodiments, the polymer film layers are independently selected. For example, in some embodiments, the outer layer provides desirable tissue contact properties discussed above, while the inner layer is puncture resistant.

[0053] Some embodiments of the sheath comprise a plurality of layers, for example, a fabric layer and a polymer film layer, or a fabric layer sandwiched between polymer film layers. In some embodiments, the layers are secured to each other. In other embodiments, the layers are independent of, or not secured to each other, for example, a polymer film layer and a layer comprising a plurality of strips or bands as discussed above.

[0054] Some embodiments of the sheath comprise a fluid-permeable layer disposed on a fluid-impermeable layer, with the fluid-impermeable layer disposed on the inside of the sheath. The fluid-permeable layer contacts the wound margins, thereby permitting a user to supply pressurized fluid and/or apply vacuum to the wound margins. For

example, in some embodiments, oxygen, moisture, therapeutic agent, and/or other fluids are supplied to the wound margins. In some embodiments, applying vacuum promotes bleeding, thereby reducing tissue necrosis. Embodiments of the fluid-permeable layer comprise at least one of open cell foam, fabrics, non-woven fabrics, and knit fabrics.

[0055] In some embodiments, at least a portion of the sheath is transparent, thereby providing a view of the retracted tissue. In some embodiments comprising a polymer membrane or film, the polymer membrane or film is transparent.

[0056] The inner ring **104** may be made of materials of sufficient hardness to retain its shape after insertion into a body cavity **904** (FIG. 2) but sufficiently flexible so as to allow the inner ring to be compressed for insertion through an incision. The materials of which the outer ring **102** is made must allow the outer ring to be turned around its annular axis as further described below. The shape of the outer ring **102** affects both its ability to grip and to provide stability during and after adjustment.

[0057] FIG. 2 illustrates the wound retractor deployed in a wound opening 900. To deploy the wound retractor, an incision in the shape of a slit is first made in the body wall **902** of a patient, such as the abdominal wall **902**. The inner ring **104** is compressed and the inner ring and sheath **106** are manually inserted into the body cavity **904** through the incision with the outer ring **102** remaining external to the body cavity. Once the inner ring **104** is within the body cavity **904**, it expands around the inner surface of the incision **900** so as to be generally parallel to the outer surface of the abdominal wall **902**. The sheath **106** provides a working channel from outside the body cavity **904** to inside the body cavity.

[0058] The outer ring **102** initially rests above the abdominal wall **902** around the wound opening **900**. Since the upper end of the sheath **106** is coupled to the outer ring **102**, the sheath **106** can be drawn upwards and radially outward or inward, thereby drawing the inner ring **104** tightly against the inner surface of the abdominal wall **902**. Moreover, the intermediate portion of the sheath **106** is drawn tightly against the sides and edges of the wound opening **900**, thereby retracting the adjacent tissue and producing a tightly sealed opening in the body cavity **904**. The sheath **106** contacts the entire surface of the wound **900** and protectively covers and seals it from contamination and infection. Depending on the size and depth of the incision **900**, the user can roll up the sheath **106** by gripping the outer ring **102** and rotating it until the sheath **106** abuts the outer edge of the wound opening **900**. The inner ring **104** is adapted for juxtaposition with the inner surface of the abdominal wall **902** and the outer ring **102** is adapted for juxtaposition with the outer surface of the abdominal wall. Both the inner ring **104** and the outer ring **102** are adapted for disposition relative to the incision **900** in the abdominal wall **902**. The sheath **106** is adapted to traverse the incision **900** in the abdominal wall **902**.

[0059] After surgery, the wound retractor **100** may be retrieved by grabbing the inner ring **104** and the sheath **106** and pulling them through the wound opening **900**. The use of the sheath **106** and the ease of retracting the outer ring **102** provide higher compression between the inner and outer rings. As a result, the wound retractor **100** provides incremental adjustability to fit a wide range of incision sizes and isolates and protects the wound from bacterial infection as diseased body parts and contaminated instruments are passed through the wound.

[0060] FIGs. 3 and 4 illustrate a new wound retractor, in which the outer ring system is designed to provide the user with both flexibility for ease of deployment and rigidity for full retraction once deployed. The outer ring system comprises a flexible outer ring **800** and one or more interchangeable rigid segments **802** that can be attached to the flexible ring to provide rigidity to the outer ring while in the resting state. The rigid segments can be strategically placed along the retracted wound where, for example, constant maximum visualization is required.

[0061] In some embodiments, the rigid segments are designed to snap fit onto the flexible outer ring, and may be partially or continuously placed along the circumference of the flexible ring based on the user's preference and desired degree of rigidity.

[0062] FIG. 3A shows a front view of the new wound retractor, in which three rigid segments **802** are snap fit onto the outer ring **800**, better seen in top view FIG. 3B or auxiliary view FIG. 3C. The skilled artisan will appreciate that the number and dimensions of the rigid segments will vary depending on intended use. Thus, for example, rigid segments may have a shorter length, in which many more such segments can be attached to the outer ring, or a longer length, in which relatively few segments are attached to provide a more rigid outer ring. Varying the number and dimensions of the rigid segments will effectively modulate the rigidity of the outer ring. Similarly, the segments can be placed anywhere on the outer ring so as to provide different degrees of rigidity. While the rigid segments shown in FIG. 3 are substantially evenly placed around the outer ring, segments can be placed in regions of the outer ring where increased rigidity is desirable while leaving other portions of the outer ring more flexible, depending on the user's particular requirements. A close-up view of the rigid

segments **802** attached to the outer ring **800** is shown in FIG. 4A (top view) and FIG. 4B (right view).

[0063] In the embodiment shown in FIGs. 3 and 4, the rigid segments are independent units, not linked together. In an alternative embodiment, as shown in FIGs. 5 and 6, interlockable rigid segments **804** comprise a boss **806** at one end and a recess **808** at the other, the recess adapted to receive the boss of an adjacent rigid segment to thereby link the segments together. In the illustrated embodiment, the interlinked rigid segments form a complete ring, which substantially covers the outer ring **800**, best seen in FIG. 5B, 5C and FIG. 6B. It should be appreciated that the boss **806** can be rigid, for easier insertion into the recess **808,** or relatively flexible, such that the shape of the interconnected ring of rigid segments **804** can conform to flexible outer rings of different shapes – e.g. circular, oval, elliptical and the like. Other interlocking devices besides a boss and recess are also contemplated in the present invention, including clamps, hooks and other interlocking means known in the art.

[0064] It should be appreciated that the outer ring system can be configured to have as many (or as few) rigid segments as needed. The rigid segments can be interconnected, as, for example, with a boss and recess configuration, or may attach to the outer ring independently. It should be further appreciated that providing rigidity to the outer ring with a series of discrete segments accommodates a range of sheath designs, such a circular, elliptical or other non-circular shapes.

[0065] In another embodiment, rigidity may be provided to a flexible outer ring by mounting the ring in a rigid base, allowing the wound to maintain its retracted shape during the duration of the procedure. For example, FIGs. 7 and 8 show a wound retractor in which a ring-shaped rigid base **810** is configured to receive the flexible ring

800 in an annular groove **812** disposed along the proximal or top surface of the base. In use, the retractor is deployed within the incision as described above and the wound retracted; the flexible outer ring **800** is then pulled up through the abdominal base and inserted into the annular groove **812**.

[0066] In an alternative embodiment, shown in FIGs. 9 and 10, the rigid base is configured to be deployed inside the flexible outer ring. In this embodiment, the ring-shaped rigid base **814** comprises an annular groove **816** along its outer circumference, adapted to receive the flexible ring **800.** After the wound retractor is deployed into the round and the wound is retracted, the rigid base **814** is inserted inside the flexible outer ring **800**, which is adapted to snap fit into the annular groove **816** to provide a rigid outer ring system.

[0067] The embodiments shown in FIGs. 7-10 are particularly suited to wound retractors adapted for use with a sealing cap. The rigid base, whether mounted under or inside the outer ring, may quickly and easily be added to the flexible outer ring to provide a uniform platform for attachment of a sealing cap. Gel caps suitable for use with wound retractors are described in detail in U.S. Patent No. 8,267,858, the entire content of which is incorporated herein in its entirety.

[0068] In still another embodiment, shown in FIGs. 11 and 12, the outer ring is detachable from the sheath. In this embodiment, the outer ring **818** attaches to the sheath **106** using magnetic attraction rather than conventional chemical or heat welding. A magnetic ring or strip **820** is imbedded in the proximal end of the sheath, while the outer ring comprises at least one magnetic or ferromagnetic ring **822** that attracts (or is attracted to) the magnetic strip **820**. Optionally, a ferromagnetic strip may be imbedded in the proximal end of the sheath, while the outer ring comprises a magnetic ring.

Optionally, as best shown in FIG. 12C, the outer ring may also comprise an elastic ring **823** and/or a rigid support ring **824**.

[0069] In yet another embodiment, the outer ring can be further configured to accept a sealing cap, such as a gel cap, to provide an instant seal of the body cavity while providing a working channel through the cap into the body cavity. In FIGs. 13 and 14, the wound retractor includes an outer ring **826** comprising two tubes, a first tube and a second tube, each having a lumen (see FIG. 14C). A rigid support ring **824** is disposed in the lumen of the first tube, providing a rigid base for attachment of a cap. A magnetic or ferromagnetic ring **822** is disposed in the lumen of the second tube, to attach the outer ring **826** to the magnetic ring **820** of the sheath **106**. Optionally, a ferrous strip may be imbedded in the proximal end of the sheath, while a magnetic ring is disposed within the lumen of the second tube.

[0070] While certain embodiments have been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope thereof as defined by the following claims.

Claims:

1. A retractor/protector comprising:
a flexible outer ring;
an inner ring;
a flexible sheath extending between the outer ring and the inner ring;
a longitudinal axis defining an instrument access channel extending through the flexible sheath from the flexible outer ring at a proximal end to the inner ring at a distal end; and
a first rigid segment having a first end and a second end, wherein the first rigid segment is adapted to detachably connect to the flexible outer ring to thereby increase the rigidity of the outer ring.

2. The retractor/protector of claim 1, further comprising a second rigid segment having a first end and a second end.

3. The retractor/protector of claim 1, further comprising a plurality of rigid segments.

4. The retractor/protector of claim 1, wherein the first rigid segment is adapted to snap fit onto the outer ring.

5. The retractor/protector of claim 2, wherein the first rigid segment and the second rigid segment are interlockable.

6. The retractor/protector of claim 5, wherein the first rigid segment further comprises a recess at the first end and a boss at the second end and the second rigid segment further comprises a recess at the first end and a boss at the second end, the recess of the first segment adapted to receive the boss of the second segment to thereby interlock the first rigid segment and the second rigid segment.

7. A retractor/protector comprising:
a flexible outer ring;
an inner ring;
a flexible sheath extending between the outer ring and the inner ring;
a longitudinal axis defining an instrument access channel extending through the flexible sheath from the flexible outer ring at a proximal end to the inner ring at a distal end; and
a ring-shaped rigid base comprising an inner circumference, an outer circumference, and an annular groove disposed around the outer circumference, the annular groove adapted to receive the flexible outer ring.

8. A retractor/protector comprising:
an outer ring comprising a first magnetic strip;
a flexible sheath having a proximal end, a distal end, and a second magnetic strip disposed around the proximal end;
an inner ring, the inner ring attached to the distal end of the flexible sheath, wherein the outer ring is detachably connected to the proximal end of the flexible sheath by magnetic attraction between the first magnetic strip and the second magnetic strip.

9. The retractor/protector of claim 8, further comprising a rigid support ring disposed within the outer ring.

10. The retractor/protector of claim 8, further comprising an elastic ring disposed within the outer ring.

11. The retractor/protector of claim 8, wherein the outer ring further comprises a proximal tube and a distal tube, the proximal tube having a first lumen and the

distal tube having a second lumen, wherein the first magnetic strip is disposed within the second lumen.

12. The retractor/protector of claim 11, further comprising a cap detachably connected to the first tube of the outer ring.

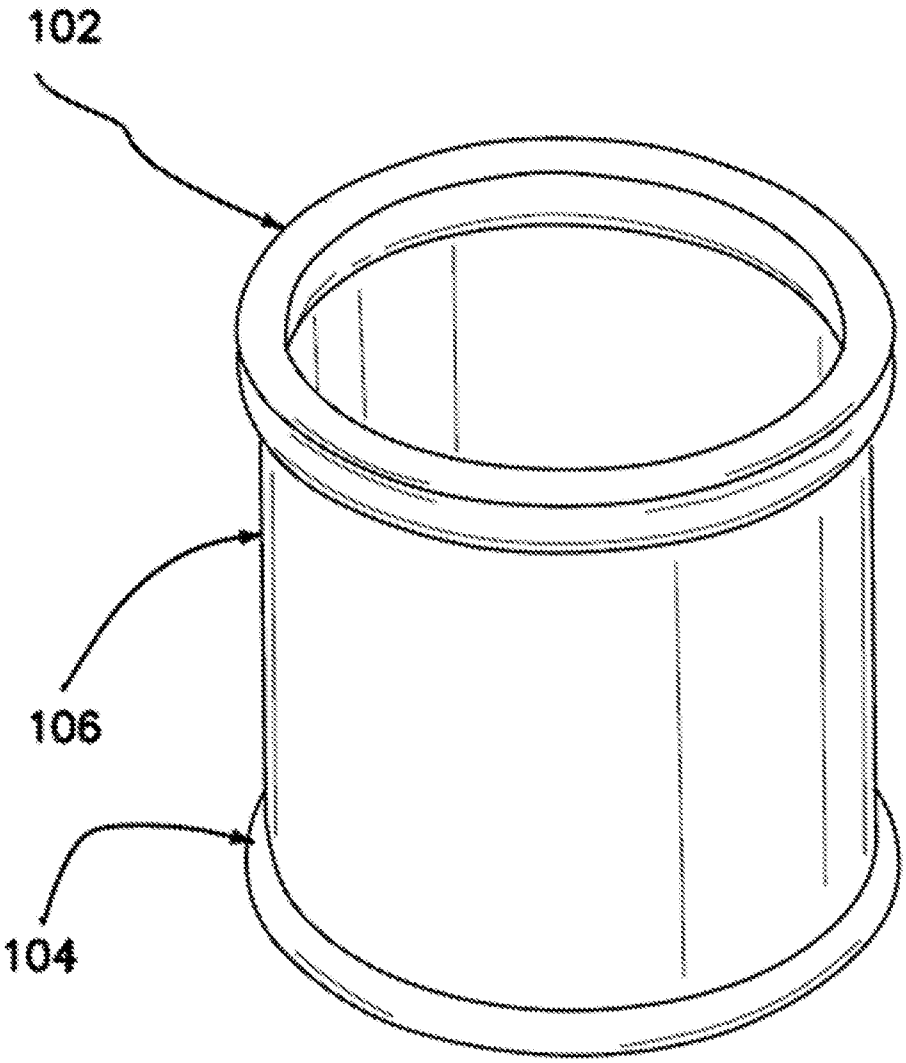

FIG. 1

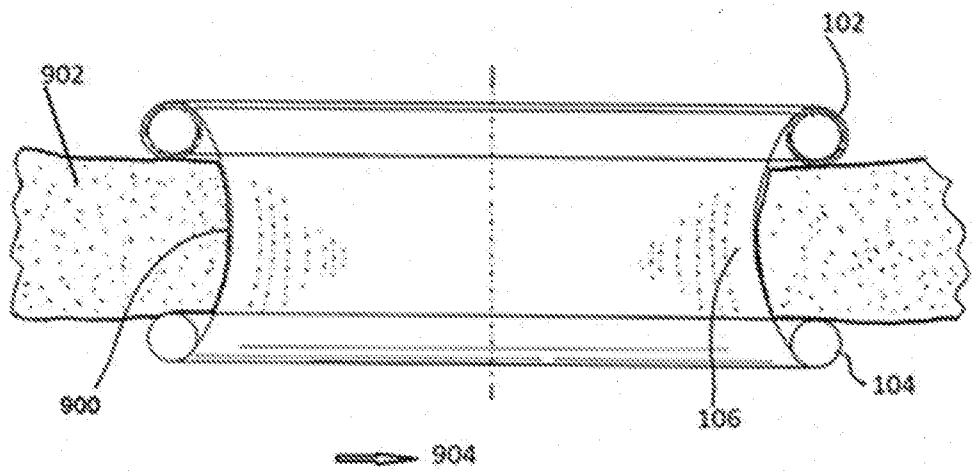

FIG. 2

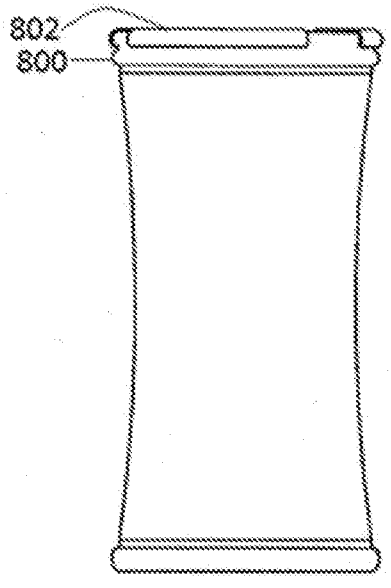

FIG. 3A

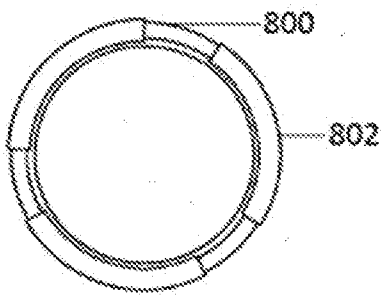

FIG. 3B

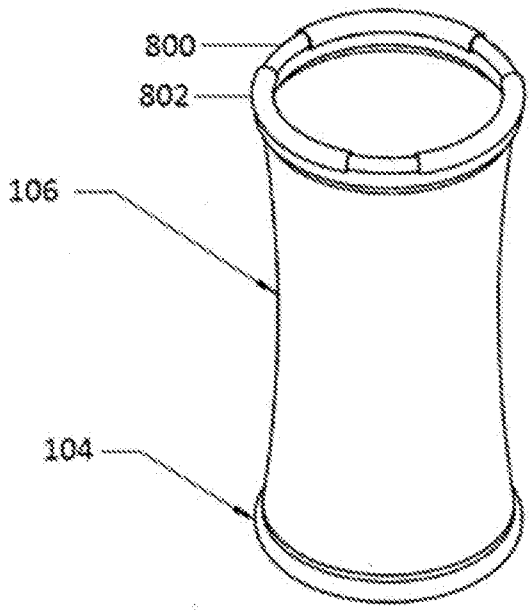

FIG. 3C

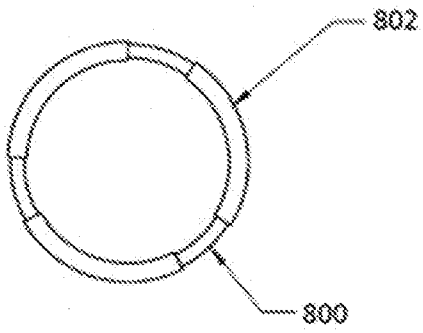

FIG. 4A

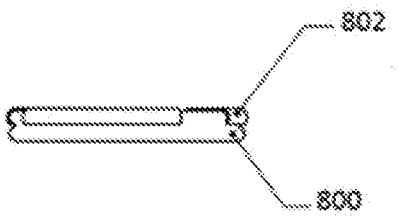

FIG. 4B

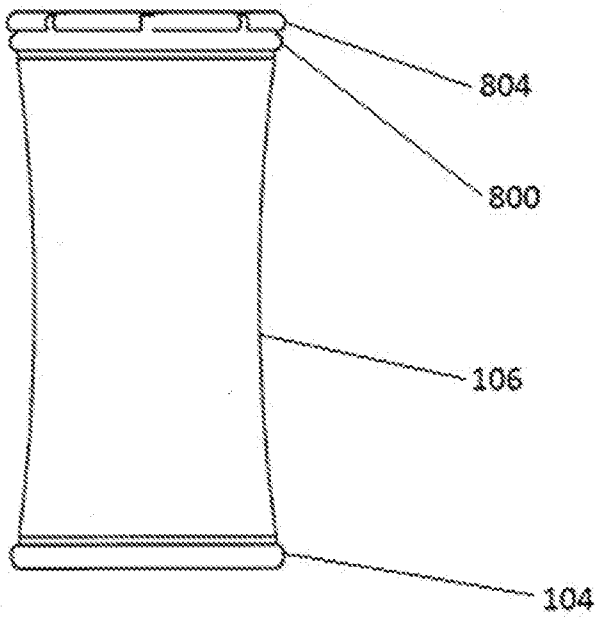

FIG. 5A

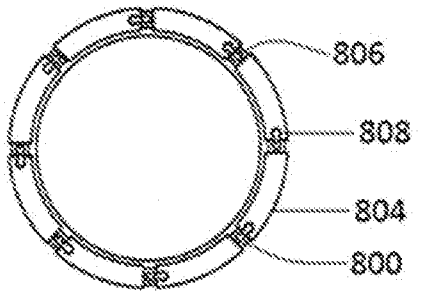

FIG. 5B

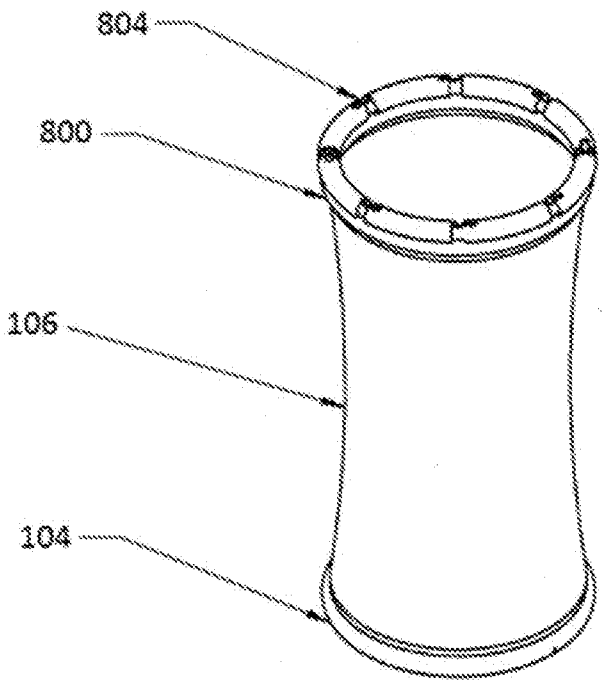

FIG. 5C

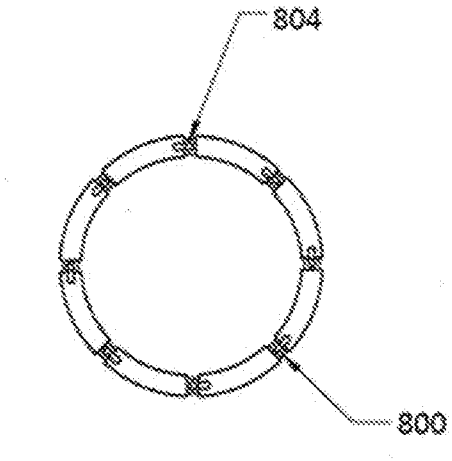

FIG. 6A

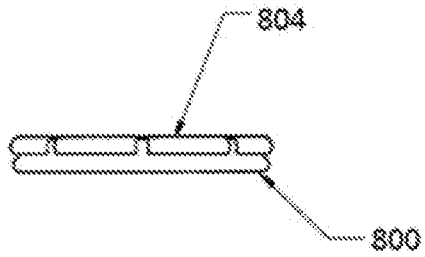

FIG. 6B

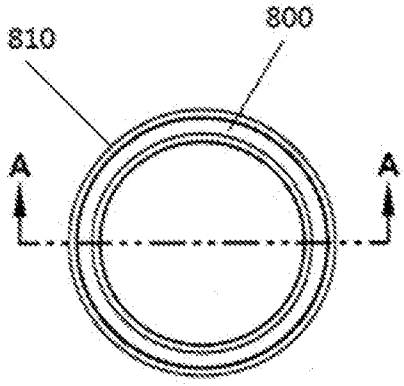

FIG. 7A

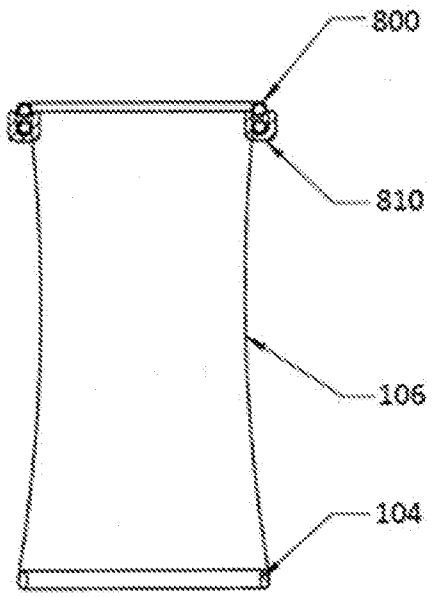

FIG. 7B

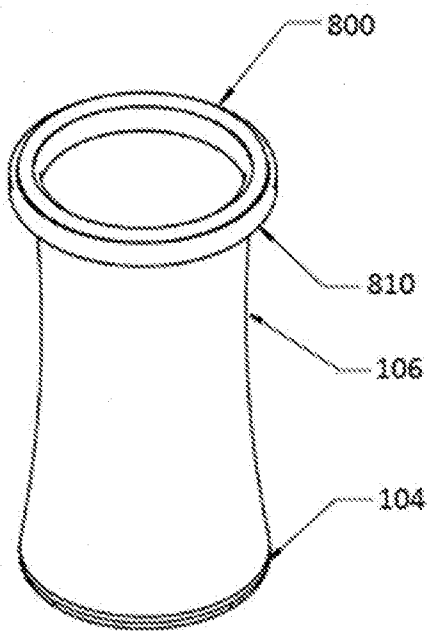

FIG. 7C

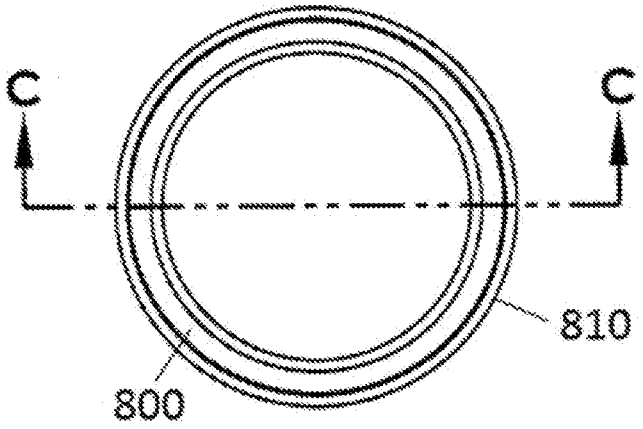

FIG. 8A

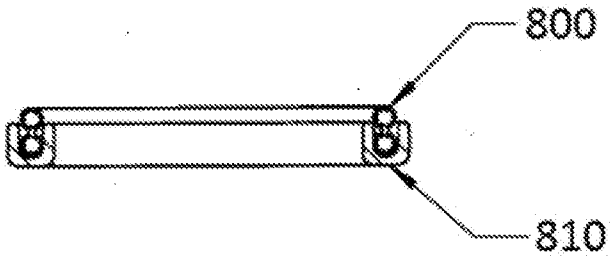

FIG. 8B

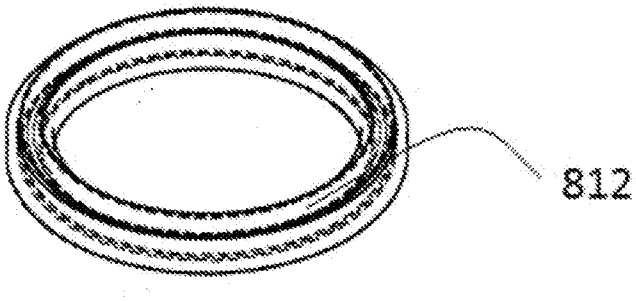

FIG. 8C

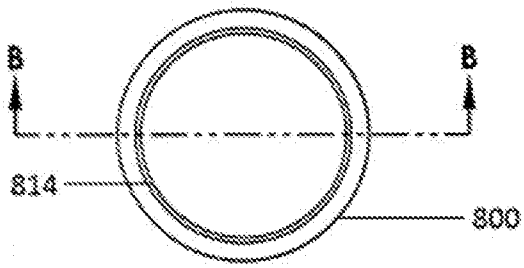

FIG. 9A

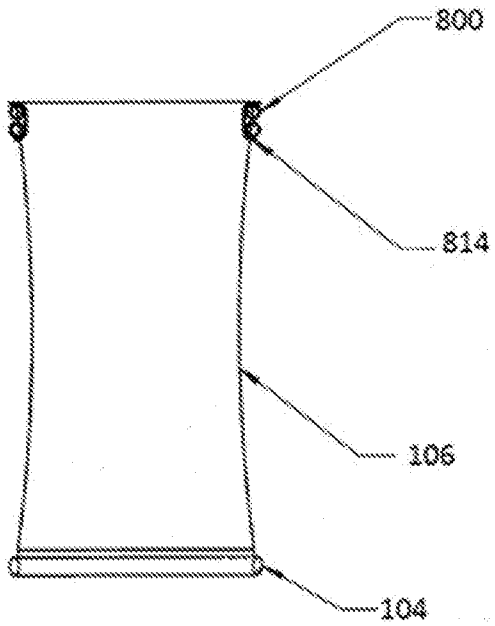

FIG. 9B

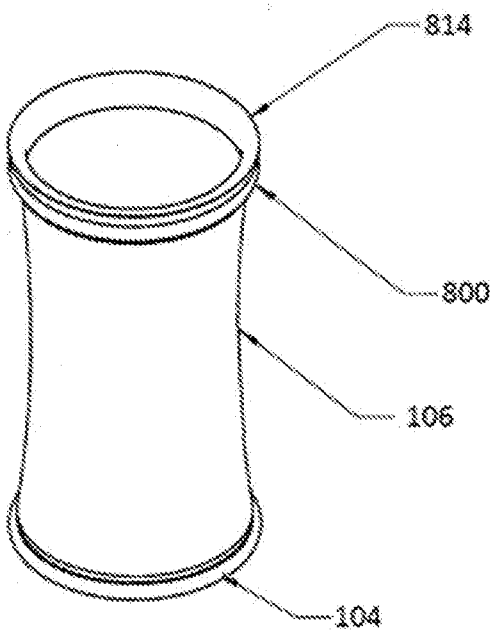

FIG. 9C

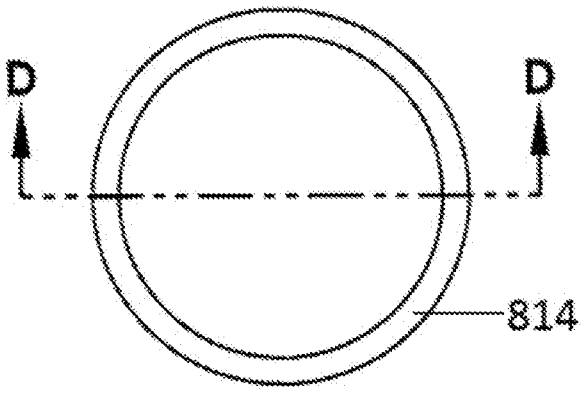

FIG. 10A

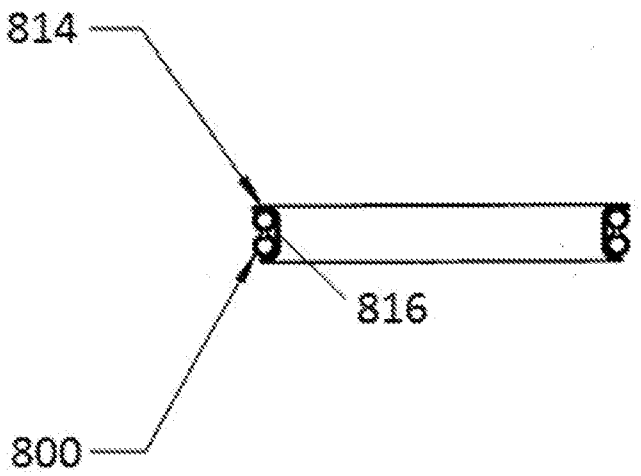

FIG. 10B

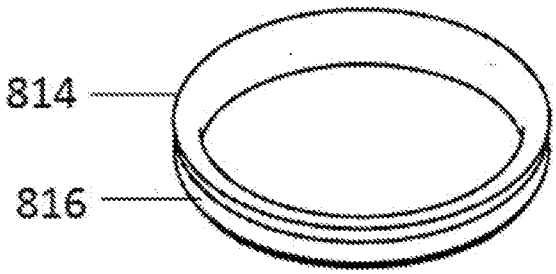

FIG. 10C

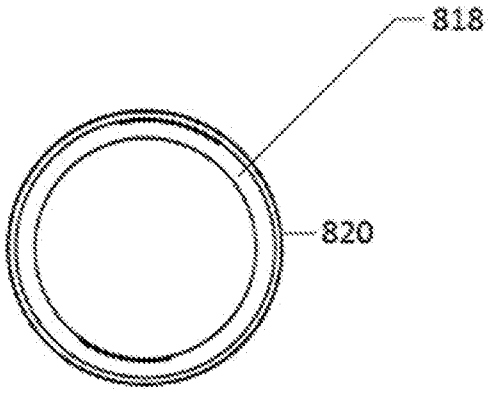

FIG. 11A

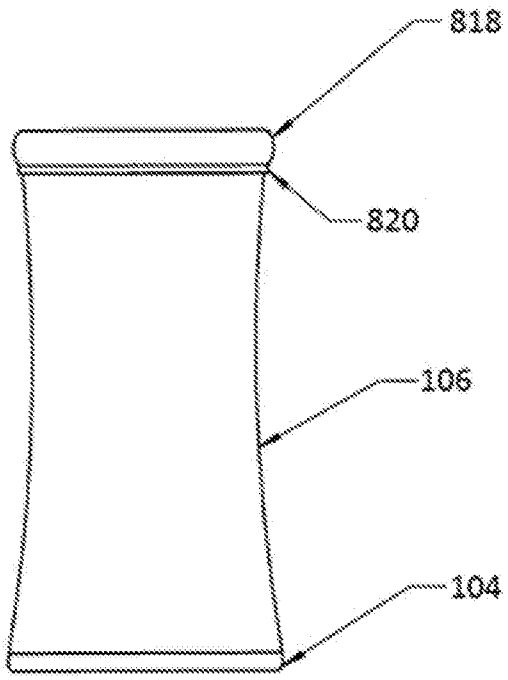

FIG. 11B

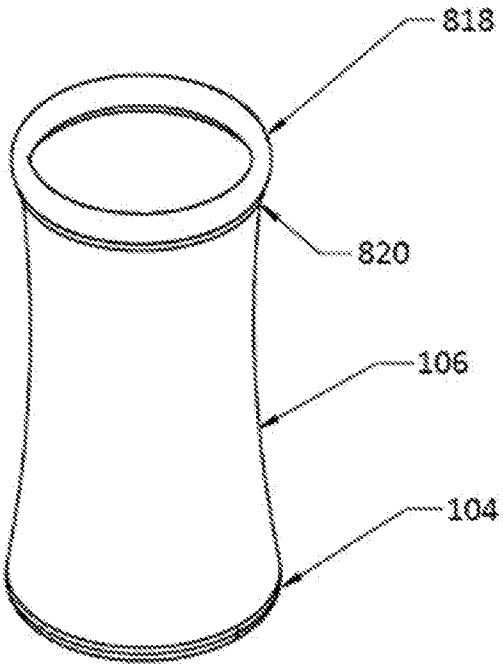

FIG. 11C

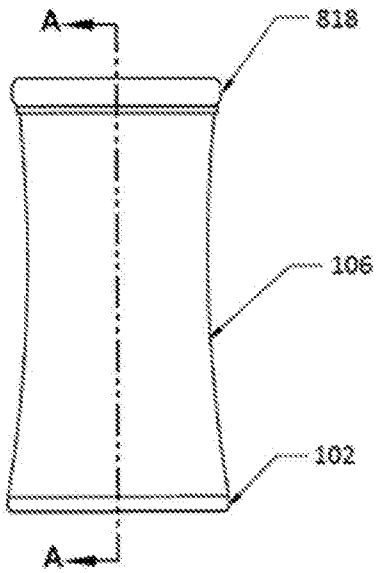

FIG. 12A

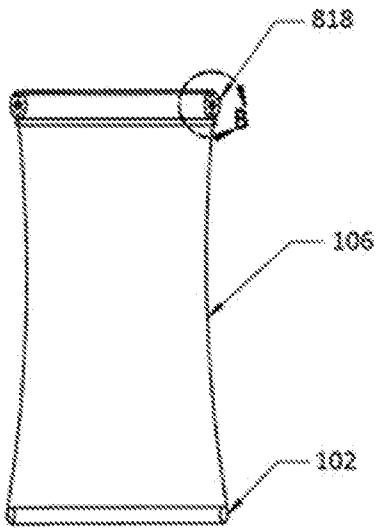

FIG. 12B

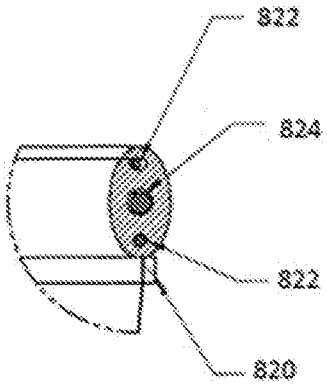

FIG. 12C

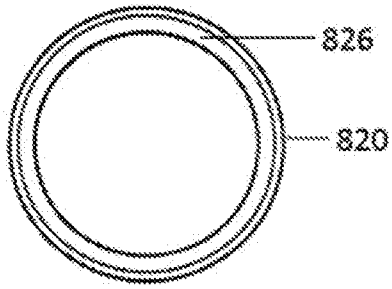

FIG. 13A

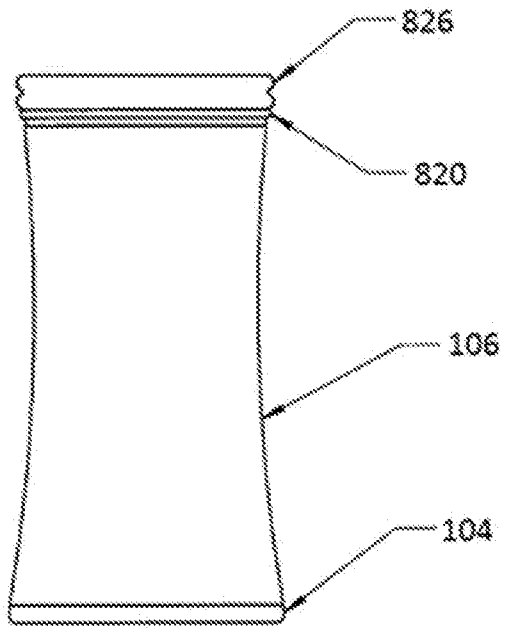

FIG. 13B

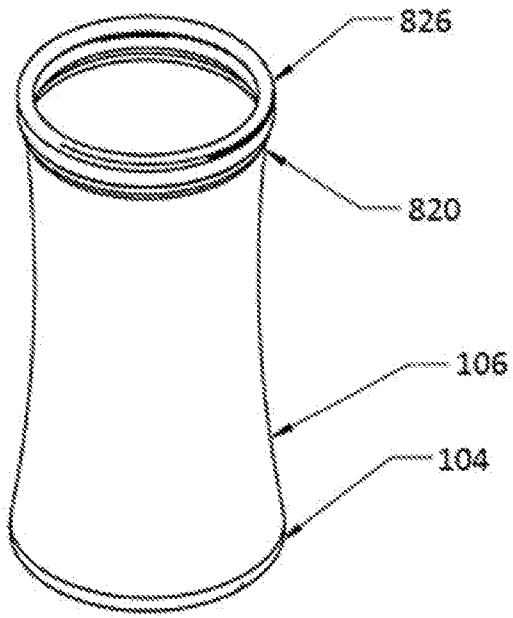

FIG. 13C

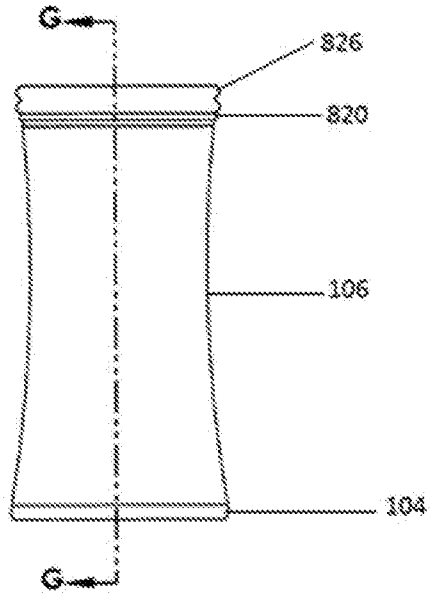

FIG. 14A

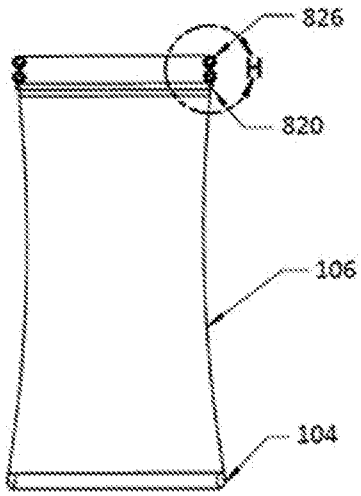

FIG. 14B

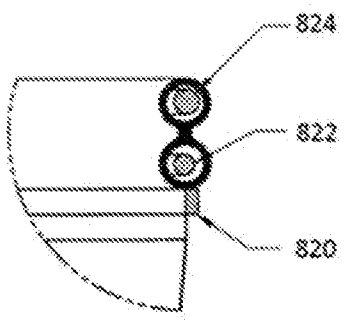

FIG. 14C