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(71) Applicant: COVIDIEN LP [US/US]; 15 Hampshire Street, Mansfield, Massachusetts 02048 (US).

(71) Applicant (for MG only): COVIDIEN (CHINA) MEDICAL DEVICES TECHNOLOGY CO., LTD. [CN/CN]; Rooms 501, No.3 Building, No. 2388, Chen Hang Road, Min Hang District, Shanghai 201114 (CN).

(72) Inventors: XU, Shunhong; Room 601 No. 62 Lane 1111, Shuying Road, Minhang District, Shanghai 201199 (CN). ZHANG, Xiliang; Room 601 No. 2 Lane 1122, Qinchun Road, Minhang District, Shanghai 201199 (CN). ZHANG, Jiangfeng; Shuangliao Road, Room 701, No. 2 Lane 155, Shanghai 200092 (CN).

(74) Agent: CCPIT PATENT AND TRADEMARK LAW OFFICE; 8th Floor, Vantone New World Plaza, 2 Fuchengmenwai Street, Xicheng District, Beijing 100037 (CN).

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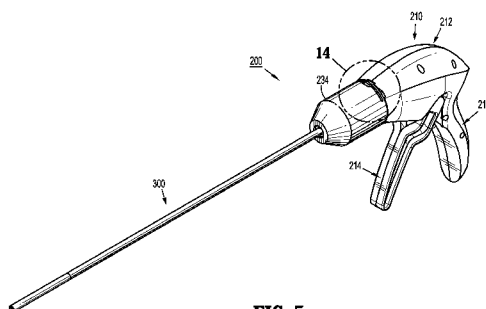


FIG. 5

(57) Abstract: An endoscopic surgical device (200) is provided and includes a handle assembly (210), an elongated tube (500a) and a loading unit (400a). The handle assembly (210) includes a handle housing (212) and a trigger (214) operatively connected to the handle housing (212), and a drive mechanism which is actuated by the trigger (214). The elongated tube (500a) is selectively connectable to the handle assembly (210). The loading unit (400a) is selectively connectable to the elongated tube (500a). The loading unit (400a) includes an outer tube (310), an inner tube (320) and a plurality of surgical anchors (100). The outer tube (310) defines a lumen (310c) therethrough and has a helical thread (330) disposed within the lumen (310c) thereof. The inner tube (320) is rotatably supported in the outer tube (310) and operatively connectable to the drive mechanism, the inner tube (320) defines a splined distal end (320b), the splined distal end (320b) of the inner tube (320) is defined by a pair of opposed longitudinally extending tines (320b₁) and a pair of opposed longitudinally extending channels (320b₂); The plurality of surgical anchors (100) are loaded in the splined distal end (320b) of the inner tube (320).

SURGICAL FASTENER APPLYING APPARATUS, KITS AND METHODS FOR ENDOSCOPIC PROCEDURES

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a surgical apparatus, device and/or system for performing endoscopic surgical procedures and methods of use thereof. More specifically, the present disclosure relates to a surgical fastener applying apparatus, device and/or system for performing endoscopic surgical procedures, which is loadable with disposable endoscopic loading units containing absorbable or permanent surgical fasteners, to kits, and methods of use thereof.

2. Background of Related Art

[0002] Various surgical procedures require instruments capable of applying fasteners to tissue to form tissue connections or to secure objects to tissue. For example, during hernia repair it is often desirable to fasten a mesh to body tissue. In certain hernias, such as direct or indirect inguinal hernias, a part of the intestine protrudes through a defect in the abdominal wall to form a hernial sac. The defect may be repaired using an open surgery procedure in which a relatively large incision is made and the hernia is closed outside the abdominal wall by suturing. The mesh is attached with sutures over the opening in the abdominal wall to provide reinforcement.

[0003] Minimally invasive, e.g., endoscopic or laparoscopic, surgical procedures are currently available to repair a hernia. In laparoscopic procedures, surgery is performed in the abdomen through a small incision, while in endoscopic procedures, surgery is performed through narrow endoscopic tubes

or cannulas inserted through small incisions in the body. Laparoscopic and endoscopic procedures generally utilize long and narrow instruments capable of reaching remote regions within the body and are configured to seal with the incision or tube they are inserted through. Additionally, the instruments must be capable of being actuated remotely, that is, from outside the body.

[0004] Currently, minimally invasive surgical techniques for hernia repair utilize surgical fasteners, e.g., surgical tacks, staples, and clips, to secure the mesh to the tissue to provide reinforcement and structure for encouraging tissue ingrowth. Surgical fasteners are often applied through an elongate instrument for delivery to the mesh, and are manipulated from outside a body cavity.

[0005] In some procedures permanent fasteners may be required, while in other procedures bioabsorbable fasteners may be required, or both. The laparoscopic or endoscopic instruments are typically loaded with either permanent fasteners or bioabsorbable fasteners. Additionally, following a surgical procedure, these laparoscopic or endoscopic instruments are typically disposed. Further, the number of fasteners desired for a particular surgical procedure varies.

[0006] Accordingly, a need exists for endoscopic or laparoscopic surgical devices which can be loaded with either permanent fasteners or bioabsorbable fasteners as needed or desired, and which may be at least partially sterilized for re-use following a surgical procedure. Additionally, a need exists for a short loading unit that includes a relative few number of fasteners therein (e.g., 5 fasteners), and a longer loading unit that includes a relative large number of fasteners therein (e.g., 30 fasteners) to be usable with the same handle assembly.

SUMMARY

[0007] The present disclosure relates to surgical devices for performing

endoscopic surgical procedures which are loadable with disposable endoscopic loading units loaded with absorbable or permanent surgical fasteners, kits, and methods of use thereof.

[0008] According to an aspect of the present disclosure, an endoscopic surgical device is provided and includes a handle assembly including a handle housing and a trigger operatively connected to the handle housing, and a drive mechanism actuatable by the trigger, an elongated tube selectively connectable to the handle assembly, and a loading unit selectively connectable to the elongated tube. The loading unit includes an outer tube defining a lumen therethrough and having a helical thread disposed within the lumen thereof, the outer tube defining a proximal end and a distal end; an inner tube rotatably supported in the outer tube, the inner tube defining a lumen therethrough and having a proximal end and a splined distal end, wherein the splined distal end of the inner tube is defined by a pair of opposed longitudinally extending tines and a pair of opposed longitudinally extending channels; a plurality of surgical anchors loaded in the lumen of the inner tube of the loading unit, wherein each anchor includes a threaded body portion, and a head portion defining a pair of opposed radially outer threads and a pair of opposed radial recesses, wherein the pair of radial recesses of each head portion receives respective tines of the inner tube and wherein the pair of opposed radially outer threads of each head portion projects from the pair of opposed longitudinally extending channels of the inner tube and engage the inner helical thread of the outer tube.

[0009] The endoscopic surgical device may include a connector having an outer connector member non-rotatably connected to the proximal end of the outer tube of the loading unit and being non-rotatably connectable to the handle assembly; and an inner connector member non-rotatably connected to the proximal end of the inner tube of the loading unit and being non-rotatably

connectable to the drive mechanism, wherein the outer connector member and the inner connector member are rotatable with respect to one another.

[0010] The handle housing may include a tooth projecting from a surface thereof, and wherein the outer connector member may include a channel formed therein. The channel of the outer connector member may receive the tooth of the handle housing when the elongated tube is connected to the handle assembly. The tooth may inhibit rotation of the outer connector member when the trigger is actuated to rotate the inner connector member of the elongated tube.

[0011] The handle assembly may include a ferrule removably and rotatably connected to the handle housing. The ferrule may define an aperture therein that is in operative alignment with the drive mechanism of the handle assembly. The ferrule may include a tooth projecting radially into the aperture of the ferrule.

[0012] The ferrule may have a first position wherein the tooth of the ferrule is radially aligned with the tooth of the handle housing; and a second position wherein the tooth of the ferrule is radially out of alignment with the tooth of the handle housing.

[0013] In use, when the ferrule is in the first position the elongated tube may be connectable to and disconnectable from the handle assembly.

[0014] The channel of the outer connector member may be formed in an outer radial surface thereof and may extend axially along an entire length thereof. During connection of the endoscopic assembly to the handle assembly and disconnection of the elongated tube from the handle assembly, the tooth of the ferrule may pass along the channel of the outer connector member.

[0015] The ferrule may be rotatable to a third position wherein the ferrule may be disconnectable from the handle housing.

[0016] The handle assembly may include a safety lock assembly supported on the handle housing. The safety lock assembly may include a proximal end

disposed within the handle housing and being in operative association with the drive mechanism, and a distal end projecting from the handle housing and being in operative association with the ferrule.

[0017] In use, when the ferrule is in the first position, the safety lock assembly may be in a first position such that the proximal end of the safety lock assembly may engage the drive mechanism to block operation of the drive mechanism. Also in use, when the ferrule is in the second position, the safety lock assembly may be in a second position such that the proximal end of the safety lock assembly is disengaged from the drive mechanism to permit operation of the drive mechanism.

[0018] The ferrule may actuate the safety lock assembly between the first and second positions thereof as the ferrule is moved between respective first and second positions thereof.

[0019] The safety lock assembly may include a lock plate supported on and extending radially from the proximal end thereof. The lock plate may have a generally pie-shaped profile. The drive mechanism may include a gear defining a slot therein. In use, the lock plate of the safety lock assembly may be disposed within the slot of the gear of the drive mechanism when the ferrule is in the first position.

[0020] The drive mechanism may include a plurality of gears, wherein at least one gear is actuated by the trigger, and wherein at least one gear actuates a drive shaft extending from the handle housing. The drive shaft may be keyed for selective connection to the inner connector member supported at the proximal end of the inner tube.

[0021] The present disclosure also relates to a surgical kit comprising a handle assembly including a handle housing and a trigger operatively connected to the handle housing, and a drive mechanism actuatable by the trigger; a long

loading unit selectively connectable to the handle assembly; an elongated tube selectively connectable to the handle assembly; and a short loading unit selectively connectable to the elongated tube wherein each loading unit includes an outer tube defining a lumen therethrough and having a helical thread disposed within the lumen thereof, the outer tube defining a proximal end and a distal end, and an inner tube rotatably supported in the outer tube, the inner tube defining a lumen therethrough and having a proximal end and a distal end. The surgical kit also includes a first quantity of surgical anchors loaded in the lumen of the inner tube of the long loading unit, and a second quantity of surgical anchors loaded in the lumen of the inner tube of the short loading unit, wherein the first quantity is greater than the second quantity.

[0022] In disclosed embodiments, the first quantity of anchors includes about 30 anchors, and the second quantity of anchors includes about five anchors.

[0023] It is further disclosed that the elongated tube is reusable.

[0024] Additionally, the surgical kit may include a plurality of short loading units.

[0025] Further details and aspects of exemplary embodiments of the present disclosure are described in more detail below with reference to the appended figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Embodiments of the present disclosure are described herein with reference to the accompanying drawings, wherein:

[0027] FIG. 1 is a perspective view of a surgical anchor for use in an endoscopic surgical device in accordance with the present disclosure;

[0028] FIG. 2 is a side, elevational view of the surgical anchor of FIG. 1;

[0029] FIG. 3 is a distal, end view of the surgical anchor of FIGS. 1 and 2;

[0030] FIG. 4 is a side, elevational view, partially broken away, of the surgical anchor of FIGS. 1-3;

[0031] FIG. 5 is a perspective view of an endoscopic surgical device according to an aspect of the present disclosure;

[0032] FIG. 6 is a top, plan view of the surgical device of FIG. 5;

[0033] FIG. 7 is a side, elevational view of the surgical device of FIGS. 5 and 6;

[0034] FIG. 8 is a rear, perspective view of the surgical device of FIGS. 5-7, illustrating a handle assembly and an endoscopic assembly thereof separated from one another;

[0035] FIG. 9 is a right, front, perspective view of the surgical device of FIGS. 5-8, illustrating a first half-section of the handle assembly removed therefrom;

[0036] FIG. 10 is a left, front, perspective view of the surgical device of FIGS. 5-8, illustrating a second half-section of the handle assembly removed therefrom;

[0037] FIG. 11 is a left, front, perspective view, with parts separated, of the surgical device of FIGS. 5-8, illustrating a second half-section of the handle assembly removed therefrom;

[0038] FIG. 12 is a front, perspective view of the surgical device of FIGS. 5-8, illustrating a ferrule removed therefrom;

[0039] FIG. 13 is an enlarged view of the indicated area of detail of FIG. 12;

[0040] FIG. 14 is an enlarged view of the indicated area of detail of FIG. 5, illustrating the ferrule in a lock position;

[0041] FIG. 15 is an enlarged view of the indicated area of detail of FIG. 6, illustrating the ferrule in the lock position;

[0042] FIG. 16 is a cross-sectional view as taken through section line 16-16

of FIG. 6;

[0043] FIG. 17 is a front, perspective view of a lock out assembly and a first bevel gear of a gear train of the present disclosure;

[0044] FIG. 18 is a rear, perspective view of the lock out assembly and the first bevel gear of the gear train of the present disclosure;

[0045] FIG. 19 is a front, plan view of the lock out assembly and the first bevel gear of the gear train of the present disclosure;

[0046] FIG. 20 is a perspective view, with parts separated, of the endoscopic assembly of the surgical device of the present disclosure;

[0047] FIG. 21 is a rear, perspective view of the endoscopic assembly of the present disclosure;

[0048] FIG. 22 is a rear, perspective view of the endoscopic assembly of the present disclosure, illustrating a shipping plug connected thereto;

[0049] FIG. 23 is a perspective view of the shipping plug of the present disclosure;

[0050] FIG. 24 is a perspective view of a distal end portion of the endoscopic assembly with an outer tube and a coil removed therefrom, shown with surgical anchors loaded therein;

[0051] FIG. 25 is a perspective view of the distal end portion of the endoscopic assembly with the outer tube and the coil removed therefrom, shown with surgical anchors separated therefrom;

[0052] FIG. 26 is a side elevational view of the handle assembly, with a housing half-section removed therefrom, illustrating the handle assembly during a firing stroke of the endoscopic surgical device;

[0053] FIG. 27 is an enlarged view of the indicated area of detail of FIG. 26;

[0054] FIG. 28 is a cross-sectional view of the distal end portion of the endoscopic assembly, as taken through section line 28-28 of FIG. 8, illustrating

the endoscopic assembly during a firing stroke of the endoscopic surgical device;

[0055] FIG. 29 is an illustration of surgical anchors of the present disclosure fixing a surgical mesh in place;

[0056] FIG. 30 is an enlarged view of the indicated area of detail of FIG. 6, illustrating the ferrule being rotated from the lock position to an exchange position;

[0057] FIG. 31 is a cross-sectional view as taken through section line 31-31 of FIG. 6, illustrating the ferrule being rotated from the lock position to the exchange position;

[0058] FIG. 32 is an enlarged view of the indicated area of detail of FIG. 6, illustrating the ferrule rotated to the exchange position;

[0059] FIG. 33 is a cross-sectional view as taken through section line 33-33 of FIG. 6, illustrating the ferrule rotated to the exchange position;

[0060] FIG. 34 is a rear, perspective view of the lock out assembly and the first bevel gear of the gear train of the present disclosure, illustrating the ferrule rotated to the exchange position;

[0061] FIG. 35 is a front, plan view of the lock out assembly and the first bevel gear of the gear train of the present disclosure, illustrating the ferrule rotated to the exchange position;

[0062] FIG. 36 is a front, perspective view of the handle assembly, illustrating the ferrule rotated to the exchange position;

[0063] FIG. 37 is a front, perspective view of the handle assembly and the endoscopic assembly, illustrating a connection of the endoscopic assembly to the handle assembly;

[0064] FIG. 38 is a front, perspective view of the handle assembly and the endoscopic assembly, illustrating the endoscopic assembly fully connected to the handle assembly;

[0065] FIG. 39 is a front, perspective view of the handle assembly (with the ferrule removed therefrom) and the endoscopic assembly, illustrating the endoscopic assembly fully connected to the handle assembly;

[0066] FIG. 40 is a front, perspective view of the handle assembly and the endoscopic assembly, illustrating the endoscopic assembly fully connected to the handle assembly, and illustrating the ferrule being rotated to the lock position;

[0067] FIG. 41 is an enlarged view of the indicated area of detail of FIG. 6, illustrating the ferrule rotated to a release position;

[0068] FIG. 42 is a cross-sectional view as taken through section line 42-42 of FIG. 6, illustrating the ferrule rotated to the release position;

[0069] FIG. 43 is a rear, perspective view of the lock out assembly and the first bevel gear of the gear train of the present disclosure, illustrating the ferrule rotated to the release position;

[0070] FIG. 44 is a front, plan view of the lock out assembly and the first bevel gear of the gear train of the present disclosure, illustrating the ferrule rotated to the release position;

[0071] FIG. 45 is a front, perspective view of the surgical device of FIGS. 5-8, illustrating a ferrule removed therefrom;

[0072] FIG. 46 is a rear, perspective view of the ferrule, illustrating internal features thereof;

[0073] FIG. 47 is an enlarged, plan view (with portions in phantom) illustrating the ferrule in the release position relative to a handle housing of the handle assembly;

[0074] FIG. 48 is a perspective view of portions of a disclosed kit illustrating a long loading unit, a short loading unit, and an elongated tube;

[0075] FIG. 49 is a cross-sectional view illustrating the short loading unit being loaded or unloaded with the elongated tube;

[0076] FIG. 50 is an enlarged view of the area indicated in FIG. 49;

[0077] FIG. 51 is a cross-sectional view illustrating the short loading unit locked with the elongated tube;

[0078] FIG. 52 is an enlarged view of the area indicated in FIG. 51; and

[0079] FIGS. 53A-53C illustrate a bayonet coupling between the short loading unit and the elongated tube.

DETAILED DESCRIPTION OF EMBODIMENTS

[0080] Embodiments of the presently disclosed endoscopic surgical device are described in detail with reference to the drawings, in which like reference numerals designate identical or corresponding elements in each of the several views. As used herein the term “distal” refers to that portion of the endoscopic surgical device, that is farther from the user, while the term “proximal” refers to that portion of the endoscopic surgical device that is closer to the user.

[0081] Referring initially to FIGS. 1-4, a surgical anchor for use with the surgical tack applier of the present disclosure is illustrated and generally designated as anchor 100. As illustrated in FIGS. 1-4, anchor 100 includes a head section 110, a mesh retention section 120, and a threaded tissue-snaring section 130. Head section 110 includes a pair of opposing threaded sections 112a, 112b having respective radially, outer, helical head threads 114a, 114b, and a pair of opposing open or slotted sections 116a, 116b. A distal surface of head section 110 is formed onto or integral with a proximal end of mesh retention section 120.

[0082] Mesh retention section 120 of anchor 100 extends from and between a distal end or surface of head section 110 and a proximal end of tissue-snaring section 130. Mesh retention section 120 functions to lock, anchor or otherwise retain a surgical mesh (not shown) on to anchor 100 when anchor 100 is screwed

into the mesh to a depth past a proximal-most segment 138 of tissue-snaring thread 132 of tissue-snaring section 130. This is achieved because there is no thread located in mesh retention section 120 that would allow anchor 100 to be unscrewed or backed out from the mesh.

[0083] Mesh retention section 120 has a cylindrical or conical transverse cross-sectional profile. Mesh retention section 120 includes a transverse radial dimension, relative to a central longitudinal axis of anchor 100, that is smaller than a transverse radial dimension of head section 110, and smaller than a transverse radial dimension of proximal-most segment 138 of tissue-snaring thread 138.

[0084] Threaded tissue-snaring section 130 of anchor 100 includes helical threads 132 formed onto a tapered truncated body section 134. A distal point or tip 136 defines the terminus of the distal most tissue-snaring thread 132.

[0085] As shown in FIG. 4, body section 134 of tissue-snaring section 130 is tapered, i.e., becoming smaller toward the distal end of threaded tissue-snaring section 130, and terminates or truncates to a distal truncation point “TP”, prior to reaching an apex or tip of anchor 100. Body section 134 includes a concave taper such that, for a given length, a minimum diameter body section 134 is defined upon truncation thereof which is approximately less than 0.01 inches.

[0086] Anchor 100 includes a transverse dimension “D”, of a distal-most thread in the threaded tissue-snaring section 130 which is as large as design constraints will allow or approximately greater than 0.040 inches. In accordance with the present disclosure, a small truncated body diameter and a large value of “D” minimizes tissue indentation. The tissue-snaring threads 132 terminate at distal tip 136, which is distal of the truncation point “TP” of body section 134.

[0087] By providing a distal tip 136 extending distally of truncation point “TP” of tissue-snaring section 130, a penetration of the mesh, by anchor 100, is

eased, and an indentation of the mesh into relatively soft tissue, by anchor 100, is minimized, as compared to an anchor having a non-truncated body with tapered threads.

[0088] For a given force applied to a surgical mesh by the surgeon, exerting a distal force on a tack applier, the larger the dimension “D” of anchor 100, the less the distal force that needs to be exerted in order to cause indentation of an underlying tissue and surgical mesh.

[0089] Anchor 100 is non-cannulated and is constructed from a suitable bioabsorbable material, such as, for example, polylactide, polyglycolide. Anchor 100 is formed from a proprietary biocompatible co-polymer (Lactomer USS L1, Boehringer Ingelheim LR 704 S, or Boehringer Ingelheim LG-857). Anchor may also be constructed from suitable non-bioabsorbable materials, or permanent material, such as, for example, stainless steel, titanium or the like.

[0090] Turning now to FIGS. 5-47, an endoscopic surgical device, in the form of an endoscopic surgical tack applier or tacker, is shown generally as 200. Tack applier 200 includes a handle assembly 210, and a removable endoscopic assembly 300 (e.g., single use loading unit SULU) extending from handle assembly 210 and configured to store and selectively release or fire a plurality of anchors 100 therefrom and into mesh “M” overlying tissue “T”. (FIG. 29).

[0091] As illustrated in FIGS. 5-15, handle assembly 210 includes a handle housing 212 formed from a first half-section 212a and a second half section 212b joined to one another. First half-section 212a and second half section 212b of handle housing 212 may be joined to one another using known methods by those of skill in the art, including and not limited to ultrasonic welding, fasteners (i.e., screws), or the like. First half-section 212a and second half section 212b of handle housing 212 are joined to one another such that a fluid-tight seal is provided therebetween.

[0092] Handle housing 212 defines a fixed handle portion 216 having a free end 216a. Handle assembly 210 includes a trigger 214 pivotably connected to handle housing 212, at a pivot point disposed within handle housing 212. Trigger 214 includes a free end 214a spaced a distance from fixed handle portion 216 when trigger 214 is in an extended or un-actuated condition. Trigger 214 includes a pivot end 214b extending therefrom and extending into handle housing 212 through a side of handle housing 212.

[0093] A fluid-tight seal may be provided between pivot end 214b of trigger 214 and handle housing 212. In accordance with the present disclosure, an X-ring or the like, including an o-ring, etc., (not shown) may be used between pivot end 214b of trigger 214 and handle housing 212.

[0094] As illustrated in FIGS. 9-19, handle assembly 210 supports a gear train 220 within handle housing 212. Gear train 220 includes a trigger or drive gear 222 keyed to or non-rotatably connected to pivot end 214b of trigger 214. Drive gear 222 is a two tiered gear including a first drive gear 222a, and a second drive gear 222b. First drive gear 222a may be in the form of a quadrant gear or the like having a plurality of gear teeth 222a₁ formed along a radial outer edge thereof and extending along an arcuate length of first drive gear 222a. First drive gear 222a includes a stem or stopper 223a extending radially therefrom, at a location proximal of gear teeth 222a₁. Second drive gear 222b defines a plurality of gear teeth 222b₁ formed along a radial outer edge thereof.

[0095] Gear train 220 further includes a transmission gear assembly 224 pivotably supported in handle housing 212. Transmission gear assembly 224 is a three tiered gear including a first transmission gear 224a, a second transmission gear 224b, and third transmission gear 224c each rotatably supported on a common pivot axis. First transmission gear 224a may be in the form of a pinion gear or the like having a plurality of gear teeth 224a₁ formed

along a radial outer edge thereof and being in meshing engagement with gear teeth 222a₁ of first drive gear 222a. Second transmission gear 224b may be in the form of a quadrant gear or the like having a plurality of gear teeth 224b₁ formed along a radial outer edge thereof and extending along an arcuate length of second transmission gear 224b. Third transmission gear 224c may be in the form of a pinion gear or the like having a plurality of gear teeth 224c₁ formed along a radial outer edge thereof and being in meshing engagement with gear teeth 224b₁ of second transmission gear 224b.

[0096] Gear train 220 also includes a clutch gear 226 pivotably and slidably supported on a pivot axis 227a in handle housing 212. Clutch gear 226 may be in the form of a pinion gear or the like having a plurality of gear teeth 226a₁ formed along a radial outer edge thereof and being in meshing engagement with gear teeth 224b₁ of second transmission gear 224b. Clutch gear 226 is biased into meshing engagement with second transmission gear 224b by a biasing member 227b (FIGS. 10 and 11). Clutch gear 226 includes an arm 226b extending radially therefrom, and a cam or ramp 226c (FIG. 11) extending/projecting from arm 226b. Cam 226c includes a front end having a height defining a shoulder, and a tail end tapering into arm 226b.

[0097] Gear train 220 further includes a first bevel gear 228 pivotably and slidably supported on pivot axis 227a in handle housing 212. First bevel gear 228 may be in the form of a crown gear or the like. First bevel gear 228 is operatively engaged/associated with clutch gear 226. First bevel gear 228 defines an arcuate slot 228a formed in first face 228d thereof for selectively receiving and engaging cam 226c of clutch gear 226. Slot 228a includes a front end wall configured to engage the front end of cam 226c of clutch gear 226, and tapers along a length thereof to be flush with the first face of first bevel gear 228.

[0098] In operation, as trigger 214 of tacker 200 is actuated, trigger 214

causes drive gear 222 to be rotated, in a first direction. As drive gear 222 is rotated in the first direction, drive gear 222 causes first transmission gear 224a and second transmission gear 224b to be rotated, in a first direction, about the pivot axis thereof. As second transmission gear 224b is rotated in the first direction, second transmission gear 224b causes clutch gear 226 to be rotated, in a first direction, about a pivot axis thereof.

[0099] As clutch gear 226 is rotated in the first direction, the front end of cam 226c of clutch gear 226 is rotated in a first direction until the front end of cam 226c engages or contacts the front end wall of slot 228a of first bevel gear 228. After the front end of cam 226c of clutch gear 226 engages or contacts the front end wall of slot 228a of first bevel gear 228, continued rotation of clutch gear 226, in the first direction, results in concomitant rotation of first bevel gear 228 in a first direction. At this point, first bevel gear 228 continues to rotate in the first direction so long as trigger 214 is being actuated to a closed or fully actuated condition.

[00100] When actuation of trigger 214 is stopped, either prior to complete actuation or following complete actuation, rotation of first bevel gear 228, in the first direction, is also stopped. Upon the completion of a partial or complete actuation of trigger 214 and a release thereof, trigger 214 causes drive gear 222 to be rotated, in a second direction (opposite the first direction). As drive gear 222 is rotated in the second direction, drive gear 222 causes first transmission gear 224a and second transmission gear 224b to be rotated, in a second direction, about the pivot axis thereof. As second transmission gear 224b is rotated in the second direction, second transmission gear 224b causes clutch gear 226 to be rotated, in a second direction, about pivot axis 227a. As clutch gear 226 is rotated in the second direction, the tail end of cam 226c thereof slides along slot 228a of first bevel gear 228, and, if the rotation in the second

direction is sufficient, slides out of slot 228a of first bevel gear 228 and along first face 228d of first bevel gear 228. As cam 226c of clutch gear 226 slides along slot 228a of first bevel gear 228, clutch gear 226 slides axially along pivot axis 227a and compresses biasing member 227b.

[00101] If trigger 214 was fully actuated, a complete release of trigger 214, will result in clutch gear 226 making a complete revolution, in the second direction, until the front end of cam 226c of clutch gear 226 clears the front end wall of slot 228b of first bevel gear 228 to thereby re-enter slot 228b of first bevel gear 228. Specifically, as the front end of cam 226c of clutch gear 226 clears the front end wall of slot 228b of first bevel gear 228, biasing member 227b forces clutch gear 226 axially along pivot axis 227a and cam 226c of clutch gear 226 back into slot 228b of first bevel gear 228.

[00102] As illustrated in FIGS. 11 and 26, handle assembly 210 includes a biasing member 225 configured for maintaining trigger 214 in an extended or un-actuated position. Biasing member 225 is also configured to have a spring constant sufficient to return trigger 214 to the un-actuated position following a partial or complete actuation of trigger 214. Biasing member 225 includes a first end 225a fixedly connected in handle housing 212 and a second end 225b connected to stem 223a extending from first drive gear 222a.

[00103] With reference to FIGS. 9-11, 26 and 27, handle assembly 210 includes an audible/tactile feedback mechanism 250 supported within handle housing 212 and in operative association with drive gear 222. Specifically, audible/tactile feedback mechanism 250 includes a dial 252 rotatably supported in handle housing 212. Dial 252 includes a tooth 252a extending therefrom. Dial 252 is spring biased to a home position. Audible/tactile feedback mechanism 250 further includes a tooth or stem 223b extending from second drive gear 222b. In operation, as trigger 214 is actuated and second drive gear

222b rotated, stem 223b of second drive gear 222b contacts tooth 252a of dial 252 causing dial 252 to rotate against the bias of a spring member 254. When stem 223b of second drive gear 222b clears tooth 252a of dial 252, dial 252 is returned to or snapped back to the home position thereof due to the bias of spring member 254. When dial 252 is snapped back to the home position thereof, dial 252 creates an audible and/or tactile response.

[00104] As shown in FIGS. 9, 11, 18 and 19, handle assembly 210 of tack applicator 200 is provided with a ratchet mechanism 260 which is configured to inhibit or prevent inner tube 320 (FIGS. 20, 24 and 25) from backing-out or reversing after anchor 100 has been at least partially driven into tissue. Ratchet mechanism 260 includes, as seen in FIGS. 9 and 11, a series of ratchet teeth 228f formed on a rear or second face of first bevel gear 228.

[00105] Ratchet mechanism 260 further includes a spring clip 262 secured within handle assembly 210. Spring clip 262 includes a resilient finger 262a configured for engagement with ratchet teeth 228f formed on rear surface of first bevel gear 228.

[00106] In operation, resilient finger 262a of spring clip 262 engages with ratchet teeth 228f of first bevel gear 228 in such a manner that as first bevel gear 228 is rotated, in a first direction, resilient finger 262a of spring clip 262 cams over ratchet teeth 228f and permits rotation of first bevel gear 228. Also, if first bevel gear 228 starts to rotate in a second direction (opposite to the first direction), resilient finger 262a of spring clip 262 stops along ratchet teeth 228f thereby preventing or inhibiting first bevel gear 228 from rotating in the second direction. As such, any reverse rotation or “backing-out” of anchor 100 or inner tube 320 of endoscopic assembly 300 (tending to cause first bevel gear 228 to rotate in the second direction), during a driving or firing stroke, is inhibited or prevented.

[00107] With reference to FIGS. 10, 11 and 26, handle assembly 210 further includes a second or pinion-bevel gear 230 rotatably supported in a distal end of handle housing 212. Pinion-bevel gear 230 includes gear teeth 230a operatively engaged or meshed with gear teeth 228c formed on the front face of first bevel gear 228. Pinion-bevel gear 230 is non-rotatably secured to a drive shaft 232 extending distally from handle housing 212. Drive shaft 232 is configured and dimensioned to engage an inner connector member 344 of endoscopic assembly 300 (FIGS. 20 and 21). In an embodiment, drive shaft 232 defines a plurality of axially extending ribs 232a at a distal end thereof.

[00108] In operation, upon squeezing of trigger 214, gear train 220 causes pinion-bevel gear 230 to rotate in a first direction. As pinion-bevel gear 230 is rotated in the first direction, pinion-bevel gear 230 transmits the rotation to inner tube 320 of endoscopic assembly 300.

[00109] With reference to FIGS. 5-16, handle assembly 210 includes a ferrule or collar 234 rotatably and removably supported on handle housing 212. Ferrule 234 defines a distal opening 234a that is axially aligned with drive shaft 232. Ferrule 234 includes a stopper or tooth 234b extending radially into distal opening 234a.

[00110] Ferrule 234 is rotatable between a lock position (anchor retaining/advancing assembly 300 is locked to handle assembly 212, and tacker 200 is ready to fire, FIGS. 14-16); an exchange position (anchor retaining/advancing assembly 300 can be connected/disconnected to/from handle assembly 212, and tacker 200 can not be fired, FIGS. 30-33); and a ferrule release position (ferrule 234 can be removed from handle housing 212, and handle housing 212 may be cleaned or sterilized, FIGS. 41 and 42).

[00111] Handle housing 212 and ferrule 234, as illustrated in FIGS. 45-47, may include complementary inter-engaging features and/or structures which

lock or fix a position/orientation of ferrule 234 relative to handle housing 212. Ferrule 234 includes opposed radially inwardly extending nubs 234c and handle housing 212 includes a pair of L-shaped slots 212d formed in an outer surface of a nose 212c thereof. Housing defines an annular shoulder 212e around a proximal end of nose 212c. Shoulder 212e defines a pair of recesses 212f, 212g formed in a distal face of shoulder 212e.

[00112] Turning now to FIGS. 10, 12, 13 and 36-40, nose 212c of handle housing 212 includes a distally extending annular wall 212h surrounding the distal end of drive shaft 232. Annular wall 212h includes a tooth 212i projecting radially inward therefrom. When ferrule 234 is in the exchange position, stopper or tooth 234b of ferrule 234 is radially aligned with tooth 212i of annular wall 212h. When ferrule 234 is in the lock position, stopper or tooth 234b of ferrule 234 is radially out of alignment with tooth 212i of annular wall 212h.

[00113] Ferrule 234 includes a second tooth 234d projecting from a proximal surface thereof. Tooth 234d is configured to engage a selected one of recesses 212f, 212g of housing 212 as ferrule 234 is rotated relative to housing 212. Tooth 234d is biased to project from proximal end of ferrule 234.

[00114] As shown in FIGS. 9-13, 16-19, 30-35 and 42-44, handle assembly 210 includes a safety lock assembly 240 supported on handle housing 212 and being configured to permit and inhibit actuation of trigger 214, and for effectuating a loading/retention and a release/removal of endoscopic assembly 300 to handle housing 212. Safety lock assembly 240 is in operative association with ferrule 234 and is actuatable upon a rotation of ferrule 234 relative to handle housing 212. Safety lock assembly 240 includes a lock pin 242 slidably supported in and projecting distally from handle housing 212. Pin 242 includes a transverse head 242a extending therefrom. Head 242a of lock pin 242 is

operatively disposed within or between internal walls 234e (FIGS. 16, 31, 33, 42 and 46) provided in ferrule 234.

[00115] Safety lock assembly 240 includes a lock plate 244 supported on a proximal end 242b of lock pin 242. Lock plate 244 has a generally pie-shaped profile. In use, lock plate 244 is caused to be rotated as lock pin 242 is rotated, due to internal walls 234e of ferrule 234 acting on head 242a of pin 242 as ferrule 234 is rotated relative to handle housing 212. In operation, when ferrule 234 is rotated to the exchange position or the ready-to-fire position, with trigger 214 in a fully un-actuated position, lock plate 244 is rotated into a radial slot 228g formed in first bevel gear 228, thereby preventing first bevel gear 228 from rotating. Moreover, when ferrule 234 is rotated to the lock position, lock plate 244 is rotated out of radial slot 228g of first bevel gear 228, thereby allowing first bevel gear 228 to rotate.

[00116] Safety lock assembly 240 further includes a biasing member 246 configured to bias head 242a of pin 242 and lock plate 244 to the rotated lock position.

[00117] Turning now to FIGS. 5, 8-10 and 20-25, as illustrated therein, endoscopic assembly 300 includes an outer tube 310, an inner tube 320 rotatably disposed within outer tube 310, a guide coil or spring 330 disposed between outer tube 310 and inner tube 320, a plurality of anchors 100 loaded within inner tube 310, and a connector 340 supported at a proximal end of outer tube 310 and inner tube 320.

[00118] Outer tube 310 of endoscopic assembly 300 includes a proximal end 310a and a distal end 310b, and defines a lumen 310c therethrough. As described briefly above, endoscopic assembly 300 further includes a guide coil or spring 330 fixedly disposed within at least a distal portion of outer tube 310.

[00119] Endoscopic assembly 300 also includes an inner tube 320 rotatably disposed within coil 330. Inner tube 320 includes a proximal end portion 320a and a splined distal end portion 320b, and defines a lumen 320c therethrough.

[00120] Distal end portion 320b of inner tube 320 is slotted, defining a pair of opposed tines 320b₁ and a pair of opposed channels 320b₂. Distal end portion 320b of inner tube 320 is capable of accepting a plurality of anchors 100 within inner tube 320. In particular, anchors 100 are loaded into endoscopic assembly 300 such that the pair of opposing threaded sections 112a, 112b of anchors 100 extend through respective channels 320b₂ of distal end portion 320b of inner tube 320 and are slidably disposed within the groove of coil 330, and the pair of tines 320b₁ of distal end portion 320b of inner tube 320 are disposed within the pair of slotted sections 116a, 116b of anchors 100.

[00121] In use, as inner tube 320 is rotated, about its longitudinal axis, with respect to coil 330, the pair of tines 320b₁ of inner tube 320 transmit the rotation to anchors 100 and advance anchors 100 distally owing to head threads 114a, 114b of anchors 100 engaging with coil 330.

[00122] As illustrated specifically in FIGS. 20 and 21, endoscopic assembly 300 includes a connector 340 having an outer connector member 342 non-rotatably connected to proximal end 310a of outer tube 310, and an inner connector member 344 non-rotatably connected to proximal end 320a of inner tube 320. Inner connector member 344 is nested within outer connector member 342. Outer connector member 342 is substantially cylindrical and defines at least one longitudinally extending outer radial groove 342a that extends through a proximal end thereof, and at least one longitudinally extending inner groove 342b. Outer connector member 342 is sized and shaped to be inserted into distal opening 234a of ferrule 234 of handle assembly 210 and into annular wall 212h

of nose 212c of handle housing 212.

[00123] Inner connector member 344 is substantially cylindrical and defines at least one longitudinally extending inner rib 344a projecting radially into a lumen thereof.

[00124] In order to connect endoscopic assembly 300 to handle assembly 210, with ferrule 234 in the exchange position, outer radial groove 342a of outer connector member 342 is first aligned with stopper or tooth 234b of ferrule 234 and with tooth 212i of annular wall 212h of nose 212c. Then, outer connector member 342 is fully inserted into ferrule 234 and annular wall 212h, tooth 212i of annular wall 212h of nose 212c is disposed within outer radial groove 342a of outer connector member 342, and stopper or tooth 234b of ferrule 234 is disposed distally of outer connector member 342.

[00125] When outer connector member 342 is fully inserted into ferrule 234 and annular wall 212h, the distal end of drive shaft 232 enters into inner connector member 344 such that the at least one longitudinally extending inner rib 344a of inner connector member 344 mechanically engages or meshes with the plurality of axially extending ribs 232a provided at the distal end of drive shaft 232.

[00126] With outer connector member 342 is fully inserted into ferrule 234 and annular wall 212h, ferrule 234 is rotated from the exchange position to the lock position, whereby stopper or tooth 234b of ferrule 234 is rotated to a radial position, out of alignment with outer radial groove 342a of outer connector member 342, to block withdrawal of outer connector member 342 from within ferrule 234 and from within annular wall 212h of nose 212c of handle housing 212.

[00127] As illustrated in FIGS. 20-23, endoscopic assembly 300 includes a shipping wedge, plug or cap 350 configured and adapted for selective

connection to connector 340. Cap 350 includes an end wall 352, at least one leg 354 extending from end wall 352 and being configured and dimensioned for selective receipt in a respective longitudinally extending outer radial groove 342a (FIG. 21) of outer connector member 342, and a stem (not shown) extending from end wall 352 and being configured and dimensioned for selective receipt into inner connector member 344 for engagement with longitudinally extending inner rib(s) 344a of inner connector member 344. When cap 350 is secured to connector 340, the at least one leg 354 and the stem of cap 350 engage outer connector member 342 and inner connector member 344 to prevent their rotation relative to one another.

[00128] Cap 350 is used to fix the radial position of inner tube 320 relative to outer tube 310 and thus ensure that the stack of surgical anchors 100 are not prematurely advanced through endoscopic assembly 300 prior to connection of endoscopic assembly 300 to handle assembly 210. If the stack of surgical anchors 100 are advanced through endoscopic assembly 300, prior to connection of endoscopic assembly 300 to handle assembly 210, a timing of the firing of tack applier 200 may be effected, whereby each fully stroke of trigger 214 may either not fully fire a surgical anchor 100 from endoscopic assembly 300 or may begin to fire a second surgical anchor 100 from endoscopic assembly 300.

[00129] In an operation of surgical tacker 200, as illustrated in FIGS. 26-28, 36 and 37, with endoscopic assembly 300 operatively connected and locked to handle assembly 210, as described above, as drive shaft 232 is rotated due to an actuation of trigger 214, also as described above, said rotation is transmitted to inner tube 320 of endoscopic assembly 300 via the engagement of the plurality of axially extending ribs 232a provided at the distal end of drive shaft 232 with the at least one longitudinally extending inner rib 344a of inner

connector member 344.

[00130] Again, as inner tube 320 is rotated, about its longitudinal axis, with respect to coil 330, the pair of tines 320a₁ of inner tube 320 transmit the rotation to the entire stack of anchors 100 and advance the entire stack of anchors 100 distally, owing to head threads 114a, 114b of anchors 100 engaging with coil 330.

[00131] In accordance with the present disclosure, the components of surgical tacker 200, and anchors 100 are dimensioned such that a single complete and full actuation of trigger 214 results in a firing of a single anchor 100 (i.e., the distal-most anchor of the stack of anchors 100 loaded in endoscopic assembly 300) from endoscopic assembly 300.

[00132] Surgical tacker 200 may be repeatedly fired to fire anchors from endoscopic assembly 300 until the surgical procedure is complete or until endoscopic assembly 300 is spent of anchors 100. If endoscopic assembly 300 is spent of anchors 100, and if additional anchors 100 are required to complete the surgical procedure, spent endoscopic assembly 300 may be replaced with a new (i.e., loaded with anchors 100) endoscopic assembly 300. Alternatively, if it is desired to change the types of anchors 100 that are being used in the surgical procedure, non-spent endoscopic assembly 300 (loaded with a first type of anchors 100) may be replaced with another endoscopic assembly 300 (loaded with a second, different type of anchors 100).

[00133] As shown in FIGS. 14-19 and 30-33, in order to replace an endoscopic assembly 300 with another endoscopic assembly 300, with trigger 214 in the fully un-actuated position, as described above, the surgeon actuates or rotates ferrule 234 from the locked position (FIGS. 14-19) to the exchange position (FIGS. 30-33) to release the loaded or connected endoscopic assembly 300, decouples or withdraws endoscopic assembly 300 from handle assembly

210, loads or connects a new endoscopic assembly 300 to handle assembly 210, and actuates or rotates ferrule 234 from the exchange position to the locked position to retain the new endoscopic assembly 300 in handle assembly 210.

[00134] Following a surgical procedure, ferrule 234 may be removed or disconnected from handle housing 212 such that the ferrule 234 and the remainder of handle assembly 210 may be cleaned by sterilization, washing, wiping, autoclaving, chemical processing and the like. With reference to FIGS. 30-33 and 41-47, in order to disconnect ferrule 234 from handle housing 212, ferrule 234 is rotated from the exchange position (FIGS. 30-33) to the release position (FIGS. 41-44), wherein ferrule 234 is rotated relative to handle housing 212 until radially inwardly extending nubs 234c of ferrule 234 are at the end of a long leg of L-shaped slots 212d of nose 212c of handle housing 212. At this point, ferrule 234 may be axially separated from handle housing 212.

[00135] In accordance with the present disclosure, it is contemplated that a plurality of different endoscopic assemblies 300 may be provided, wherein endoscopic assemblies may be available which are loaded with surgical anchors fabricated from different materials (e.g., bioabsorbable, permanent, etc.), or endoscopic assemblies may be available having different lengths (e.g., short, medium, long, etc.) wherein the particular length endoscopic assembly is loaded with a respective number of surgical anchors. Accordingly, depending on the particular surgical procedure (i.e., hernia procedure), the surgeon may select any one or combination of endoscopic assemblies desired or needed, and the surgeon may interchange or exchange endoscopic assemblies as needed or desired during the surgical procedure.

[00136] In an embodiment, it is contemplated that all the endoscopic assemblies may have the same length, but be loaded with varying numbers of surgical anchors therein. In this manner, the surgeon may choose an endoscopic

assembly loaded with fewer or more surgical anchors depending on the type of surgical procedure to be performed.

[00137] With reference to FIGS. 48-53C, the present disclosure also relates to tack applier 200 including handle assembly 210, as described above, which is usable with both a first, endoscopic assembly 300, as described above, including a long loading unit 400, and a second, endoscopic assembly 300a, including a short loading unit 400a. As shown in FIG. 48, when tack applier 200 is used with second endoscopic assembly 300a, an elongated tube 500a interconnects handle assembly 210 (see FIG. 5) and short loading unit 400a. It is envisioned that elongated tube 500a is reusable. As can be appreciated, a shorter length loading unit 400a (including fewer tacks or anchors 100) would be less expensive to manufacture than a longer length loading unit 400 (including more tacks or anchors 100). As such, when a surgical procedure necessitates (or when a surgeon chooses) relatively few tacks 100, second endoscopic assembly 300a can be used as a cost-saving measure.

[00138] Additionally, due to the disposable nature of loading units, the single use of a relatively long loading unit 400 (which may only be filled with a relatively few number of tacks 100), results in waste. As can be appreciated, the use of short loading unit 400a and reusable elongated tube 500a helps reduce waste.

[00139] Elongated tube 500a includes a proximal end 502a configured to releasably engage handle assembly 210 of tack applier 200. Moreover, proximal end 502a of elongated tube 500a includes similar features as endoscopic assembly 300 to enable interconnection with ferrule 234 of handle assembly 210. Specifically, elongated tube 500a includes a connector 340a at proximal end 502a thereof. Accordingly, the locking/unlocking abilities and functional coupling between endoscopic assembly 300 and handle assembly 210,

as discussed in detail above, are also enabled between elongated tube 500a and handle assembly 210.

[00140] More particularly, for example, while actuation of trigger 214 causes rotation of inner tube 320 of a properly engaged endoscopic assembly 300 about its longitudinal axis, as discussed above, actuation of trigger 214 also causes rotation of an inner tube 510a of elongated tube 500a of a property engaged second endoscopic assembly 300a about its longitudinal axis.

[00141] Additionally, elongated tube 500a of endoscopic assembly 300a is configured to releasably engage loading unit 400a adjacent a distal end thereof. With particular reference to FIGS. 49-52, the engagement between elongated tube 500a and loading unit 400a is shown. In FIGS. 49 and 50, loading unit 400a is shown being loaded/unloaded with respect to a distal end of elongated tube 500a. In FIGS. 51 and 52, loading unit 400a is shown in a loaded and locked position with respect to the distal end of elongated tube 500a.

[00142] With continued reference to FIGS. 49-52, distal end of elongated tube 500a includes an inner tube 510a, an outer tube 520a, and a flexible finger 530a. Flexible finger 530a extends distally from inner tube 510a and is engageable with outer tube 520a. More particularly, flexible finger 530a includes a hook 532a disposed at a distal end thereof. Hook 532a is engageable with a recess 522a within outer tube 520a. It is envisioned that hook 532a is biased toward a radial center of a bore 512a defined by inner tube 510a.

[00143] With particular reference to FIGS. 49 and 50, where loading unit 400a is shown being loaded/unloaded, loading unit 400a is able to longitudinally translate with respect to elongated tube 500a because the amount of engagement “E” between finger 530a (inclusive of hook 532a) and outer tube 520a is smaller than a gap “G1” between the portion of loading unit 400a adjacent hook 532a and an inner wall 524a of outer tube 520a.

[00144] With particular reference to FIGS. 51 and 52, where loading unit 400a is shown in a loaded and locked position, loading unit 400a is not able to freely longitudinally translate with respect to elongated tube 500a because the amount of engagement “E” between finger 530a (inclusive of hook 532a) and outer tube 520a is larger than a gap “G2” between the portion of loading unit 400a adjacent hook 532a and inner wall 524a of outer tube 520a. Here, loading unit 400a is effectively longitudinally locked with elongated tube 500a. Additionally, a proximal extension 410a of loading unit 400a is configured to frictionally engage an inner wall 514a of inner tube 510a. As shown, proximal extension 410a includes a tapered end 412a to facilitate engagement between proximal extension 410a and inner tube 510a. The frictional engagement between proximal extension 410a and inner tube 510a is configured to be sufficiently strong such that the rotational movement of inner tube 510a (accomplished by actuation of trigger 214, as discussed above), is directly transferred to proximal extension 410a of loading unit 400a. Additionally, in embodiments where hook 532a is biased toward a radial center of bore 512a of inner tube 510a, this biasing further links loading unit 400a and elongated tube 500a.

[00145] Loading unit 400a also includes, as seen in FIGS. 49 and 51, an inner connector member 444a. A proximal portion 445a of inner connector member 444a is disposed within a distal opening 414a of proximal extension 410a and is rotationally fixed therewith. As such, rotation of proximal extension 410a causes a corresponding rotation of inner connector member 444a. As can be appreciated, other portions of loading unit 400a are similar to those of endoscopic portion 300, as described above, such that rotation of inner connector member 444a causes the ejection of tacks or anchors 100 held within loading unit 400a.

[00146] Additionally, as shown in FIGS. 53A-53C, a bayonet coupling 600a is used to help secure outer tube 520a of elongated tube 500a with loading unit 400a. That is, outer tube 520a is translatable and rotatable with respect to loading unit 400a to lock/unlock elongated tube 500a with loading unit 400a, such that a boss 450a on loading unit 400a travels through an L-shaped slot 550a within outer tube 520a of elongated tube 500a.

[00147] The present disclosure also includes a surgical kit. The kit includes handle assembly 210 (e.g., reusable), a plurality of long loading units 400 (e.g., disposable), a plurality of short loading units 400a (e.g., disposable), and at least one elongated tube 500a (e.g., reusable). In disclosed embodiments, loading units 400 and 400a include tacks or anchors 100 therein. For instance, it is envisioned that long loading units 400 include about 30 anchors 100 therein, and that short loading units 400a include about five anchors 100 therein. Additionally, it is envisioned that the total length of long loading unit 400 is approximately equal to the length of short loading unit 400a plus the length of elongated tube 500a.

[00148] In accordance with the present disclosure, it is also contemplated that handle assembly 210 may be replaced by an electromechanical control module configured and adapted to drive the inner tube of anchor retaining/advancing assembly to fire or actuate the surgical device. The electromechanical control module may include at least one microprocessor, at least one drive motor controllable by the at least one microprocessor, and a source of power for energizing the at least one microprocessor and the at least one drive motor.

[00149] It will be understood that various modifications may be made to the embodiments disclosed herein. For example, the length of the linear row of staples or fasteners may be modified to meet the requirements of a particular

surgical procedure. Thus, the length of the linear row of staples and/or fasteners within a staple cartridge assembly may be varied accordingly. Therefore, the above description should not be construed as limiting, but merely as exemplifications of various embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended thereto.

CLAIMS

What is claimed is:

1. An endoscopic surgical device, comprising;
a handle assembly including a handle housing and a trigger operatively connected to the handle housing, and a drive mechanism actuatable by the trigger;
an elongated tube selectively connectable to the handle assembly; and
a loading unit selectively connectable to the elongated tube, the loading unit including:
an outer tube defining a lumen therethrough and having a helical thread disposed within the lumen thereof, the outer tube defining a proximal end and a distal end;
an inner tube rotatably supported in the outer tube, the inner tube defining a lumen therethrough and having a proximal end and a distal end, wherein the splined distal end of the inner tube is defined by a pair of opposed longitudinally extending tines and a pair of opposed longitudinally extending channels;
a plurality of surgical anchors loaded in the lumen of the inner tube of the loading unit, wherein each anchor includes a threaded body portion, and a head portion defining a pair of opposed radially outer threads and a pair of opposed radial recesses, wherein the pair of radial recesses of each head portion receives respective tines of the inner tube and wherein the pair of opposed radially outer threads of each head portion projects from the pair of opposed longitudinally extending channels of the inner tube and engage the inner helical thread of the outer tube.
2. The endoscopic surgical device according to claim 1, further comprising a connector having an outer connector member non-rotatably

connected to a proximal end of the outer tube of the loading unit and being non-rotatably connectable to the handle assembly, and an inner connector member non-rotatably connected to a proximal end of the inner tube of the loading unit and being non-rotatably connectable to the drive mechanism, wherein the outer connector member and the inner connector member are rotatable with respect to one another.

3. The endoscopic surgical device according to claim 2, wherein the handle housing includes a tooth projecting from a surface thereof, and wherein the outer connector member includes a channel formed therein, wherein the channel of the outer connector member receives the tooth of the handle housing when the elongated tube is connected to the handle assembly, wherein the tooth inhibits rotation of the outer connector member when the trigger is actuated to rotate the inner connector member of the elongated tube.

4. The endoscopic surgical device according to claim 3, wherein the handle assembly includes a ferrule removably and rotatably connected to the handle housing, the ferrule defining an aperture therein that is in operative alignment with the drive mechanism of the handle assembly, the ferrule including a tooth projecting radially into the aperture of the ferrule, the ferrule having:

a first position wherein the tooth of the ferrule is radially aligned with the tooth of the handle housing; and

a second position wherein the tooth of the ferrule is radially out of alignment with the tooth of the handle housing.

5. The endoscopic surgical device according to claim 4, wherein when the ferrule is in the first position the elongated tube is connectable to and disconnectable from the handle assembly.

6. The endoscopic surgical device according to claim 5, wherein the

channel of the outer connector member is formed in an outer radial surface thereof and extends axially along an entire length thereof, and

wherein during connection of the elongated tube to the handle assembly and disconnection of the elongated tube from the handle assembly, the tooth of the ferrule passes along the channel of the outer connector member.

7. The endoscopic surgical device according to claim 4, wherein the ferrule is rotatable to a third position wherein the ferrule is disconnectable from the handle housing.

8. The endoscopic surgical device according to claim 4, wherein the handle assembly includes a safety lock assembly supported on the handle housing, the safety lock assembly includes a proximal end disposed within the handle housing and being in operative association with the drive mechanism, and a distal end projecting from the handle housing and being in operative association with the ferrule.

9. The endoscopic surgical device according to claim 8, wherein:

when the ferrule is in the first position, the safety lock assembly is in a first position such that the proximal end of the safety lock assembly engages the drive mechanism to block operation of the drive mechanism; and

when the ferrule is in the second position, the safety lock assembly is in a second position such that the proximal end of the safety lock assembly is disengaged from the drive mechanism to permit operation of the drive mechanism.

10. The endoscopic surgical device according to claim 9, wherein the ferrule is dimensioned to actuate the safety lock assembly between the first and second positions thereof as the ferrule is moved between respective first and second positions thereof.

11. The endoscopic surgical device according to claim 9, wherein the

safety lock assembly includes a lock plate supported on and extending radially from the proximal end thereof, wherein the lock plate has a generally pie-shaped profile, wherein the drive mechanism includes a gear defining a slot therein, and wherein the lock plate of the safety lock assembly is disposed within the slot of the gear of the drive mechanism when the ferrule is in the first position.

12. The endoscopic surgical device according to claim 11, wherein the drive mechanism includes a plurality of gears, wherein at least one gear is actuated by the trigger, and wherein at least one gear actuates a drive shaft extending from the handle housing, wherein the drive shaft is keyed for selective connection to the inner connector member supported at the proximal end of the inner tube.

13. A surgical kit, comprising:

a handle assembly including a handle housing and a trigger operatively connected to the handle housing, and a drive mechanism actuatable by the trigger;

a long loading unit selectively connectable to the handle assembly;

an elongated tube selectively connectable to the handle assembly;

a short loading unit selectively connectable to the elongated tube, each loading unit including:

an outer tube defining a lumen therethrough and having a helical thread disposed within the lumen thereof, the outer tube defining a proximal end and a distal end;

an inner tube rotatably supported in the outer tube, the inner tube defining a lumen therethrough and having a proximal end and a distal end; and

a first quantity of surgical anchors loaded in the lumen of the inner tube of the long loading unit, and a second quantity of surgical anchors loaded in the lumen of the inner tube of the short loading unit, wherein the first quantity is

greater than the second quantity.

14. The surgical kit according to claim 13, wherein the first quantity of anchors includes about 30 anchors.

15. The surgical kit according to claim 14, wherein the second quantity of anchors includes about five anchors.

16. The surgical kit according to claim 15, wherein the elongated tube is reusable.

17. The surgical kit according to claim 13, wherein the elongated tube is reusable.

18. The surgical kit according to claim 17, further including a plurality of short loading units.

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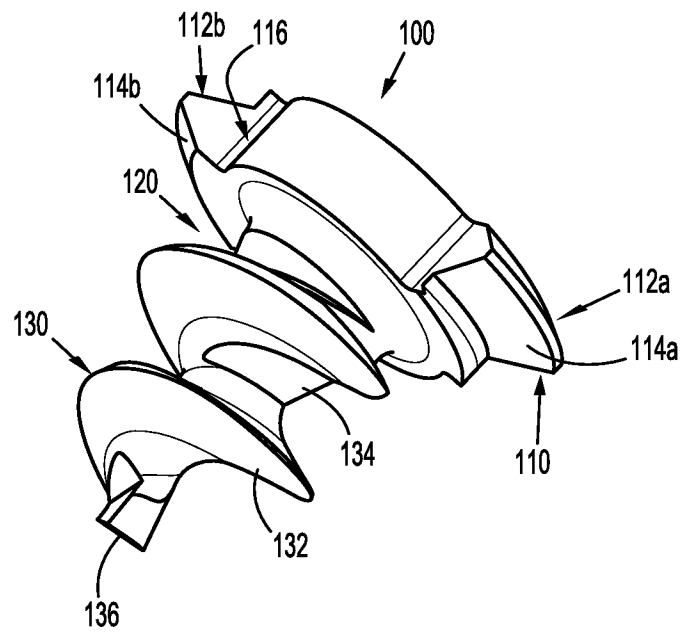


FIG. 1

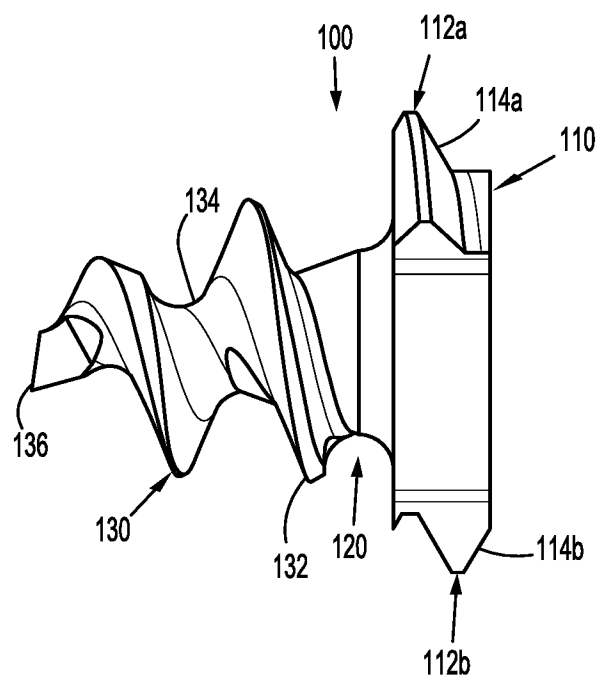


FIG. 2

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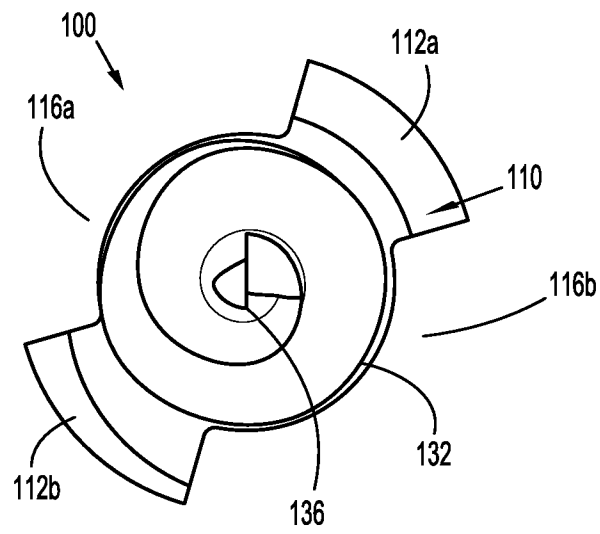


FIG. 3

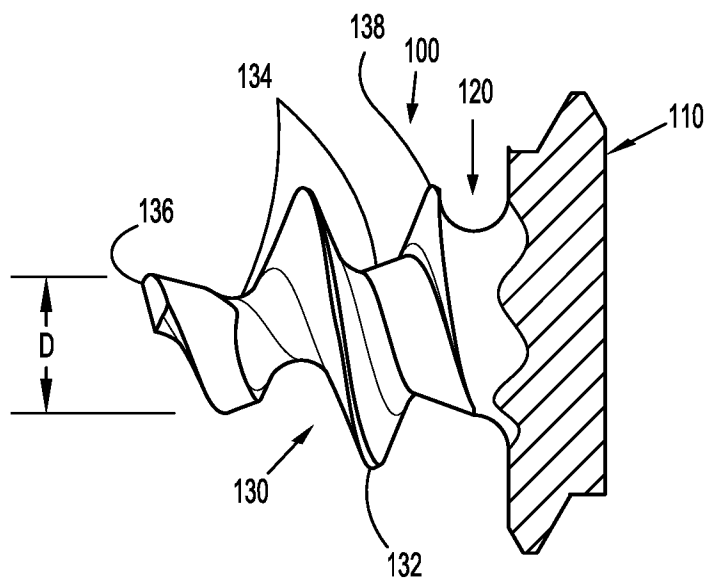


FIG. 4

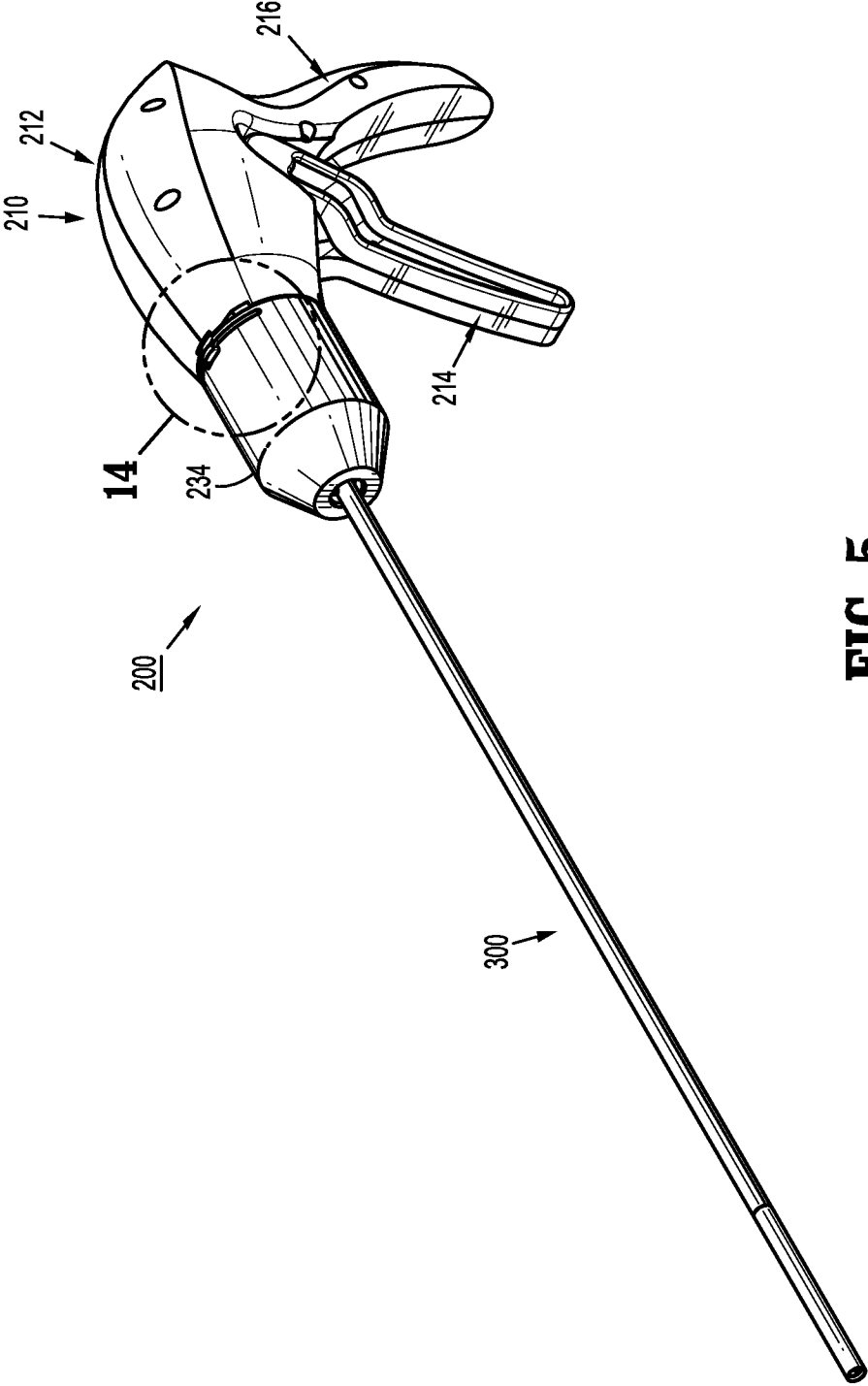


FIG. 5

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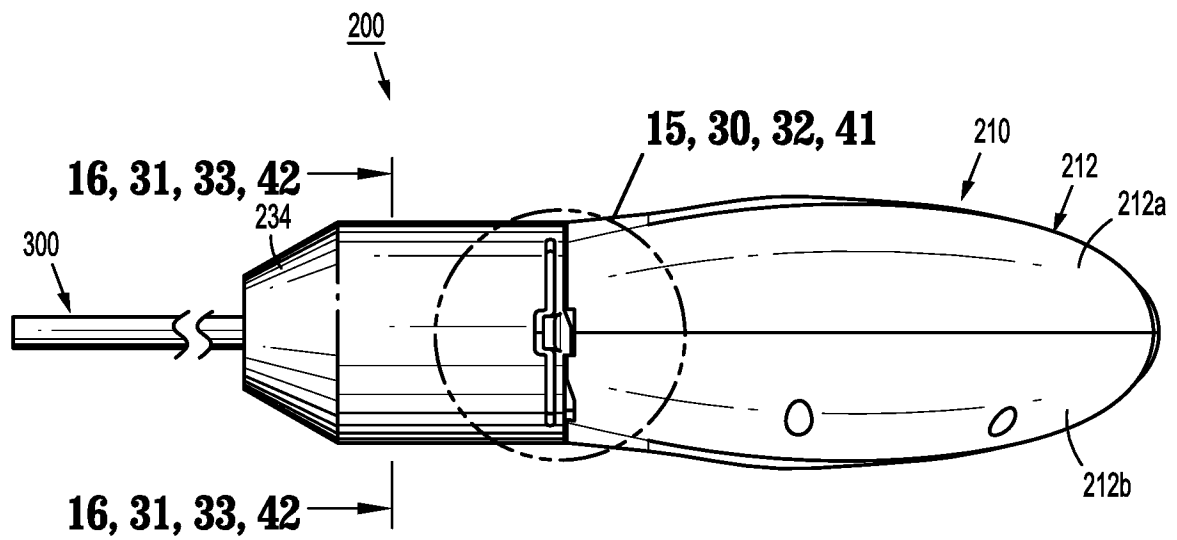


FIG. 6

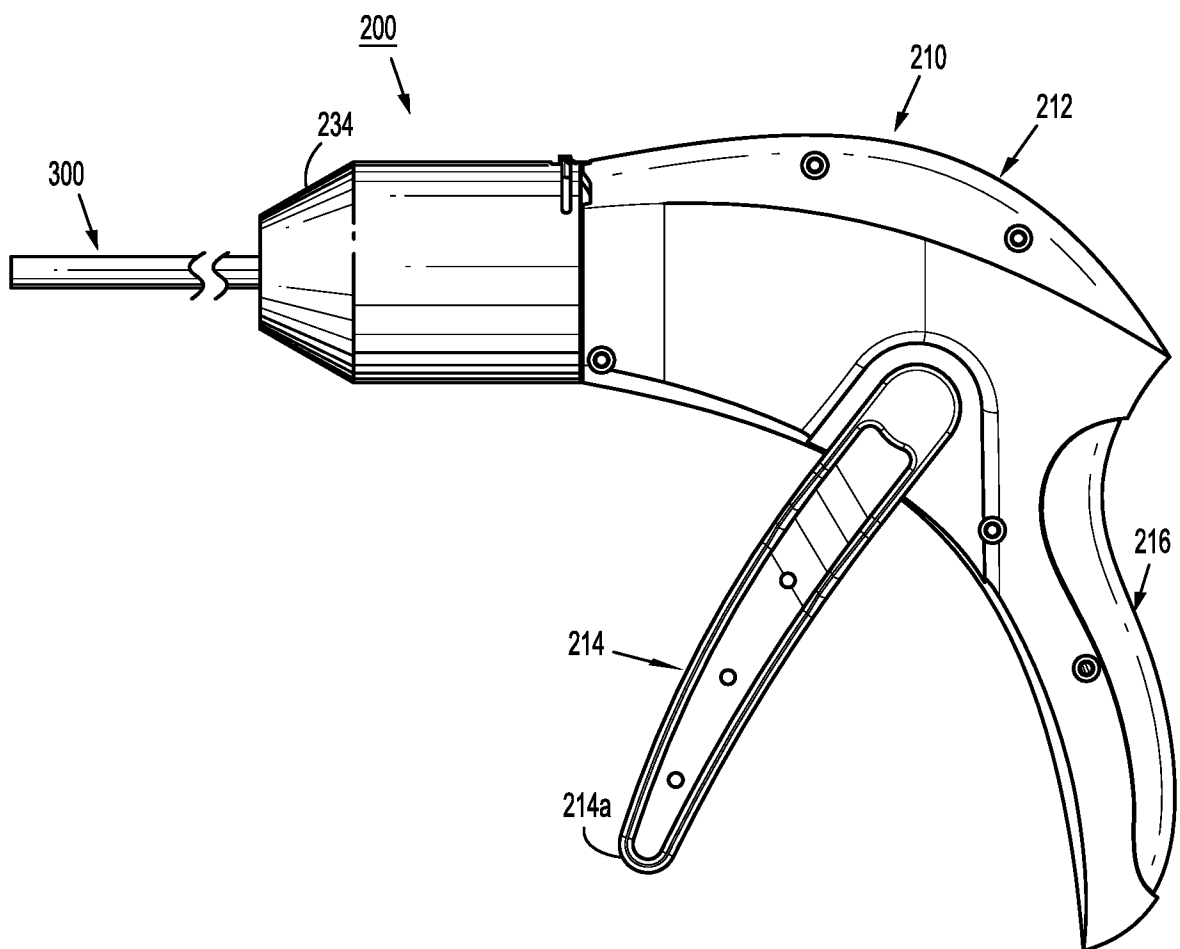


FIG. 7

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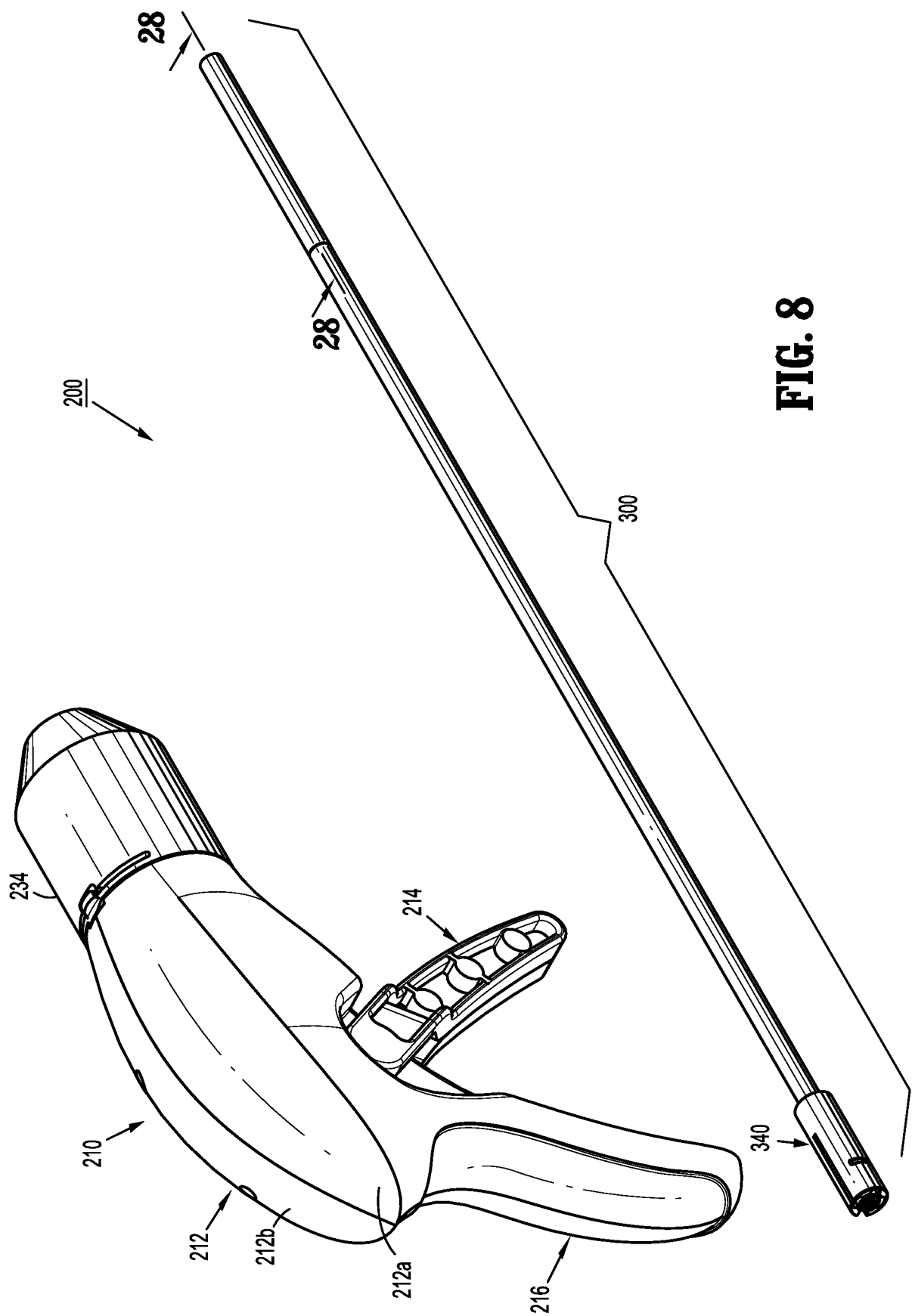


FIG. 8

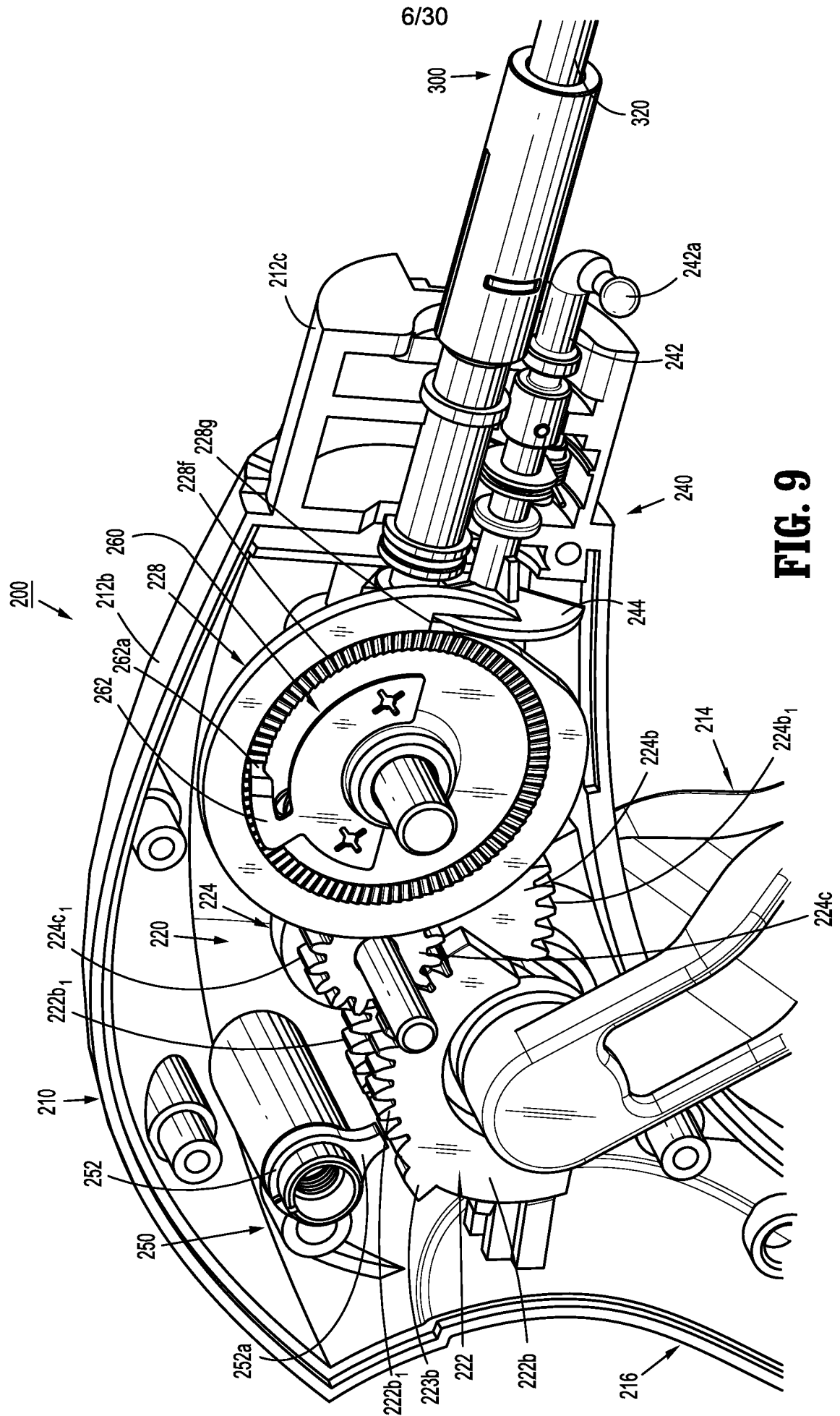


FIG. 9

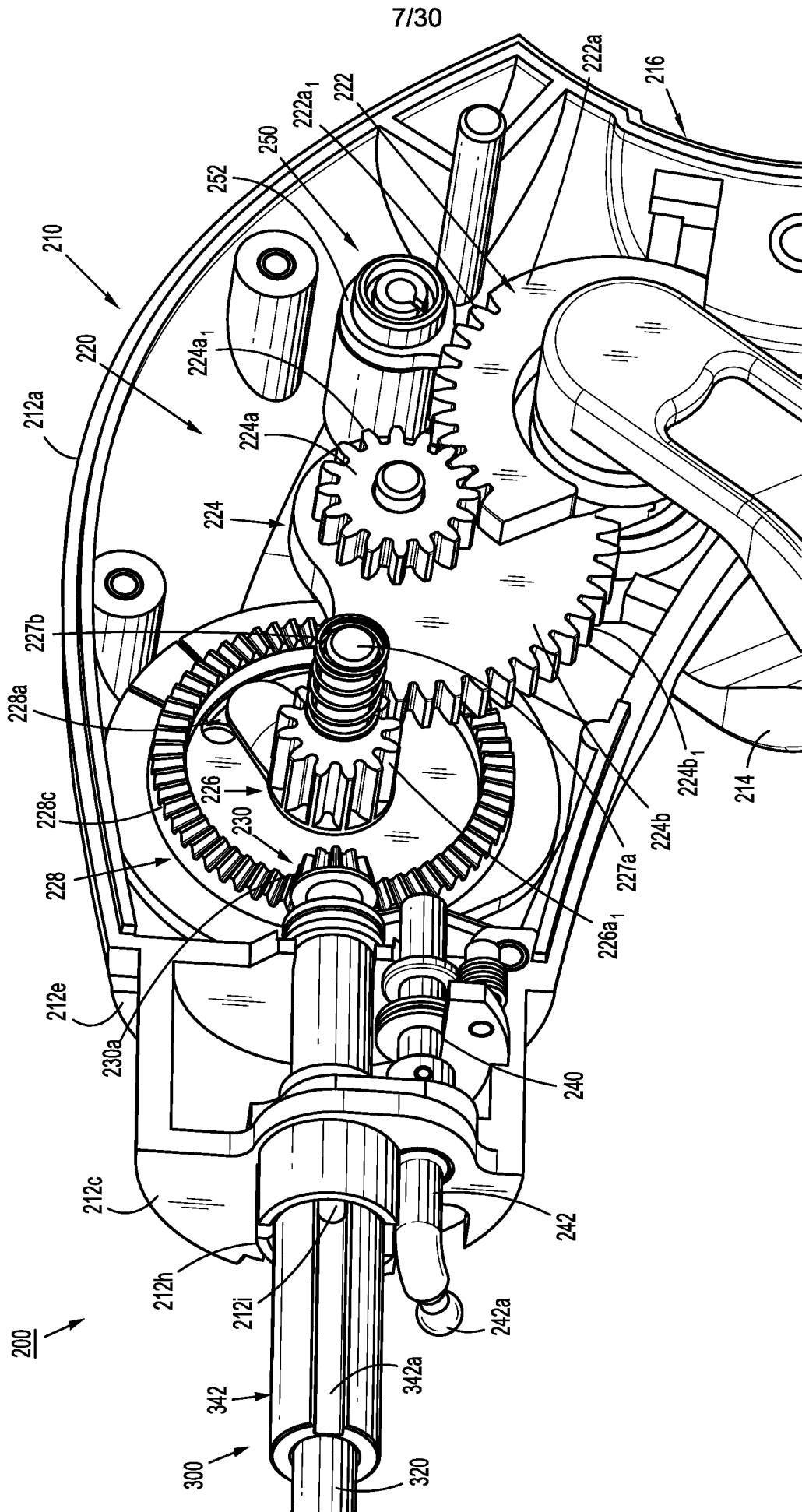
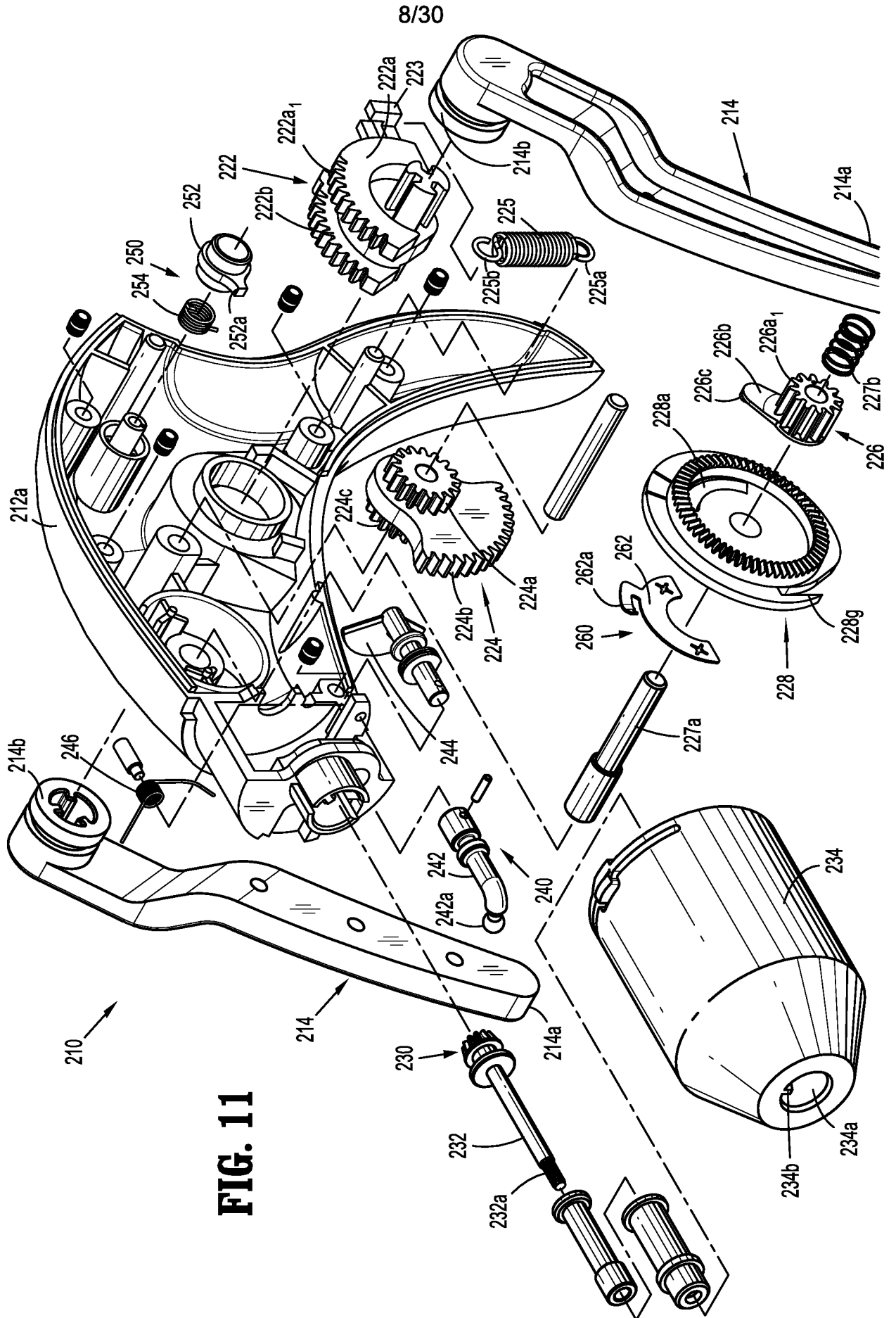


FIG. 10



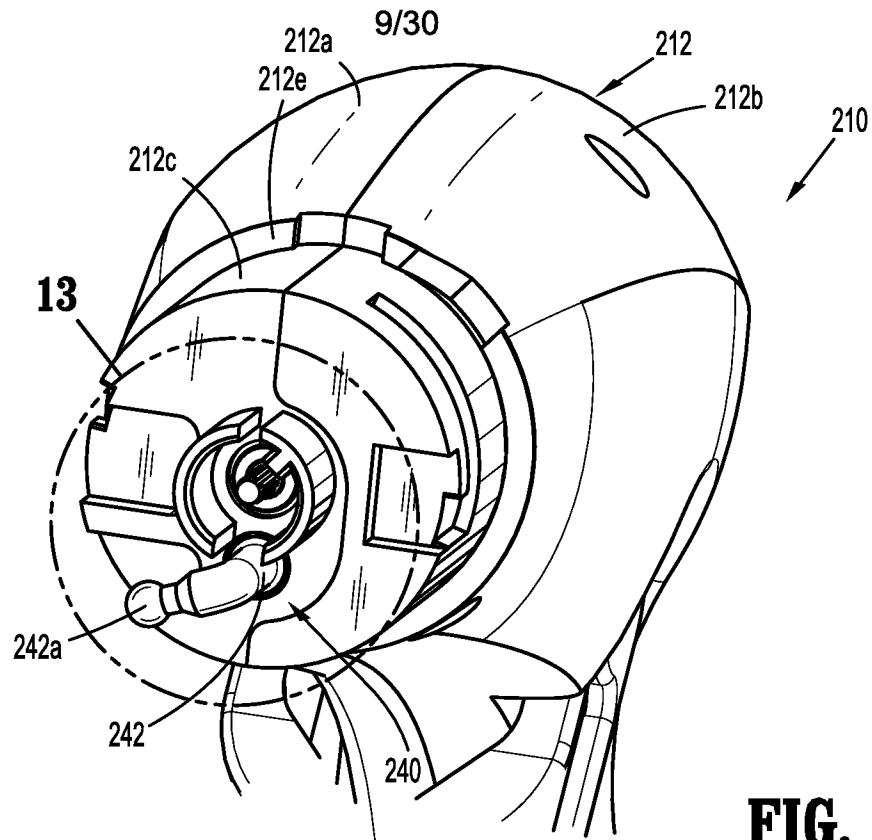


FIG. 12

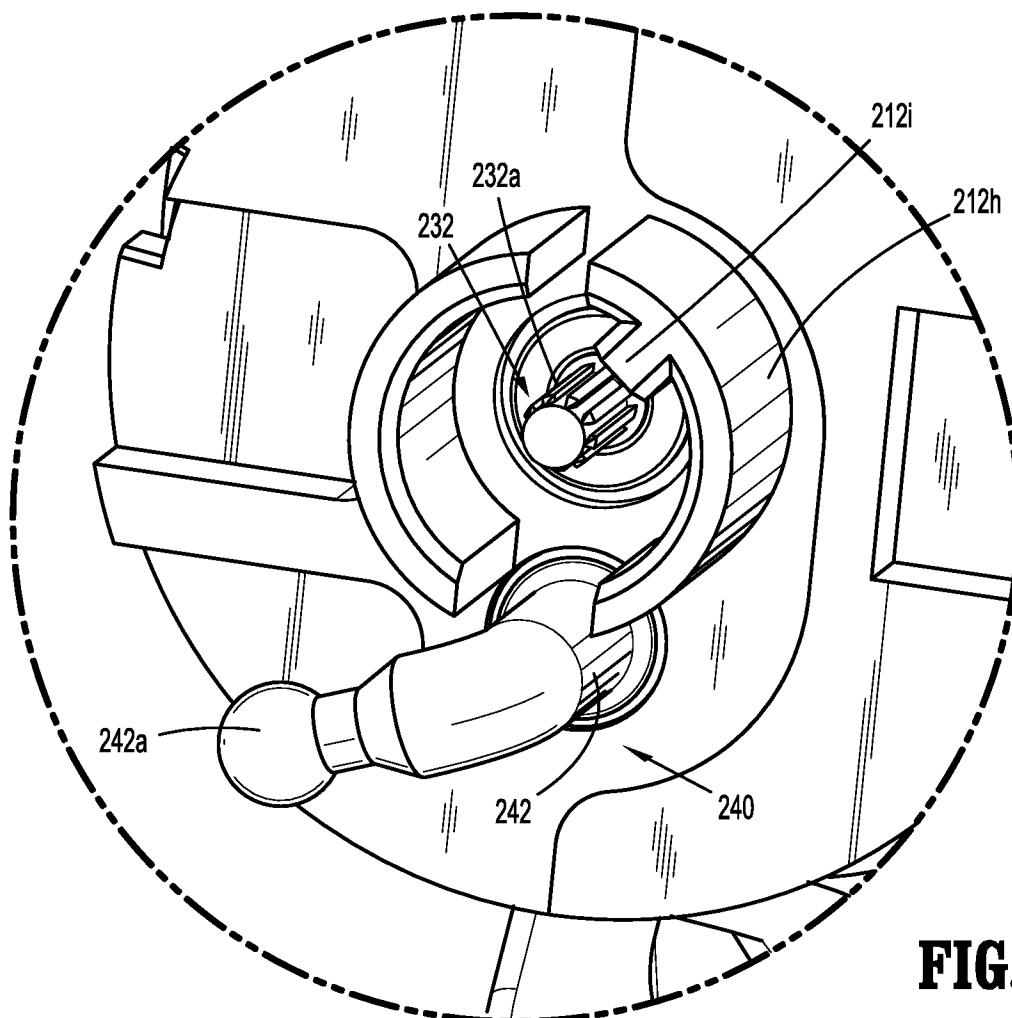


FIG. 13

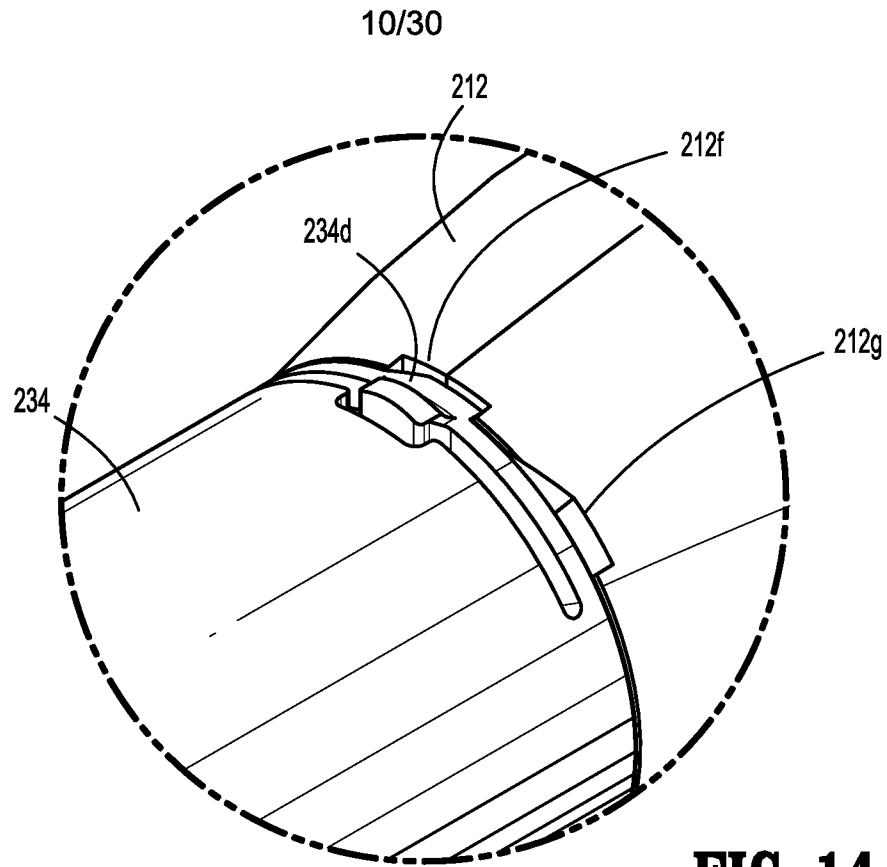


FIG. 14

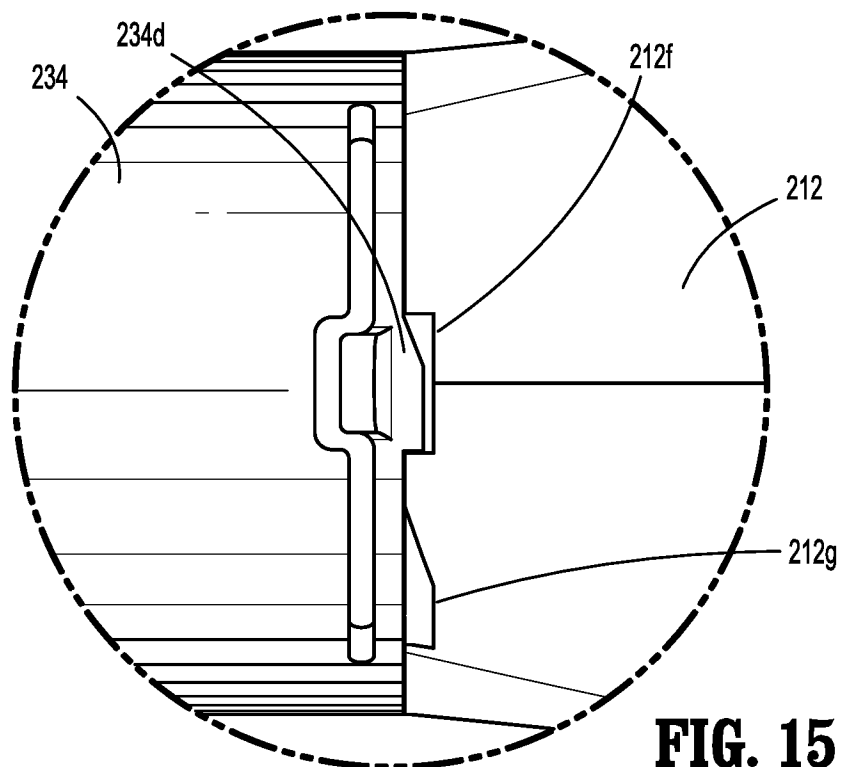
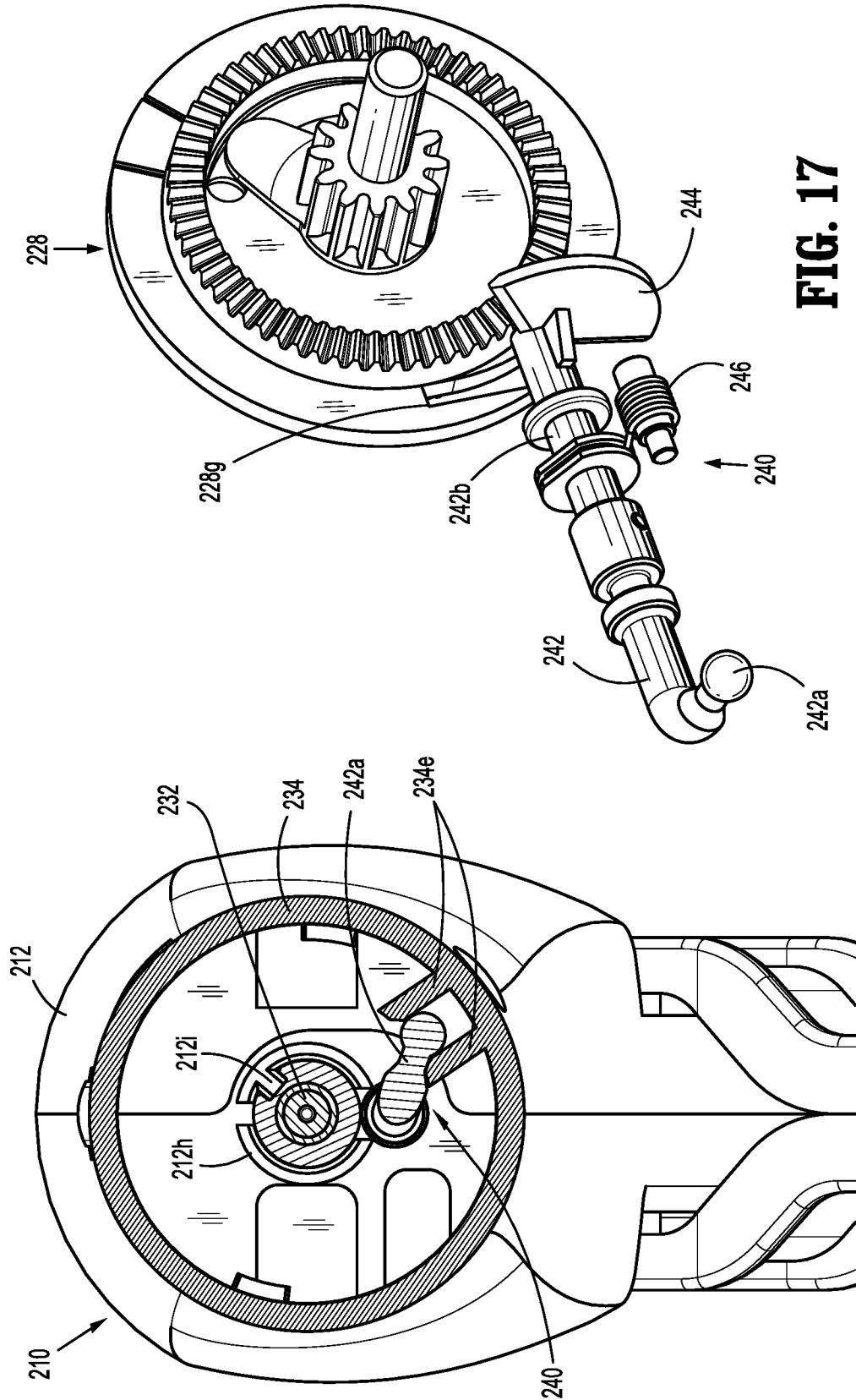


FIG. 15



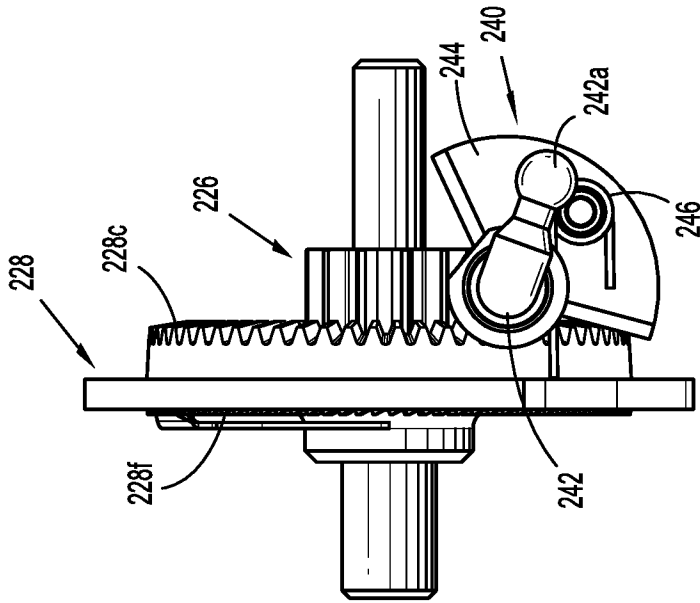


FIG. 19

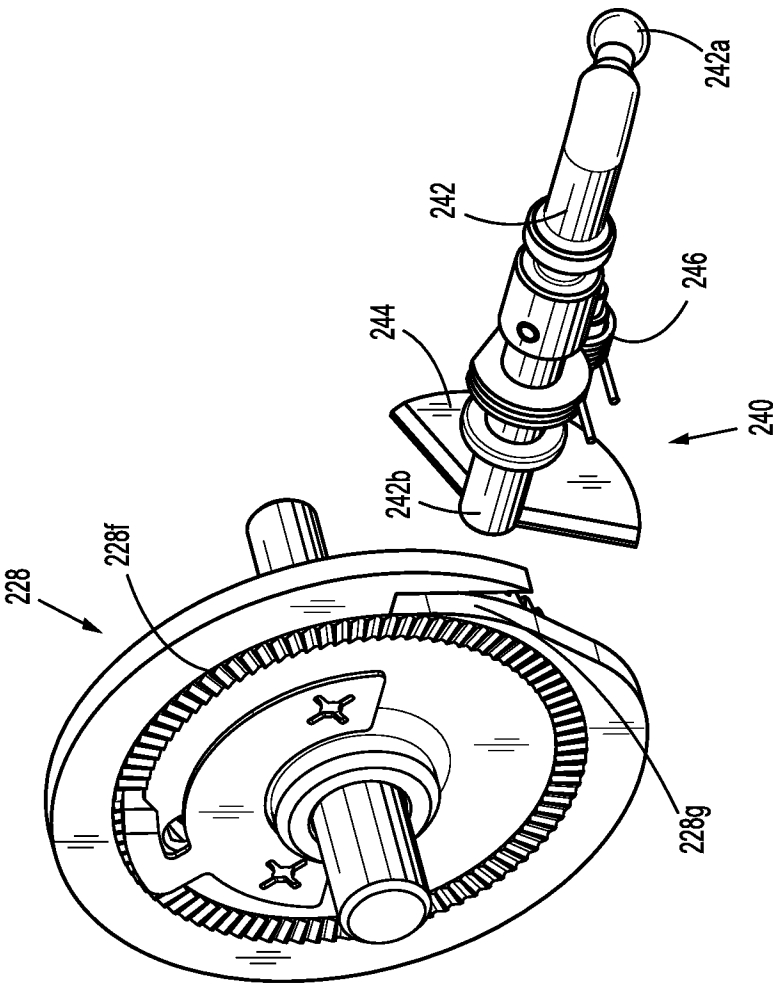
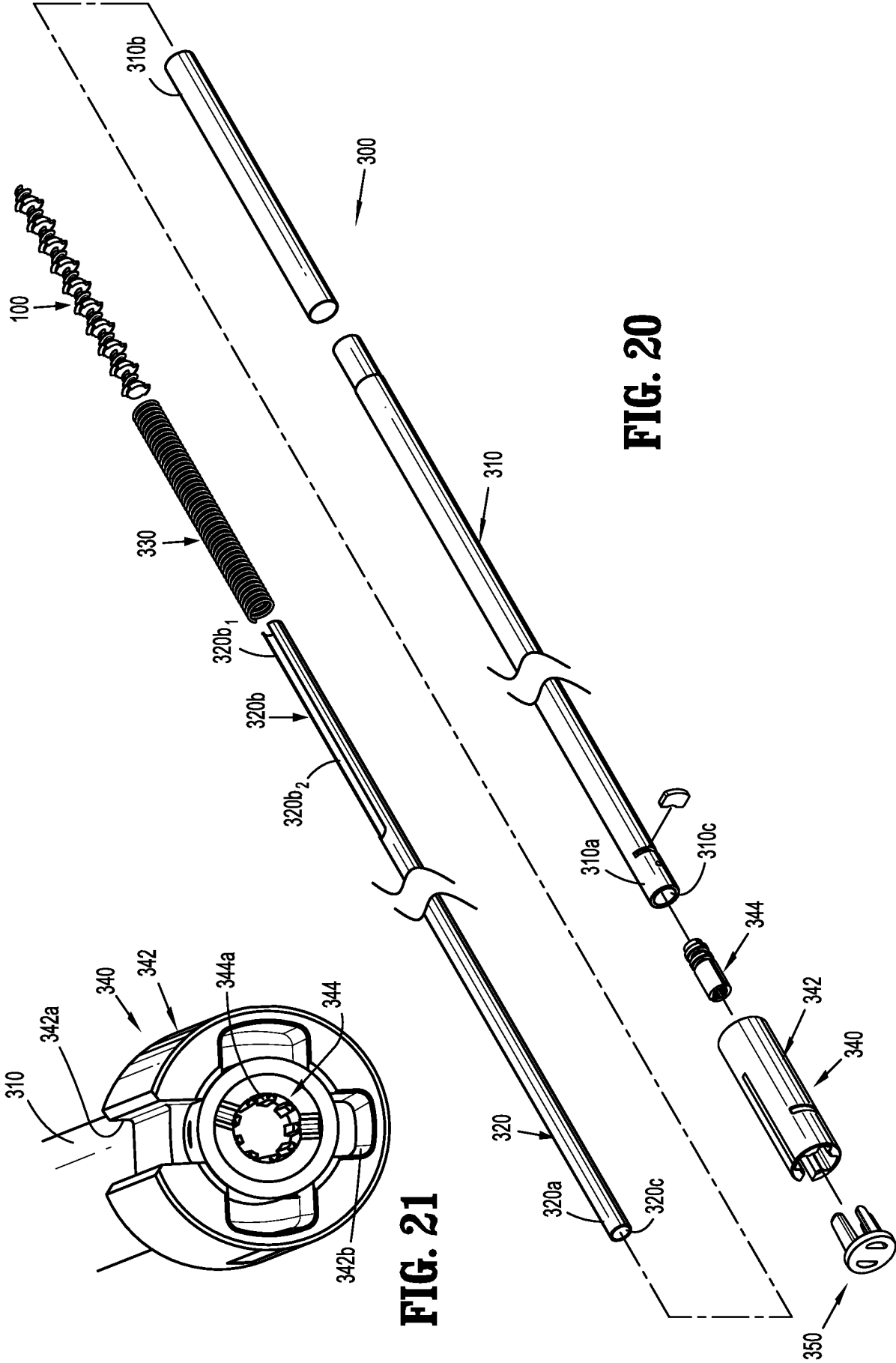


FIG. 18



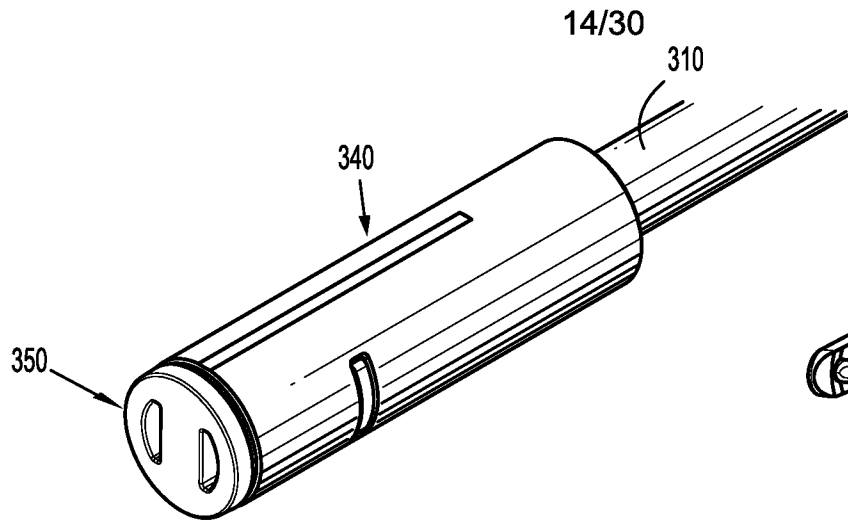


FIG. 22

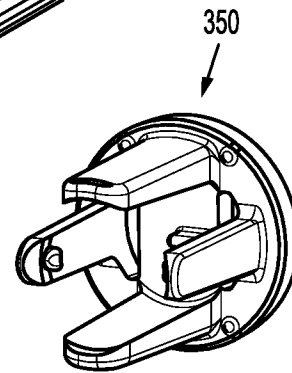


FIG. 23

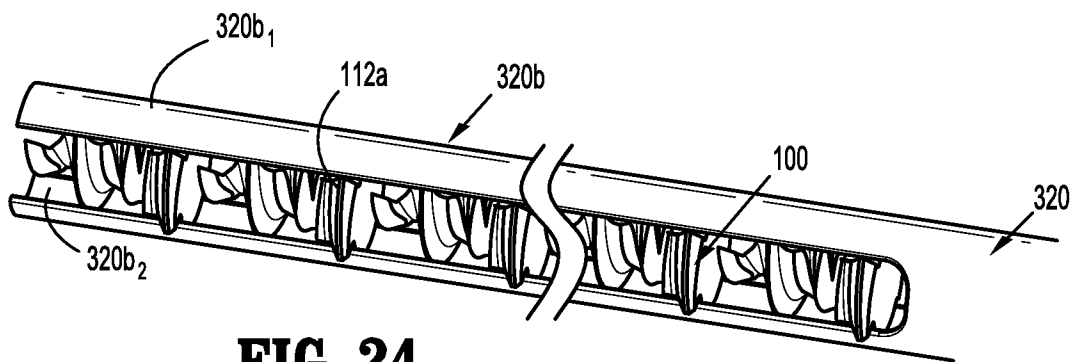


FIG. 24

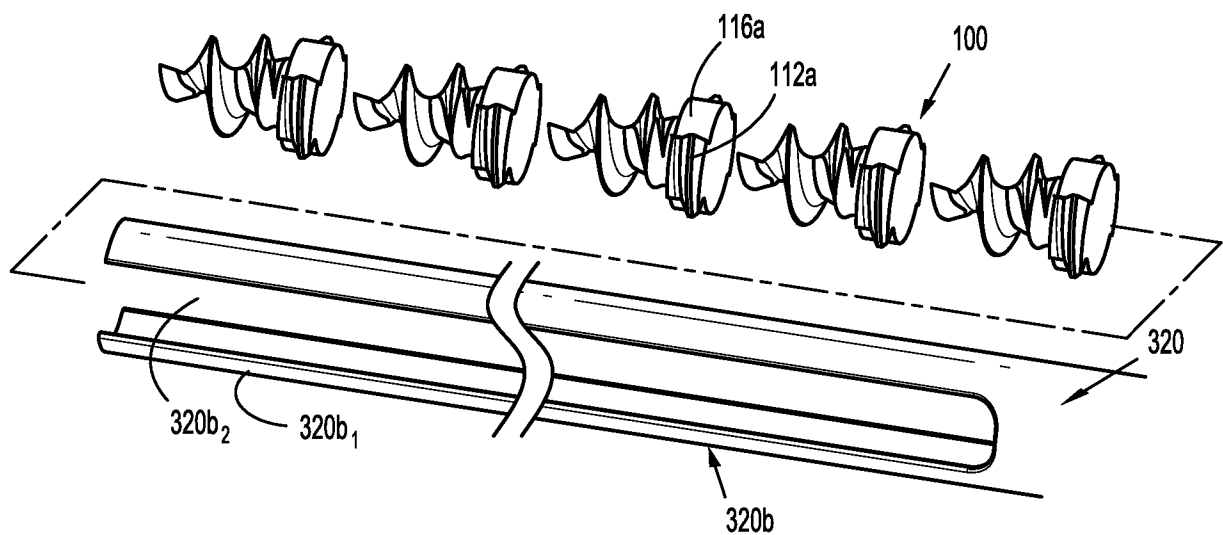


FIG. 25

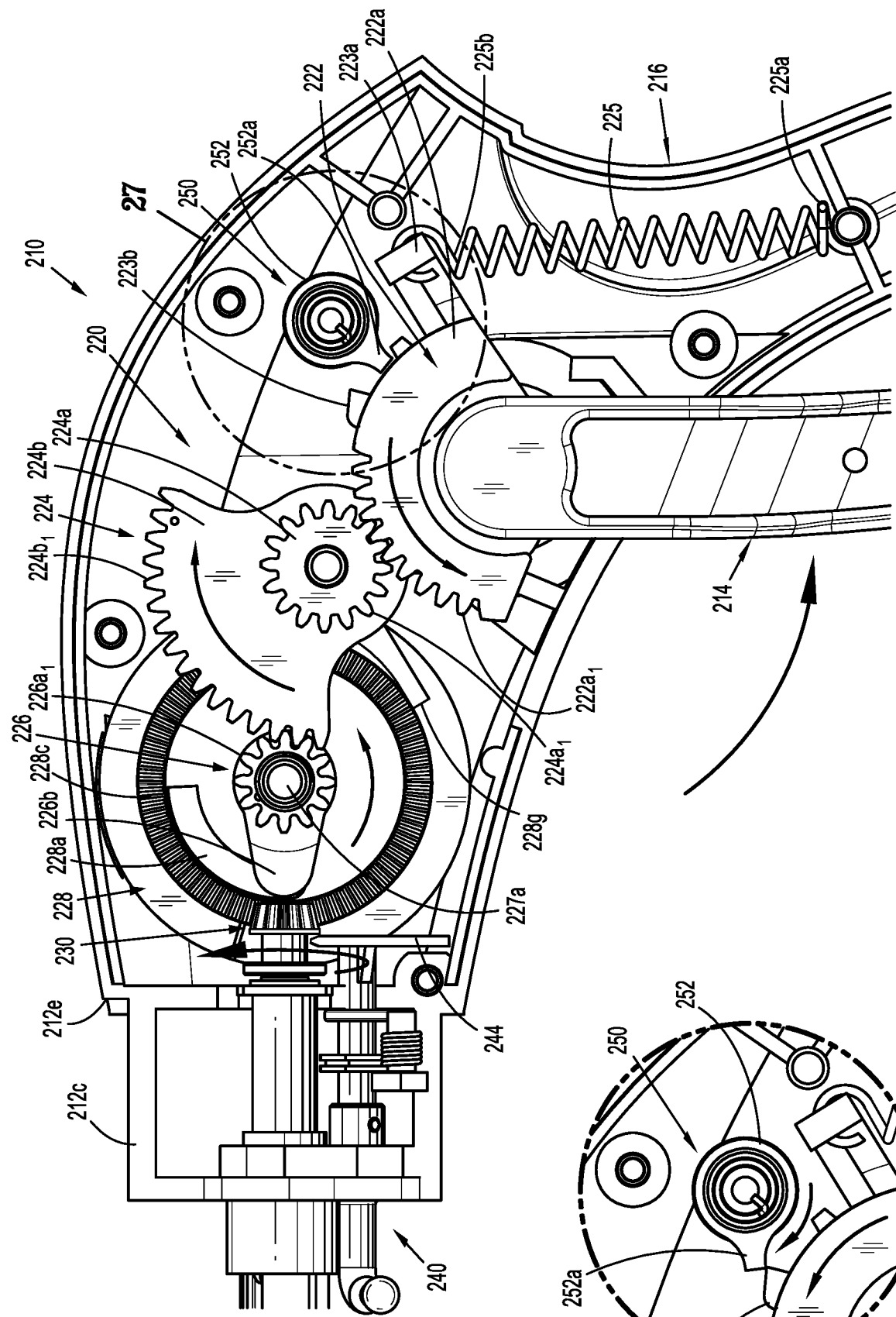


FIG. 26

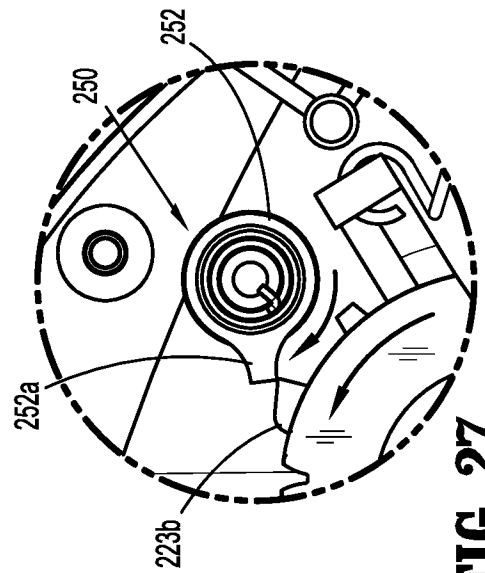


FIG. 27

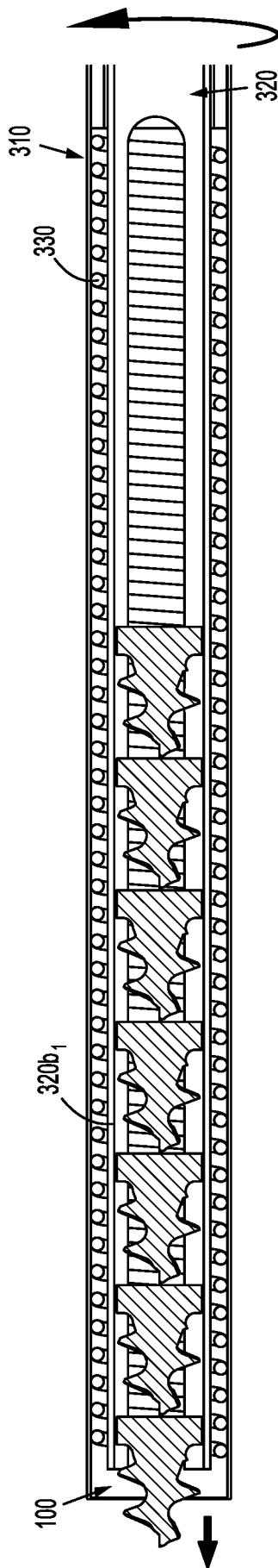


FIG. 28

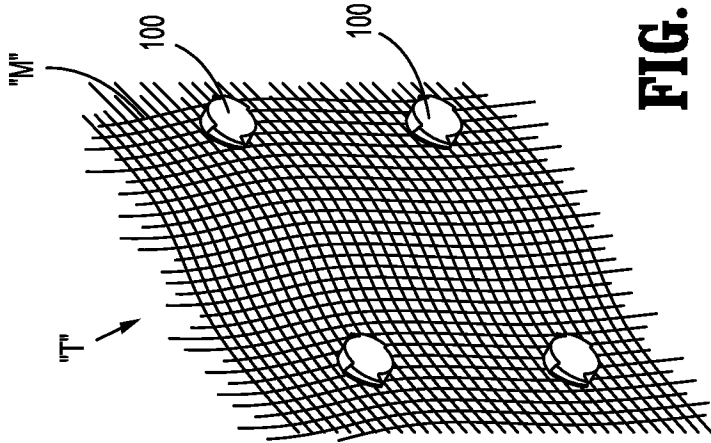


FIG. 29

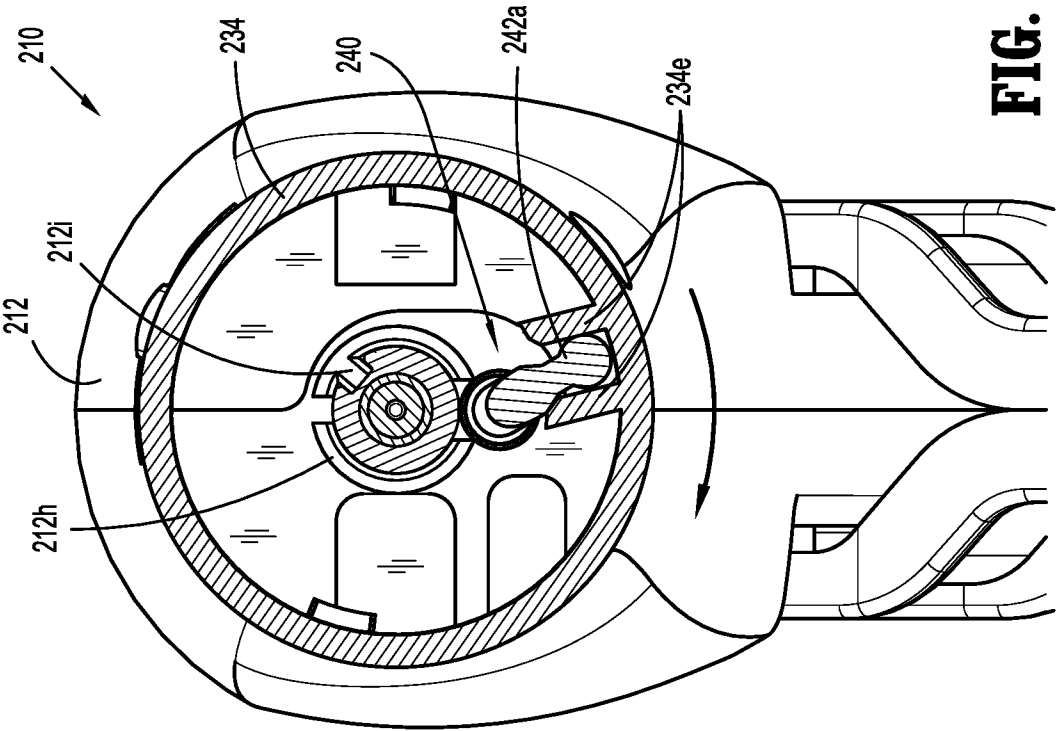


FIG. 31

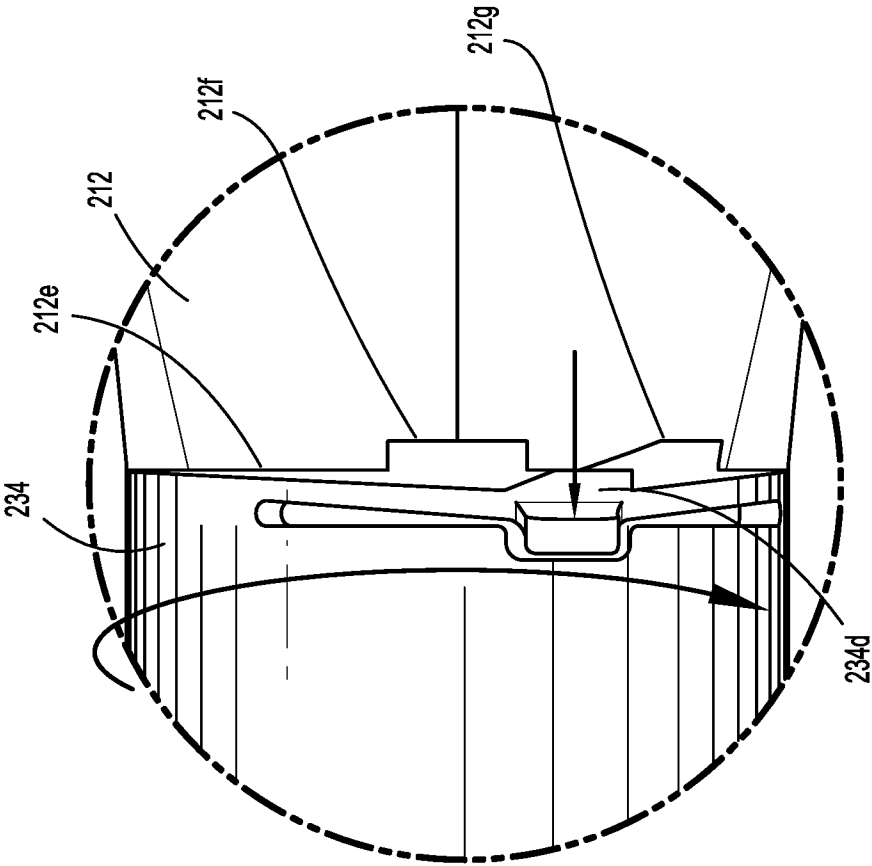


FIG. 30

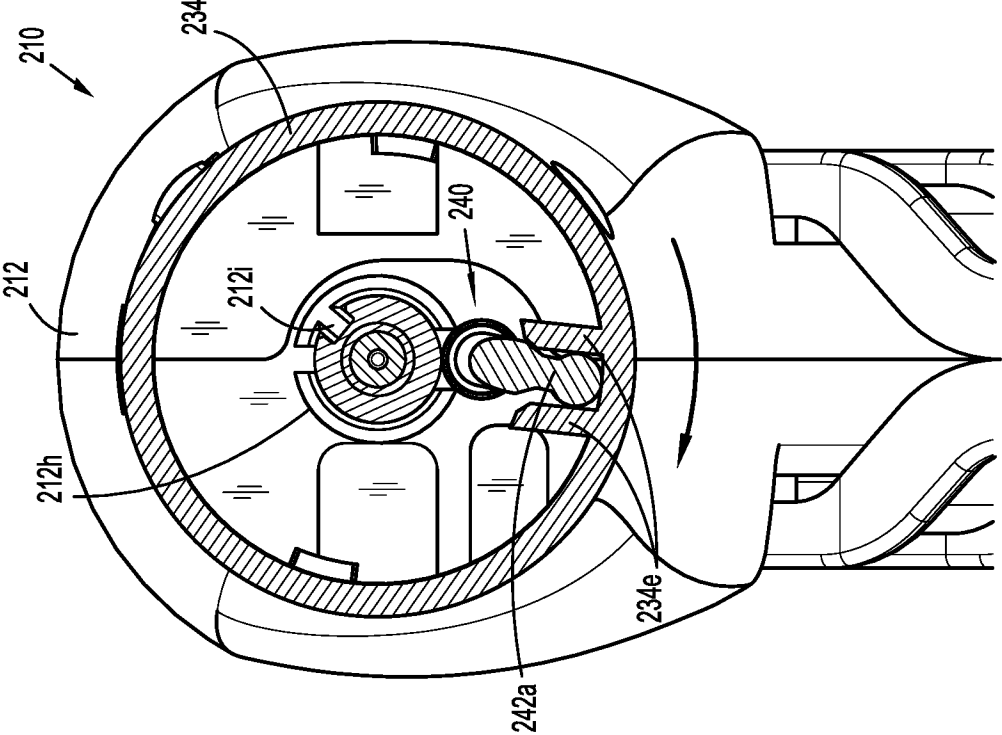


FIG. 33

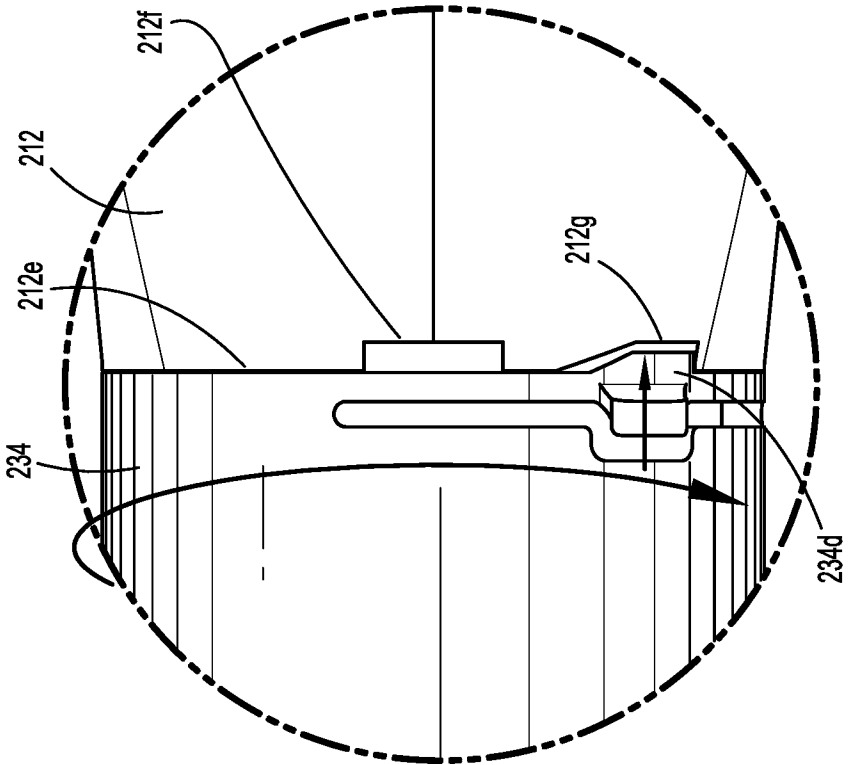


FIG. 32

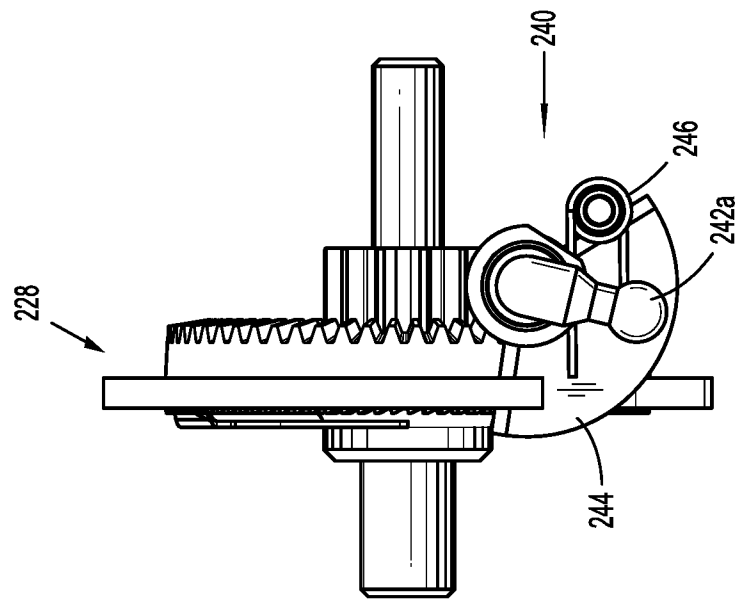


FIG. 35

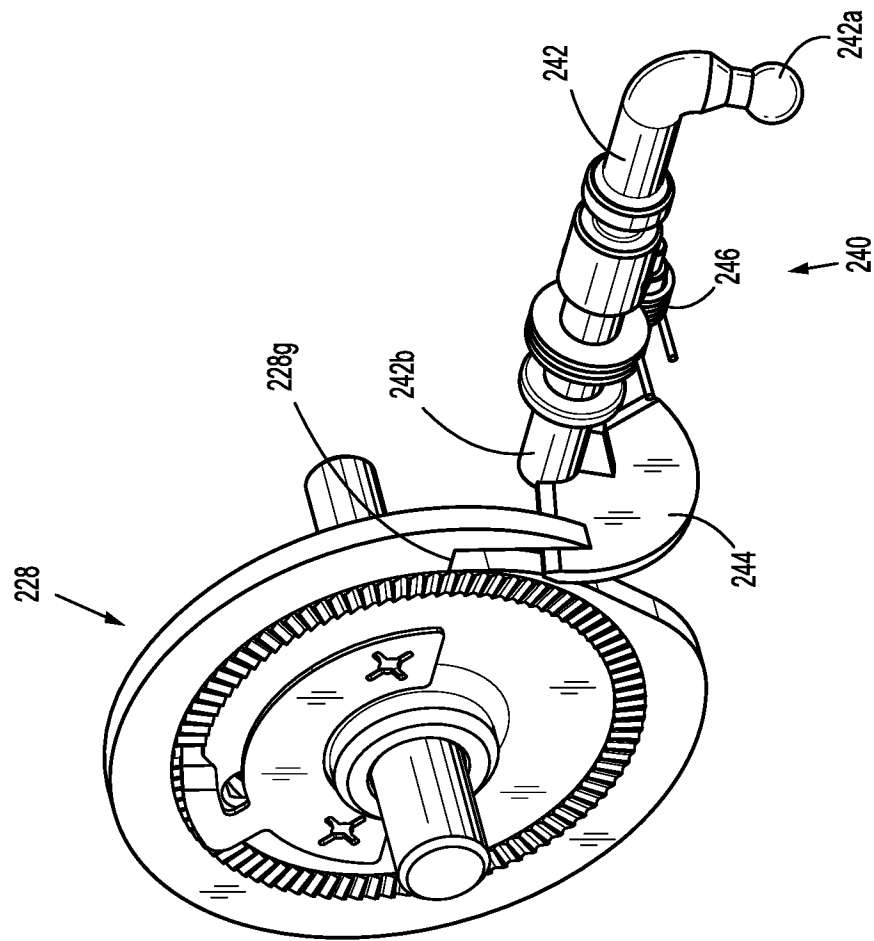


FIG. 34

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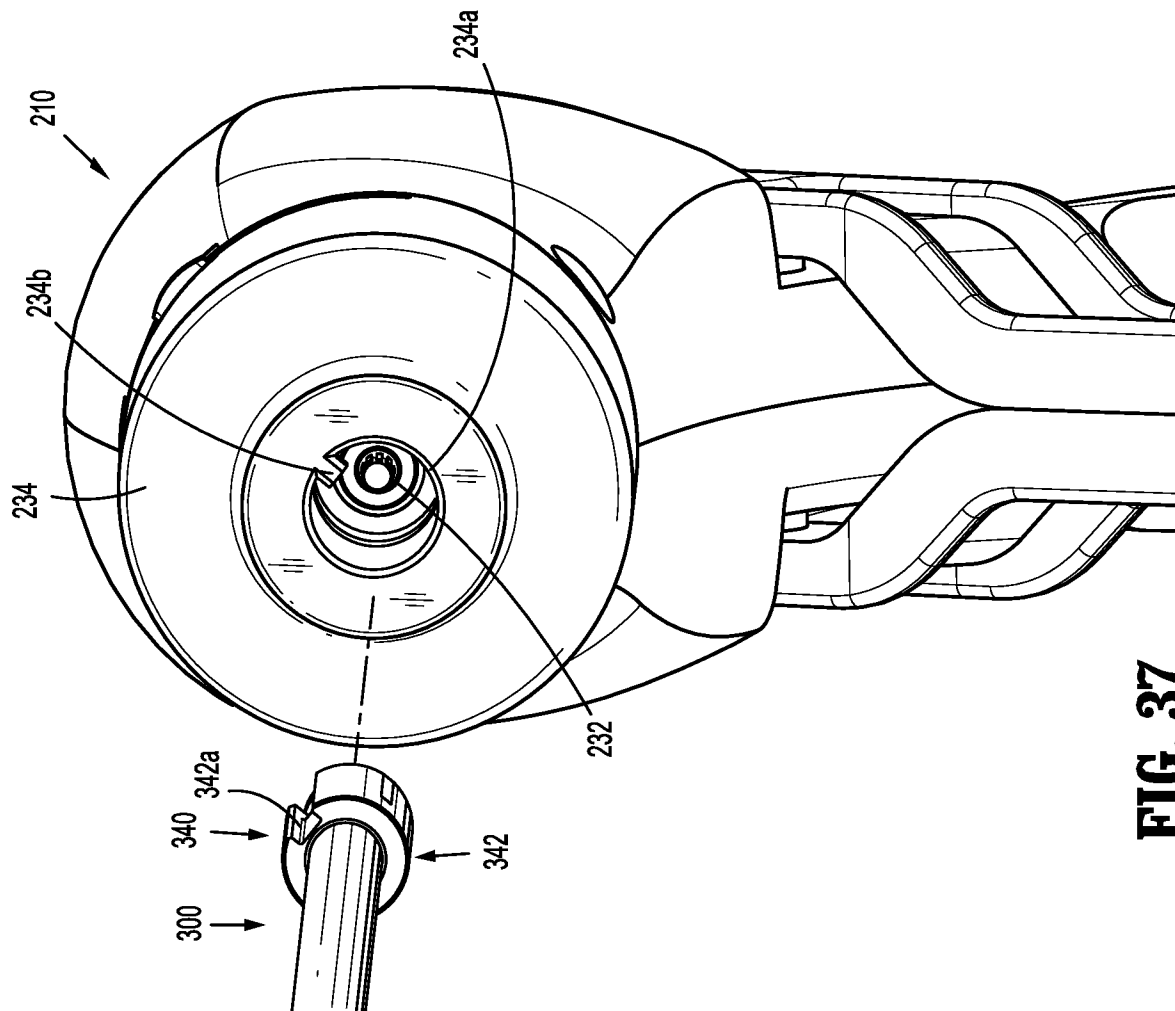


FIG. 37

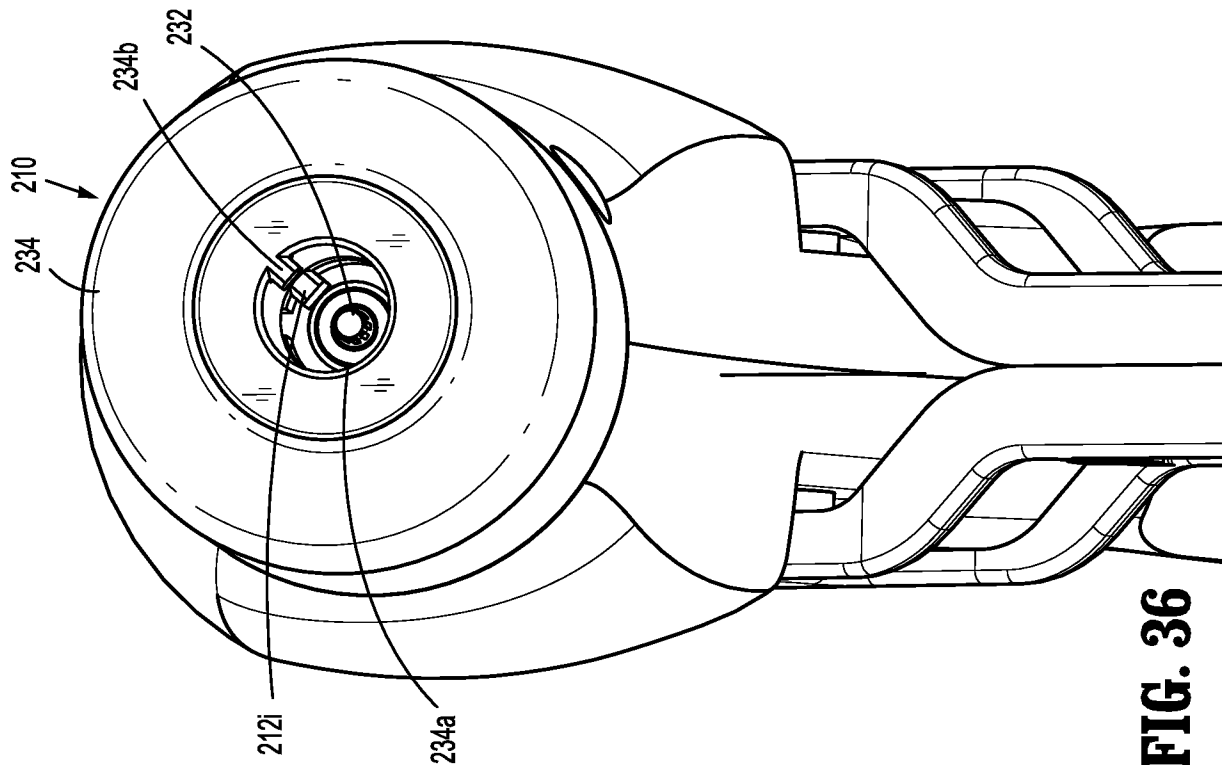


FIG. 36

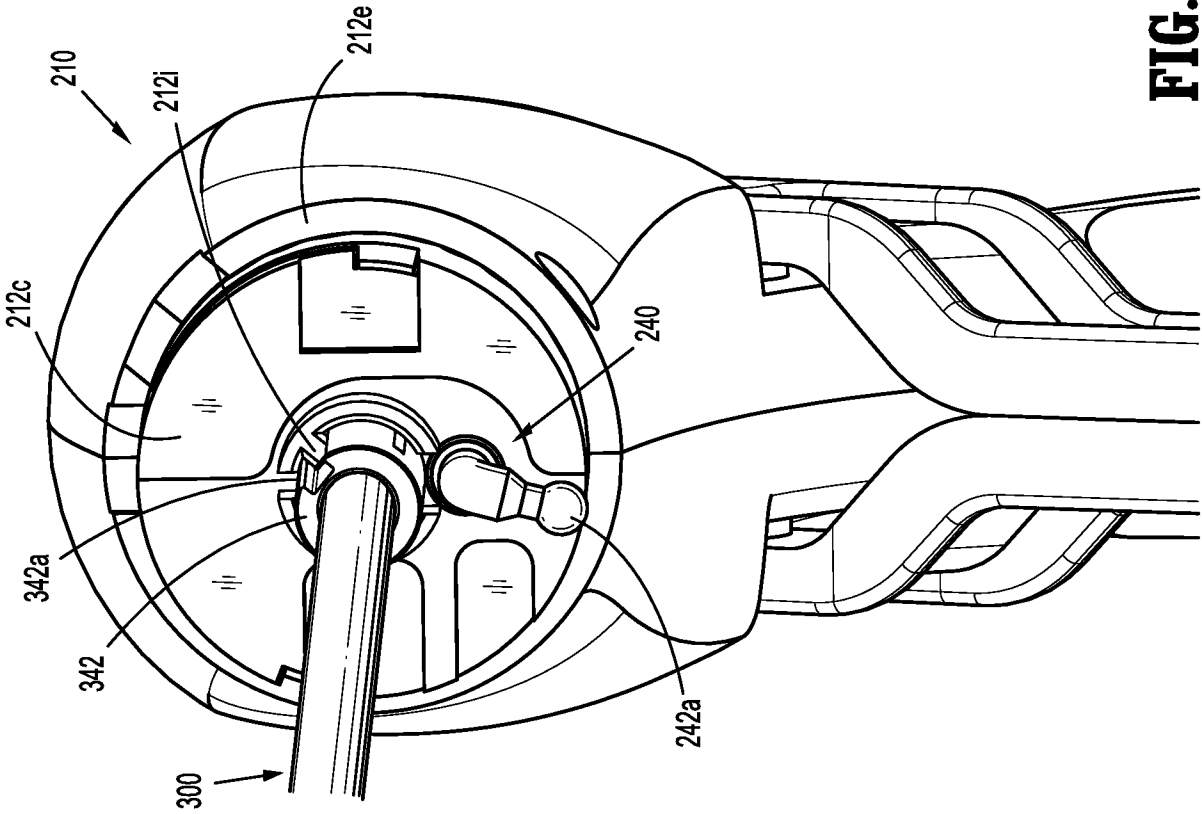


FIG. 39

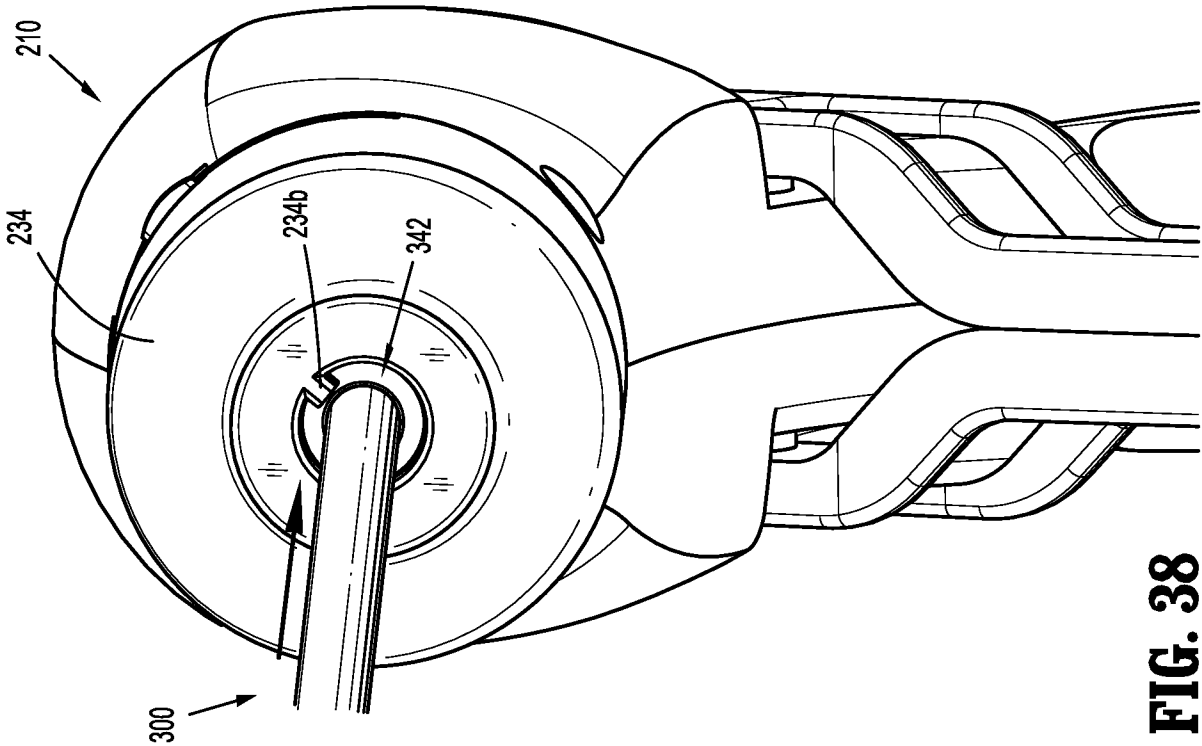


FIG. 38

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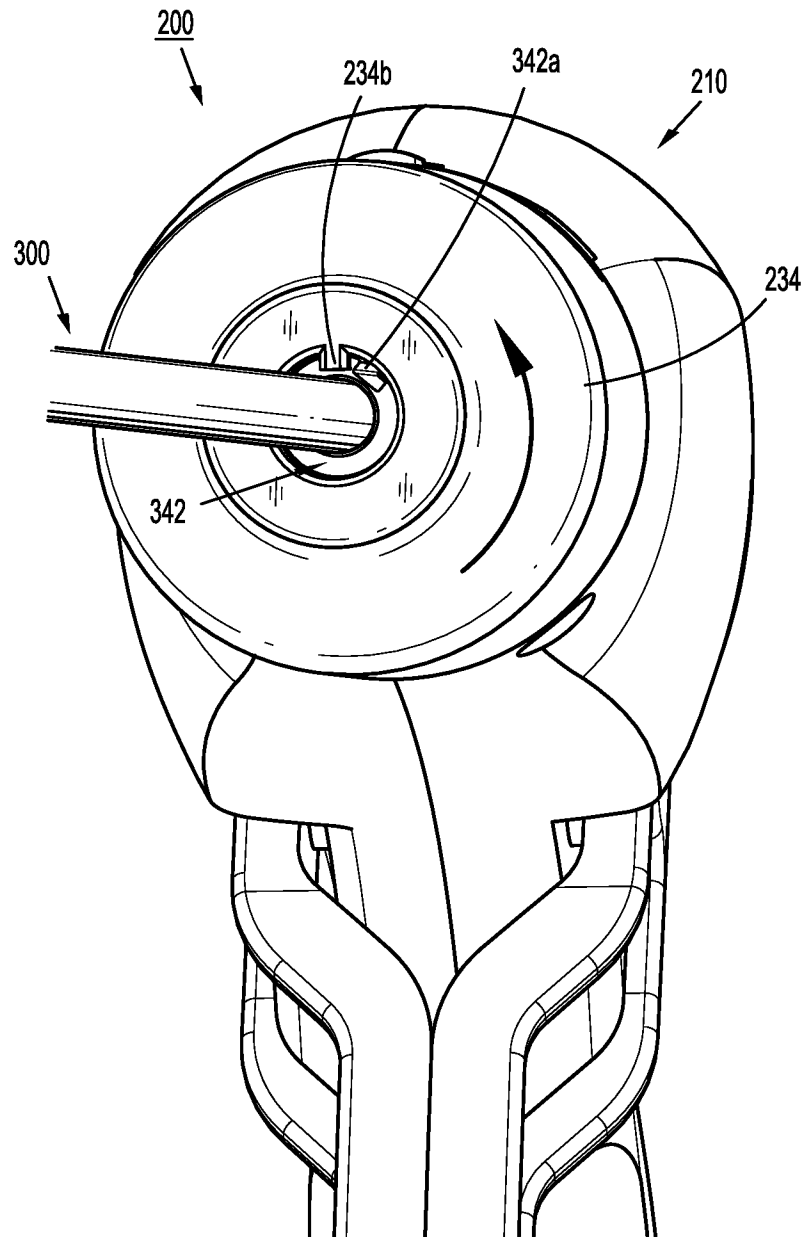


FIG. 40

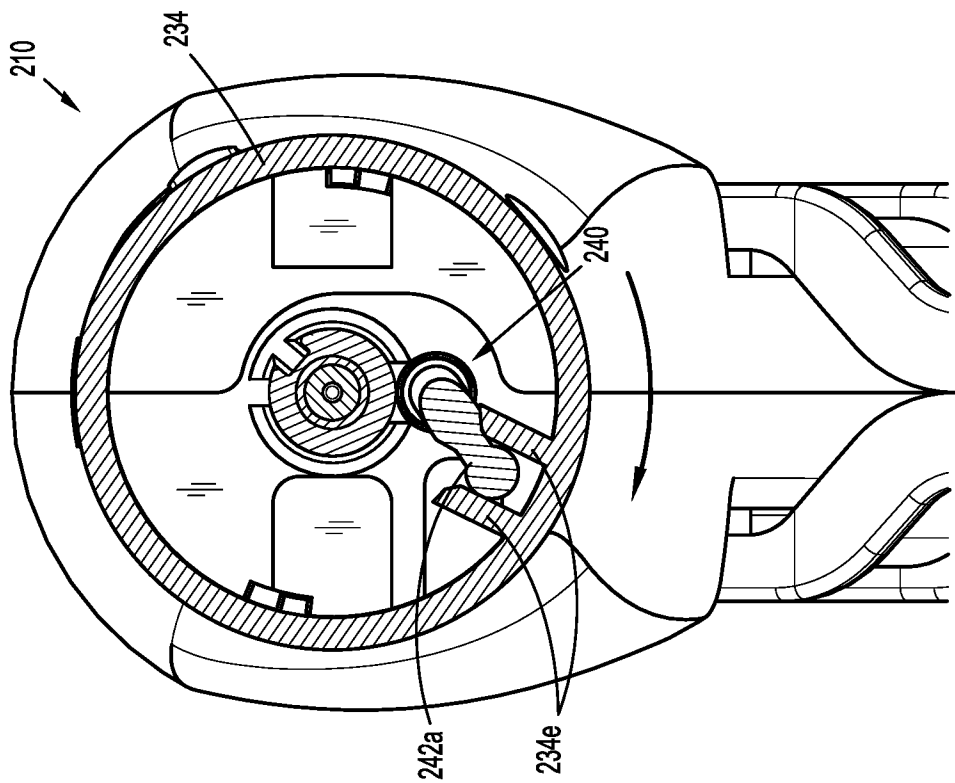


FIG. 42

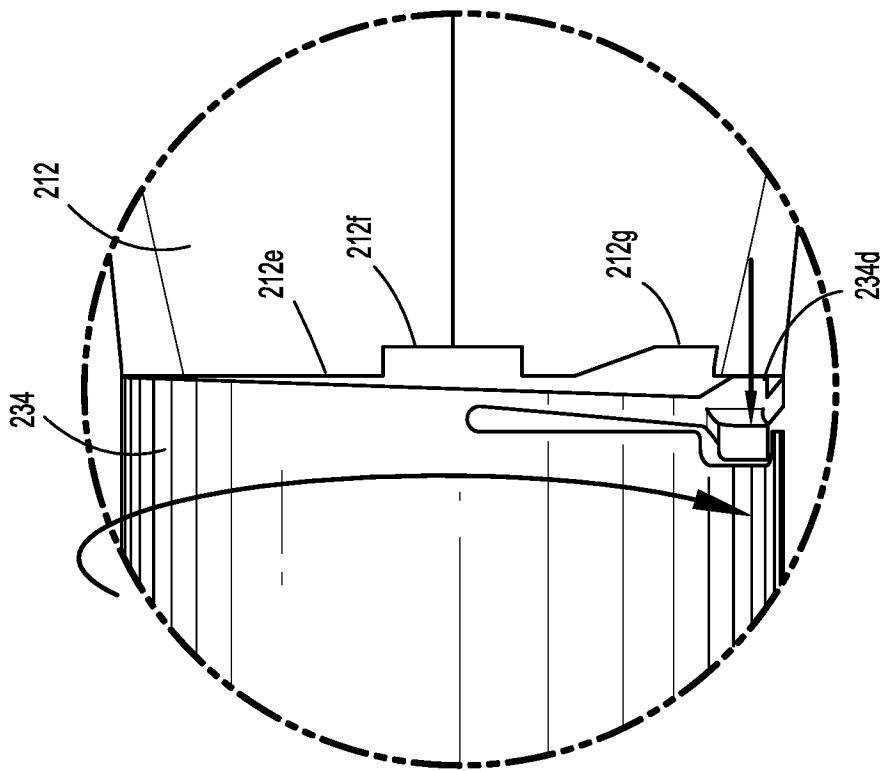


FIG. 41

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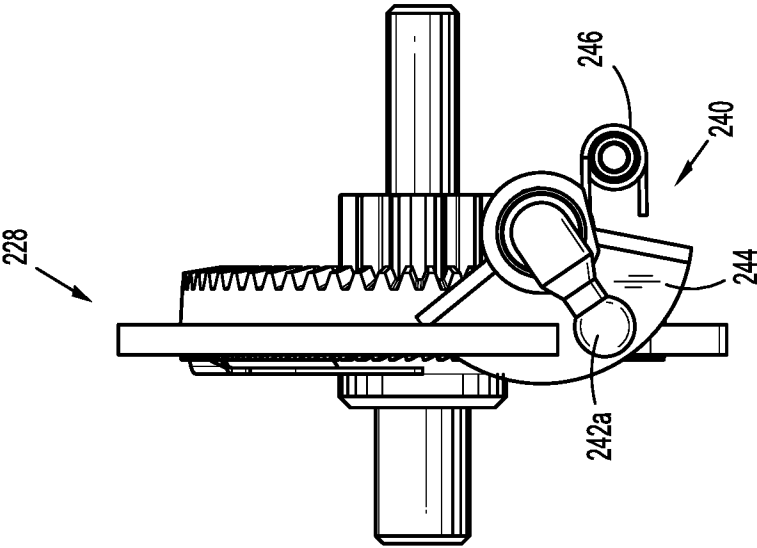


FIG. 44

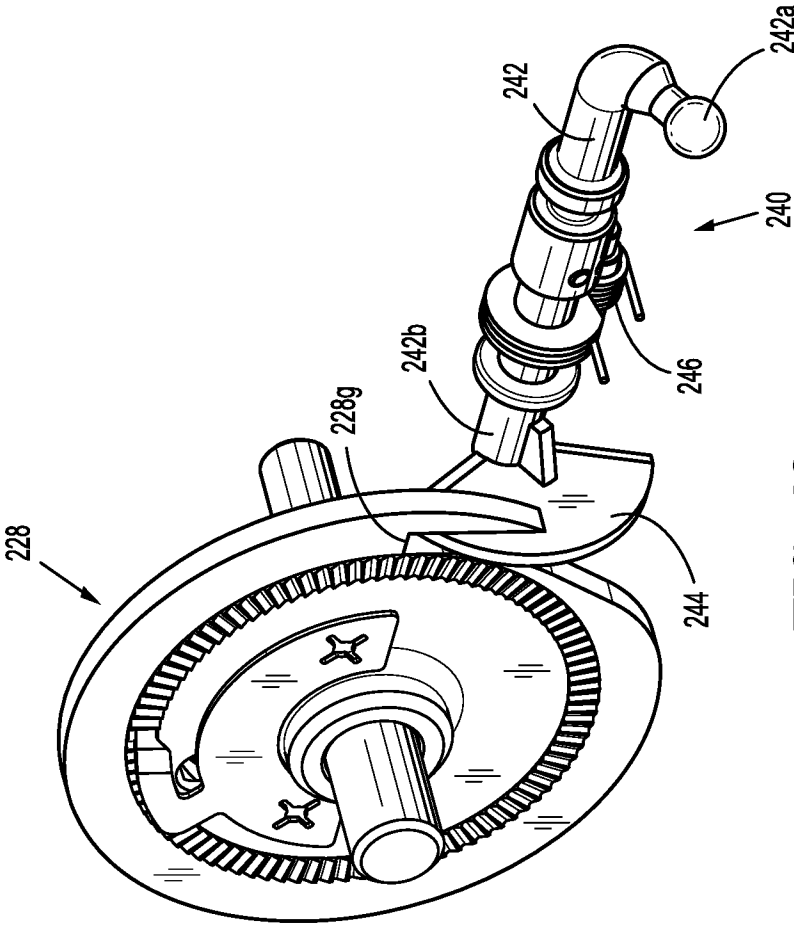


FIG. 43

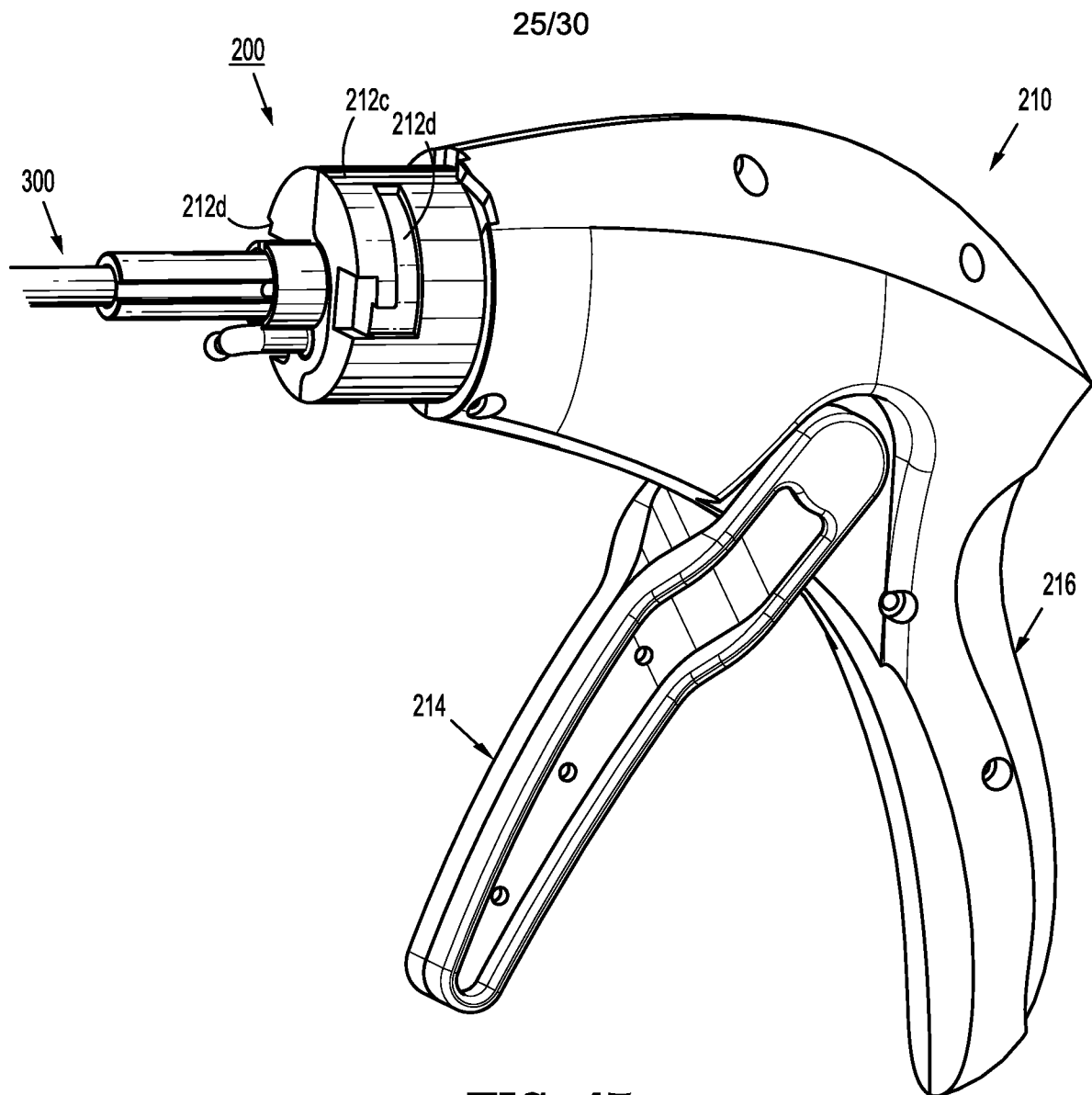


FIG. 45

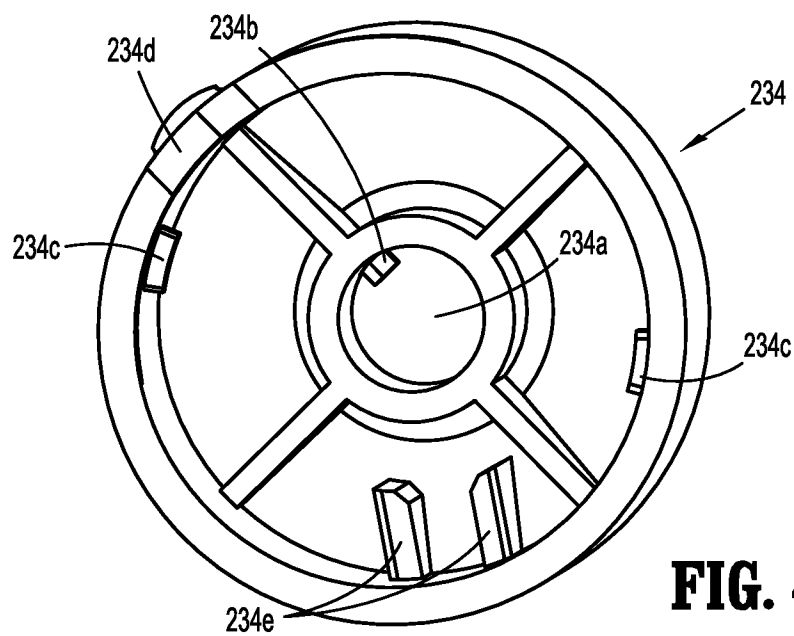
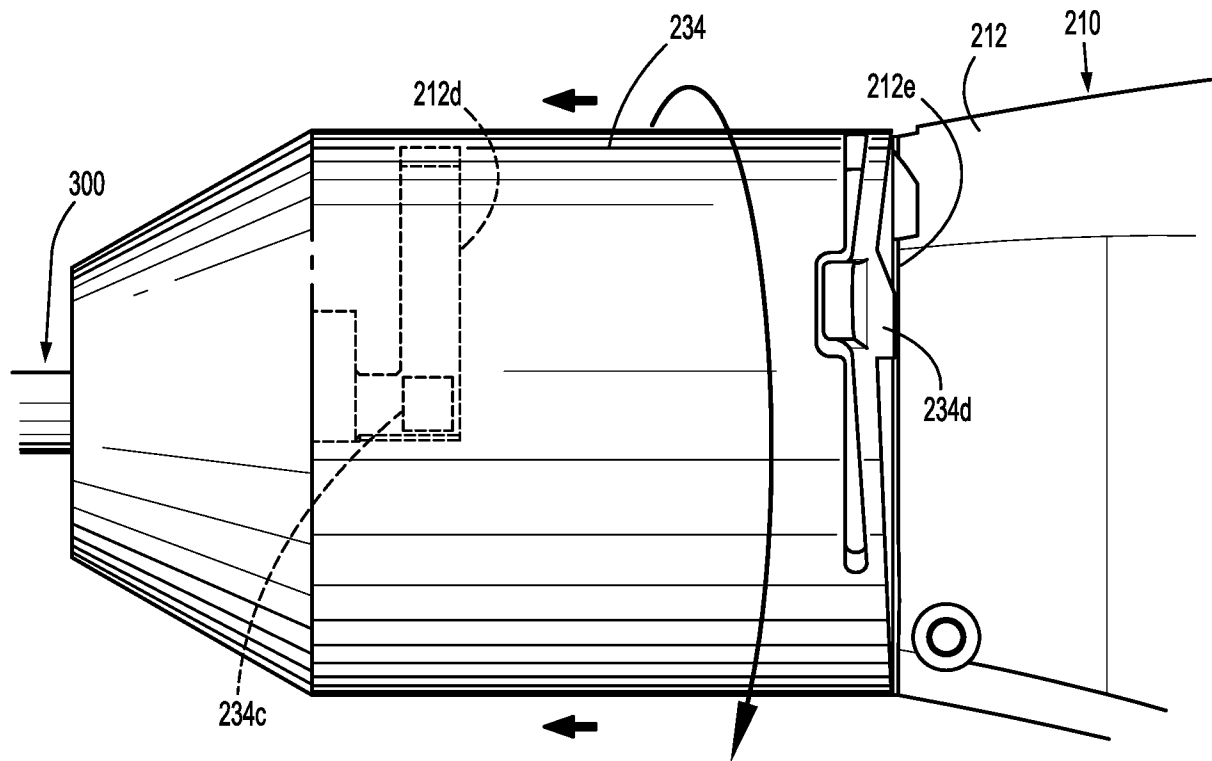


FIG. 46

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**FIG. 47**

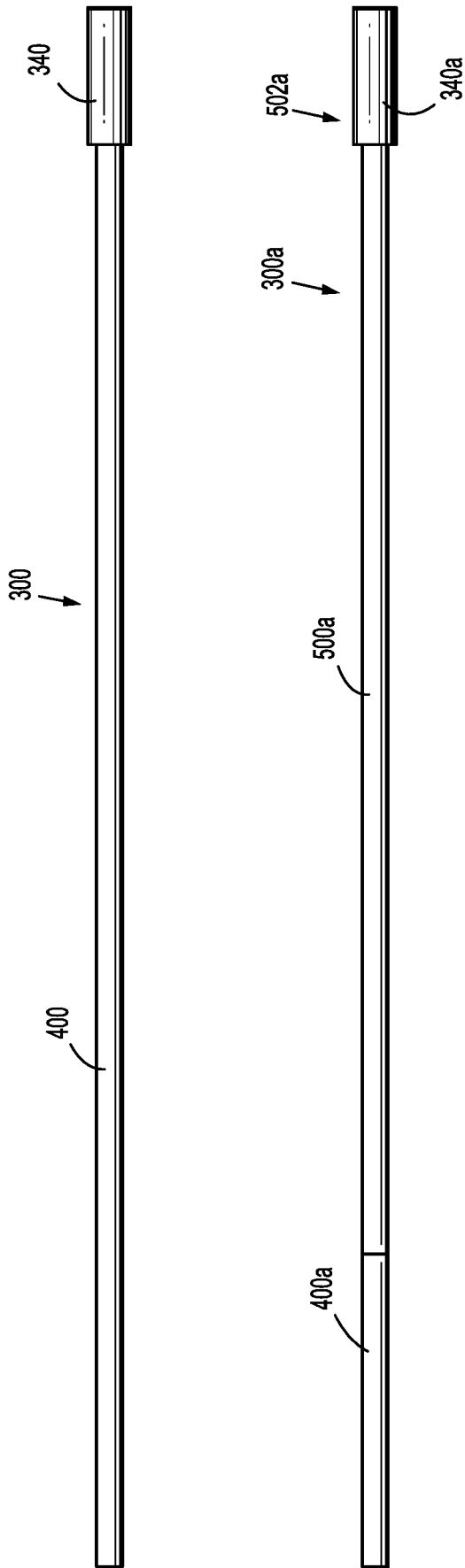


FIG. 48

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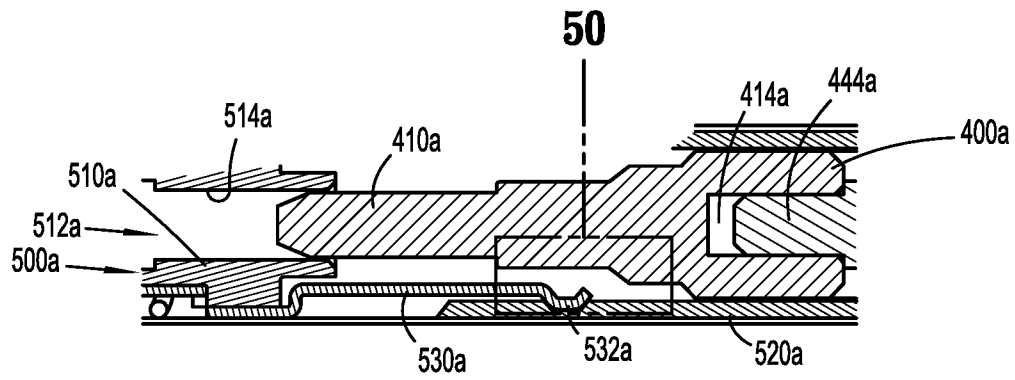


FIG. 49

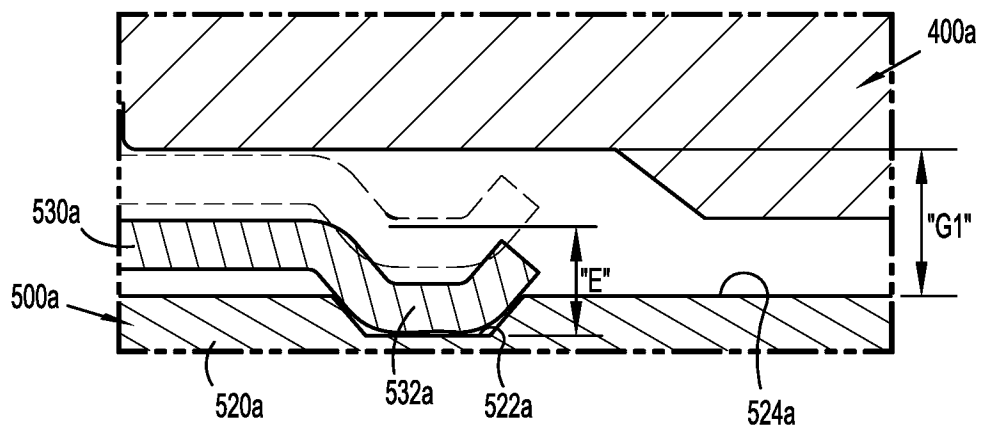


FIG. 50

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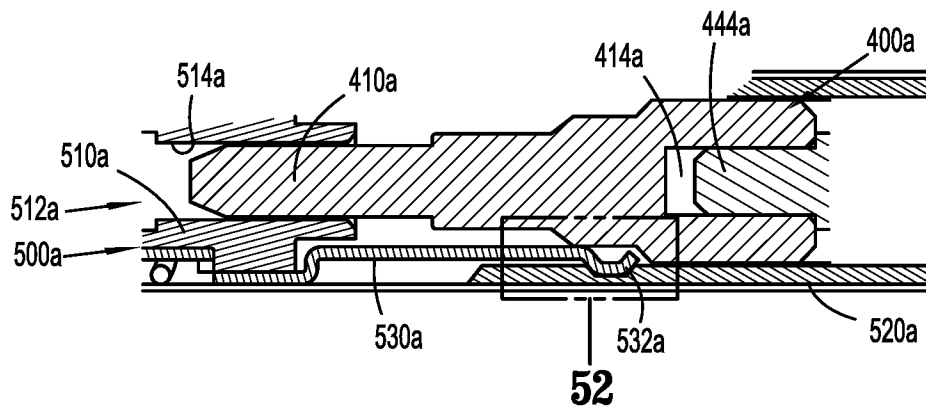


FIG. 51

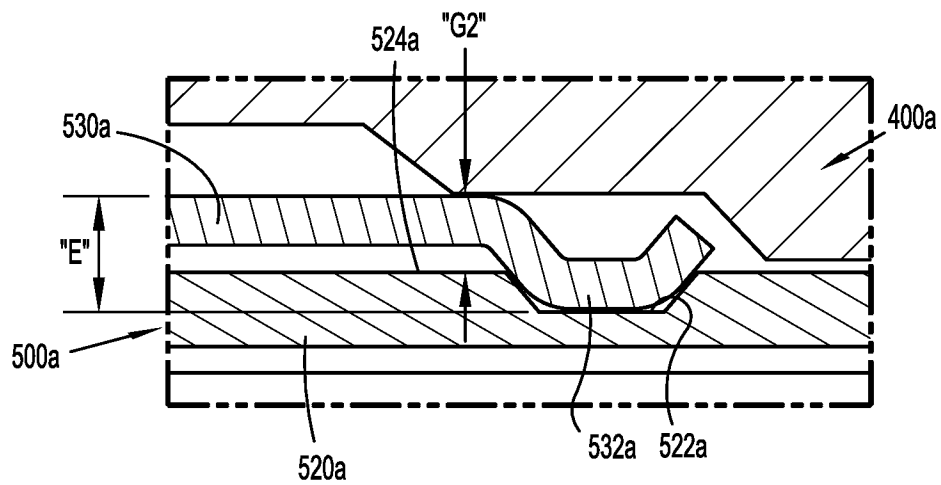


FIG. 52

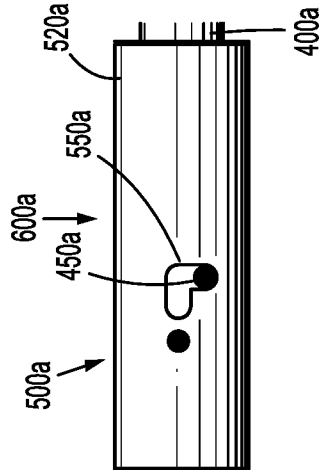


FIG. 53A

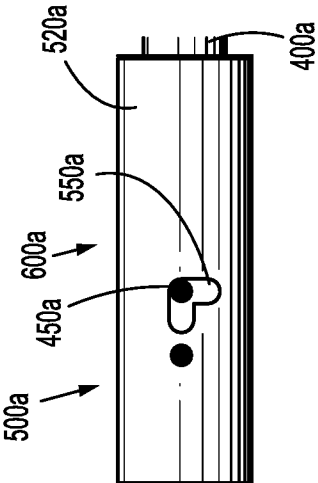


FIG. 53B

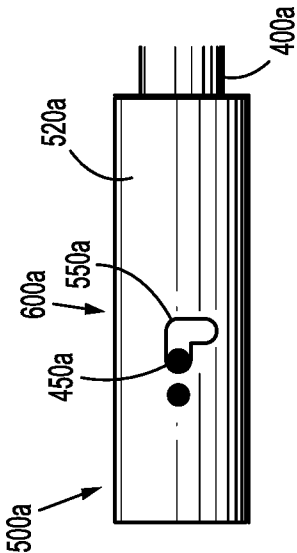


FIG. 53C

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/081620

A. CLASSIFICATION OF SUBJECT MATTER

A61B 17/94(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B17/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: endoscop+, outer or inner, tube, anchor? or screw or helical, spring or helical, rotat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	CN 104248456 A (COVIDIEN LP) 31 December 2014 (2014-12-31) paragraphs [0123]-[0135] and [0181]-[0189] in the description, figures 1-5 and 19-44	1
X	US 2008086154 A1 (TAYLOR, ERIC J. ET AL.) 10 April 2008 (2008-04-10) paragraphs [0047]-[0075] in the description, figures 1-10, 15, 19 and 25-26	13-18
Y	US 2008086154 A1 (TAYLOR, ERIC J. ET AL.) 10 April 2008 (2008-04-10) paragraphs [0047]-[0075] in the description, figures 1-10, 15, 19 and 25-26	1-3
Y	US 2008281336 A1 (ZERGIEBEL, EARL M.) 13 November 2008 (2008-11-13) paragraphs [0096]- [0102], [0114]-[0119] in the description, figures 1A-1E, 2-3, 8, 10, 29-32	1-3
A	CN 103767751 A (SHANGHAI YISI MEDICAL TECHNOLOGY CO., LTD. ET AL.) 07 May 2014 (2014-05-07) the whole document	1-18
A	CN 103338712 A (ETHICON INC.) 02 October 2013 (2013-10-02) the whole document	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

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“E” earlier application or patent but published on or after the international filing date

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“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

23 March 2015

Date of mailing of the international search report

09 April 2015

Name and mailing address of the ISA/CN

STATE INTELLECTUAL PROPERTY OFFICE OF THE
P.R.CHINA(ISA/CN)
6,Xitucheng Rd., Jimen Bridge, Haidian District, Beijing
100088, China

Facsimile No. (86-10)62019451

Authorized officer

DONG,Xijian

Telephone No. (86-10)62414499

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/081620

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 102525586 A (SHANGHAI YISI MEDICAL TECHNOLOGY CO., LTD.) 04 July 2012 (2012-07-04) the whole document	1-18

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2014/081620

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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				AU	2014202972	A1	22 January 2015
				KR	2015002522	A	07 January 2015
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				AU	2007216809	A1	24 April 2008
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				EP	1635723	A2	22 March 2006
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				US	2005267478	A1	01 December 2005
				US	2006241622	A1	26 October 2006
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2014/081620

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					US	8414627 B2	09 April 2013
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					WO	2004112841 A2	29 December 2004
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