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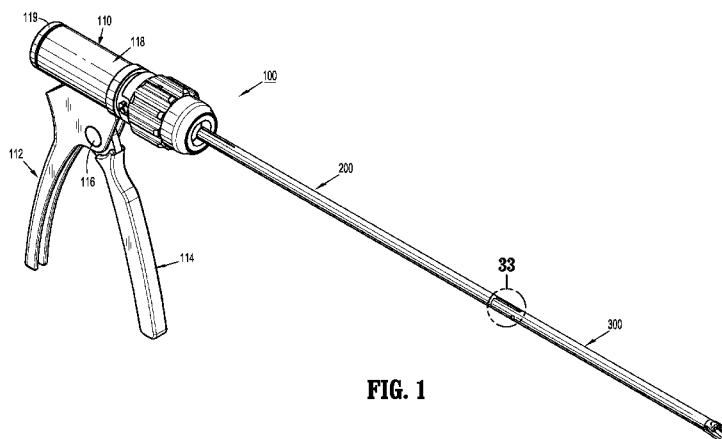


FIG. 1

(57) Abstract: A reposcopic surgical clip applier (100) is provided and includes a handle assembly (110) having a trigger (114) and a drive assembly (120), the drive assembly including a drive rod (122) and a rocker (126) supported on the drive rod; an outer tube assembly (200) connectable to the handle assembly; and a clip cartridge assembly (300) selectively connectable to the distal end of the drive rod and to a distal end of the outer tube assembly. The clip cartridge assembly including a clip tray (302) having a first plurality of resilient fingers (302d); a cartridge clip pusher bar (304) including a second plurality of resilient fingers (304e); surgical clips (C) loaded within the clip tray; a drive sled (308) disposed proximal of the surgical clips, wherein the rocker is in operative contact with the drive sled; a cartridge pusher rod (306) interconnecting the drive sled and the cartridge clip pusher bar; and a spring (310) supported on the cartridge pusher rod.



# ENDOSCOPIC REPOSABLE SURGICAL CLIP APPLIER

## **BACKGROUND**

### *Technical Field*

[0001] The technical field relates to surgical clip appliers. More particularly, the present disclosure relates to endoscopic reusable surgical clip appliers having a reusable handle assembly, a reusable shaft assembly, and a disposable clip cartridge assembly.

### *Description of Related Art*

[0002] Endoscopic staplers and clip appliers are known in the art and are used for a number of distinct and useful surgical procedures. In the case of a laparoscopic surgical procedure, access to the interior of an abdomen is achieved through narrow tubes or cannulas inserted through a small entrance incision in the skin. Minimally invasive procedures performed elsewhere in the body are often generally referred to as endoscopic procedures. Typically, a tube or cannula device is extended into the patient's body through the entrance incision to provide an access port. The port allows the surgeon to insert a number of different surgical instruments therethrough using a trocar and for performing surgical procedures far removed from the incision.

[0003] During a majority of these procedures, the surgeon must often terminate the flow of blood or another fluid through one or more vessels. The surgeon will often apply a surgical clip to a blood vessel or another duct to prevent the flow of body fluids therethrough during the procedure. An endoscopic clip applier is known in the art for applying a single clip during an entry to the body cavity. Such clips are typically fabricated from a

biocompatible material and are usually compressed over a vessel. Once applied to the vessel, the compressed clip terminates the flow of fluid therethrough.

**[0004]** Endoscopic clip appliers that are able to apply multiple clips in endoscopic or laparoscopic procedures during a single entry into the body cavity are described in commonly-assigned U.S. Pat. Nos. 5,084,057 and 5,100,420 to Green et al., which are both incorporated by reference in their entirety. Another multiple endoscopic clip applier is disclosed in commonly-assigned U.S. Pat. No. 5,607,436 by Pratt et al., the contents of which is also hereby incorporated by reference herein in its entirety. These devices are typically, though not necessarily, used during a single surgical procedure. U.S. Pat. No. 5,695, 502 to Pier et al., the disclosure of which is hereby incorporated by reference herein, discloses a resterilizable surgical clip applier. The clip applier advances and forms multiple clips during a single insertion into the body cavity. This resterilizable clip applier is configured to receive and cooperate with an interchangeable clip magazine so as to advance and form multiple clips during a single entry into a body cavity.

**[0005]** During endoscopic or laparoscopic procedures it may be desirable and/or necessary to use different size surgical clips depending on the underlying tissue or vessels to be ligated. In order to reduce overall costs of a surgical clip applier, it is desirable for a single surgical clip applier to be loadable with and capable of firing different size surgical clips as needed.

**[0006]** Accordingly, a need exists for endoscopic surgical clip appliers that include reusable handle assemblies, reusable shaft assemblies, and disposable clip cartridge assemblies, with each clip cartridge assembly being loaded with a particularly sized clip (e.g., relatively small, relatively medium, or relatively large).

**SUMMARY**

[0007] The present disclosure relates to reusable endoscopic surgical clip appliers.

[0008] According to an aspect of the present disclosure, a reusable surgical clip applier is provided and includes a handle assembly, an outer tube assembly, and a clip cartridge assembly.

[0009] The handle assembly includes a housing, a fixed handle, a trigger, and a drive assembly removably supported within the housing and operatively actuatable by the trigger. The drive assembly includes a drive rod having a proximal end and a distal end, the distal end of the drive rod defining a camming feature; and a rocker pivotally supported on the drive rod, the rocker including a proximal end extending proximally of a pivot point, and a distal end extending distal of the pivot point.

[0010] The outer tube assembly is selectively connectable to the housing of the handle assembly. The outer tube assembly including an outer tube defining a lumen therethrough for receiving at least a portion of the drive assembly therein, wherein the distal end of the drive rod of the drive assembly extends distally beyond the outer tube when the drive assembly is loaded into the housing of the handle assembly.

[0011] The clip cartridge assembly is selectively connectable to the distal end of the drive rod of the drive assembly of the handle assembly and to a distal end of the outer tube of the outer tube assembly. The clip cartridge assembly includes an outer tube fixedly supporting a jaw blade therein, wherein a pair of jaws of the jaw blade extend distally beyond the outer tube, wherein the distal end of the drive rod of the drive assembly extends through the outer tube of the clip cartridge assembly when the clip cartridge assembly is connected to the

outer tube assembly, and wherein the camming feature of the drive rod is in operative association with a corresponding camming feature of the pair of jaws.

[0012] The clip cartridge assembly also includes a clip tray disposed within the outer tube of the clip cartridge assembly. The clip tray includes a first plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof.

[0013] The clip cartridge assembly further includes a cartridge clip pusher bar slidably disposed within the clip tray. The cartridge clip pusher bar includes a second plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof and extending towards the first plurality of distally oriented, deflectable, resilient fingers, each resilient finger of the cartridge clip pusher bar terminating in a distal shoulder.

[0014] The clip cartridge assembly includes a plurality of surgical clips loaded within the clip tray and interposed between the base wall of the clip tray and the base wall of the cartridge clip pusher bar, wherein a surgical clip is disposed distally of each resilient finger of the clip tray and each resilient finger of the cartridge clip pusher bar when the cartridge clip pusher bar is at a proximal-most position relative to the clip tray.

[0015] The clip cartridge assembly also includes a drive sled slidably disposed within the clip tray, the drive sled being positioned proximal of the plurality of surgical clips, wherein the distal end of the rocker of the drive assembly is in operative contact with the drive sled when the clip cartridge assembly is connected to the outer tube assembly; a cartridge pusher rod extending distally from the drive sled, the cartridge pusher rod having a distal end connected to a proximal end of the cartridge clip pusher bar; and a biasing member supported on the cartridge pusher rod and tending to bias the drive sled and the cartridge clip pusher bar to a proximal-most position.

**[0016]** The clip tray may include a first channel defined by a base wall and a pair of first side rails extending along longitudinal sides of the base wall, wherein the first plurality of distally oriented, deflectable, resilient fingers project into the first channel, and wherein the plurality of surgical clips are slidably supported in the first channel. The clip tray may also include a second channel, adjacent to the first channel, defined by a pair of second side rails supported on respective ones of the pair of first side rails, wherein the cartridge clip pusher bar is slidably disposed within the second channel, and wherein the second plurality of distally oriented, deflectable, resilient fingers project into the first channel of the clip tray.

**[0017]** The housing of the handle assembly may be a hollow barrel housing having the fixed handle extending therefrom, the barrel housing defining a bore therethrough, an open proximal end and an open distal end. The trigger may be pivotally supported on and may extend from the barrel housing. The trigger may include an actuating end extending into the bore of the barrel housing.

**[0018]** In use, upon a distal actuation of the cartridge clip pusher bar, the second plurality of distally oriented, deflectable, resilient fingers thereof may contact a proximal surface of a backspan of a respective surgical clip to distally advance all the surgical clip simultaneously.

**[0019]** In use, following distal actuation of the cartridge clip pusher bar, upon a proximal actuation of the cartridge clip pusher bar, the second plurality of distally oriented, deflectable, resilient fingers thereof may contact a proximal surface of the backspan of a respective remaining one of the surgical clips to proximally move all the remaining surgical clips until the backspans of the remaining surgical clips contact a respective one of the first plurality of distally oriented, deflectable, resilient fingers of the clip tray to block proximal movement of the remaining surgical clips.

**[0020]** In use, distal actuation of the cartridge clip pusher bar may result from a distal movement of the drive sled that distally advances the cartridge pusher rod, wherein distal advancement of the drive sled biases the biasing member.

**[0021]** An initial actuation of the trigger of the handle assembly may result in distal advancement of the drive rod and the rocker of the drive assembly relative to the outer tube of the outer tube assembly and relative to the outer tube of the clip cartridge assembly, wherein a distal end of the rocker of the drive assembly may engage the drive sled of the clip cartridge assembly to distally advance the clip cartridge pusher bar, and to compress the biasing member supported on the cartridge pusher rod.

**[0022]** In use, during the initial actuation of the trigger, a pusher at the distal end of the clip cartridge pusher bar may engage a distal-most clip of the plurality of surgical clips and may advance the distal-most clip into the pair of jaws.

**[0023]** A further actuation of the trigger of the handle assembly may result in further distal advancement of the drive rod and the rocker of the drive assembly relative to the outer tube of the outer tube assembly and relative to the outer tube of the clip cartridge assembly. The rocker may engage a reversing feature provided in the outer tube of the outer tube assembly, thereby disengaging the distal end of the rocker from the drive sled permitting the biasing member supported on the cartridge pusher rod to expand and withdraw the clip cartridge pusher bar in a proximal direction.

**[0024]** The reversing feature may include a cam pin extending across an inner lumen of the outer tube of the outer tube assembly; and a camming surface formed at a proximal end of the rocker of the drive assembly, wherein contact of the camming surface of the rocker with the cam pin of the outer tube of the outer

tube assembly causes the rocker to pivot and causes the distal end of the rocker to move out of axial alignment with the drive sled.

**[0025]** In use, during the further actuation of the trigger of the handle assembly, the camming feature at the distal end of the drive rod may engage the camming feature of the pair of jaws to close the pair of jaws relative to one another.

**[0026]** The drive assembly may include a biasing member acting on the rocker to urge the distal end of the rocker into axial alignment with the drive sled of the clip cartridge assembly.

**[0027]** The handle assembly may include a biasing member supported on the proximal end of the drive rod. The biasing member may be interposed between a flange provided on the proximal end of the drive rod and a distal surface of the barrel housing.

**[0028]** The trigger of the handle assembly may include an actuating end, wherein the actuating end of the trigger may be disposed proximal of the drive rod and may be in operative contact with the drive rod.

**[0029]** The handle assembly may include an end cap selectively securable to the proximal end of the barrel housing.

**[0030]** The trigger of the handle assembly may be pivotable to a position wherein the actuating end of the trigger is not within the bore of the bore housing.

**[0031]** In use, when the actuating end of the trigger is not within the bore of the bore housing, the distal end of the drive assembly may be insertable into the proximal end of the barrel housing and may be advanceable through the barrel housing and through the outer tube assembly.

**[0032]** The outer tube assembly may include a knob supporting the outer tube thereof, wherein the barrel housing of the handle assembly and the knob of

the outer tube assembly may be selectively connectable to one another via a bayonet-type connection.

**[0033]** A proximal end of the clip cartridge assembly may be selectively connectable to a distal end of the outer tube assembly via a snap-fit connection.

**[0034]** According to another aspect of the present disclosure, a reusable surgical clip applier is provided and includes a handle assembly having a housing, a fixed handle, a trigger, and a drive assembly removably supported within the housing and operatively actuatable by the trigger. The drive assembly includes a drive rod having a distal end defining a camming feature, and a rocker pivotally supported on the drive rod, the rocker including a proximal end extending proximally of a pivot point, and a distal end extending distal of the pivot point.

**[0035]** The reusable surgical clip applier further includes an outer tube assembly selectively connectable to the housing of the handle assembly. The outer tube assembly is configured to receive at least a portion of the drive assembly therein, wherein the distal end of the drive rod of the drive assembly extends distally beyond the outer tube when the drive assembly is loaded into the housing of the handle assembly.

**[0036]** The reusable surgical clip applier also includes a clip cartridge assembly selectively connectable to the distal end of the drive rod of the drive assembly of the handle assembly and to a distal end of the outer tube assembly.

**[0037]** The clip cartridge assembly includes a clip tray having a first plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof; a cartridge clip pusher bar slidably disposed adjacent the clip tray, the cartridge clip pusher bar including a second plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof and extending towards the first plurality of distally oriented, deflectable, resilient fingers; and a

plurality of surgical clips loaded within the clip tray and interposed between the base wall of the clip tray and the base wall of the cartridge clip pusher bar. A surgical clip is disposed distally of each resilient finger of the clip tray and each resilient finger of the cartridge clip pusher bar when the cartridge clip pusher bar is at a proximal-most position relative to the clip tray.

[0038] The clip cartridge assembly also includes a drive sled slidably disposed proximal of the plurality of surgical clips, wherein the distal end of the rocker of the drive assembly is in operative contact with the drive sled when the clip cartridge assembly is connected to the outer tube assembly; a cartridge pusher rod extending distally from the drive sled, the cartridge pusher rod having a distal end connected to a proximal end of the cartridge clip pusher bar; and a biasing member supported on the cartridge pusher rod and tending to bias the drive sled and the cartridge clip pusher bar to a proximal-most position.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0039] A particular embodiment of a surgical clip applier is disclosed herein with reference to the drawings wherein:

[0040] FIG. 1 is a top, front, perspective view, of a reusable endoscopic surgical clip applier, according to the present disclosure;

[0041] FIG. 2 is a rear, perspective view, with parts separated, of the reusable endoscopic surgical clip applier of FIG. 1;

[0042] FIG. 3 is a perspective view, with parts separated, of a handle assembly of the reusable endoscopic surgical clip applier of FIGS. 1 and 2;

[0043] FIG. 4 is a perspective view, with parts separated, of an outer tube assembly of the reusable endoscopic surgical clip applier of FIGS. 1 and 2;

[0044] FIG. 5 is an enlarged, perspective view of an interface sleeve and an outer tube of the outer tube assembly of FIG. 4;

- [0045] FIG. 6 is a perspective view illustrating the handle assembly and the outer tube assembly connected to one another;
- [0046] FIG. 7 is a cross-sectional view as taken along section line 7-7 of FIG. 6;
- [0047] FIG. 8 is a perspective view of a main shaft assembly of the handle assembly of FIGS. 1 and 2;
- [0048] FIG. 9 is a perspective view, with parts separated, of the main shaft assembly of FIG. 8;
- [0049] FIG. 10 is a rear, perspective view of a disposable clip cartridge assembly according to an embodiment of the present disclosure;
- [0050] FIG. 11 is a perspective view, with parts separated, of the disposable clip cartridge assembly of FIG. 10;
- [0051] FIG. 12 is a perspective view of the disposable clip cartridge assembly of FIGS. 10 and 11, with an outer tube thereof removed;
- [0052] FIG. 13 is an enlarged view of the indicated area of detail of FIG. 12;
- [0053] FIG. 14 is a perspective view of the indicated area of detail of FIG. 12;
- [0054] FIG. 15 is a bottom, perspective view of the disposable clip cartridge assembly of FIGS. 10-14, with an outer tube and cartridge clip tray thereof removed;
- [0055] FIG. 16 is an enlarged view of the indicated area of detail of FIG. 15;
- [0056] FIG. 17 is a cross-sectional view of the disposable clip cartridge assembly of FIGS. 10-16, as taken along section line 17-17 of FIG. 10;
- [0057] FIG. 18 is an enlarged view of the indicated area of detail of FIG. 17;
- [0058] FIG. 19 is a cross-sectional view of the disposable clip cartridge assembly of FIGS. 10-18, as taken along section line 19-19 of FIG. 10, with a clip pusher bar thereof removed;

- [0059] FIG. 20 is an enlarged view of the indicated area of detail of FIG. 19;
- [0060] FIG. 21 is a cross-sectional view of the handle assembly illustrating an insertion of a main shaft assembly into the handle assembly;
- [0061] FIG. 22 is a perspective view of the reusable endoscopic surgical clip applier illustrating a connection of the disposable clip cartridge assembly of FIGS. 10-19 to the main shaft assembly of the handle assembly;
- [0062] FIG. 23 is an enlarged view of the indicated area of detail of FIG. 23;
- [0063] FIG. 24 is a longitudinal cross-sectional view of the reusable endoscopic surgical clip applier of FIG. 1, shown in an unactuated condition, and with the disposable clip cartridge assembly removed therefrom;
- [0064] FIG. 25 is an enlarged view of the indicated area of detail of FIG. 24;
- [0065] FIG. 26 is a cross-sectional view as taken along section line 26-26 of FIG. 25;
- [0066] FIG. 27 is a cross-sectional view as taken along section line 27-27 of FIG. 26;
- [0067] FIG. 28 is an enlarged view of the indicated area of detail of FIG. 24;
- [0068] FIG. 29 is an enlarged view of the indicated area of detail of FIG. 28;
- [0069] FIG. 30 is a longitudinal cross-sectional view of the disposable clip cartridge assembly, shown connected to the outer tube assembly of the reusable endoscopic surgical clip applier;
- [0070] FIG. 31 is an enlarged view of the indicated area of detail of FIG. 30;
- [0071] FIG. 32 is a bottom, perspective of the distal end of the disposable clip cartridge assembly;
- [0072] FIG. 33 is an enlarged, perspective view of the indicated area of detail of FIG. 1, illustrating a connection of the disposable clip cartridge assembly to the outer tube assembly of the reusable endoscopic surgical clip applier;

[0073] FIG. 34 is a longitudinal cross-sectional view of the handle assembly of the reusable endoscopic surgical clip applier of FIG. 1, illustrating an actuation or squeezing of a trigger thereof;

[0074] FIGS. 35-37 are side, cross-sectional, elevational views of the disposable clip cartridge assembly and the outer tube assembly of the reusable endoscopic surgical clip applier, illustrating an actuation of the main shaft during the squeezing of the trigger;

[0075] FIGS. 38 and 39 are side, cross-sectional, elevational views the disposable clip cartridge assembly, illustrating an actuation of the cartridge clip pusher bar; and

[0076] FIG. 40 is a cross-sectional, elevational view of an overload protection assembly of the reusable endoscopic surgical clip applier.

#### **DETAILED DESCRIPTION OF EMBODIMENTS**

[0077] Embodiments of reusable surgical clip appliers, in accordance with the present disclosure, will now be described in detail with reference to the drawing figures wherein like reference numerals identify similar or identical structural elements. As shown in the drawings and described throughout the following description, as is traditional when referring to relative positioning on a surgical instrument, the term “proximal” refers to the end of the apparatus which is closer to the user and the term “distal” refers to the end of the apparatus which is further away from the user.

[0078] Referring initially to FIGS. 1-3, a surgical clip applier in accordance with an embodiment of the present disclosure is generally designated as 100. Surgical clip applier 100 includes a handle assembly 110, an elongated outer tube assembly 200 projecting from or extending from handle assembly 110, and a clip cartridge assembly 300 that can be removably and selectively mounted on a distal end of outer tube assembly 200. As will be described in greater detail

below, a plurality of surgical clips “C” (FIG. 11) are loaded into clip cartridge assembly 300. Also, as will be described in greater detail below, in operation, as handle assembly 110 is actuated, a single surgical clip “C” is fired and formed around a vessel to be ligated.

**[0079]** Handle assembly 110, as shown in FIGS. 1-3, includes a fixed handle 112 and a squeezable trigger 114 pivotally attached to fixed handle 112 at pivot shaft 116. Squeezable trigger 114 includes a proximal actuating end 114a, which extends proximally beyond pivot shaft 116, and which extends into a bore 118a of a barrel 118 supported on fixed handle 112..

**[0080]** A barrel 118 is supported on fixed handle 112 and is configured to receive a proximal end of outer tube assembly 200. Barrel 118 defines a lumen or bore 118a therethrough. A threaded end cap 119 closes a proximal end of barrel 118. A nose 118b of barrel 118 includes a pair of diametrically opposed nubs 118c projecting radially therefrom, and which are configured and dimensioned to slidably engage a respective pair of oppositely disposed J-shaped notches 204a of an outer collar or knob 204 of outer tube assembly 200, in the manner of a bayonet-like connection, to secure outer tube assembly 200 to handle assembly 110.

**[0081]** With reference to FIGS. 2, 8, and 9, handle assembly 110 supports and/or includes a main drive assembly or advancing mechanism 120 removably supported within bore 118b of barrel 118 or removably connected to barrel 118. Main drive assembly 120 includes a main drive rod 122 having a proximal end 122a and a distal end 122b. Proximal end 122a of main drive rod 122 supports a flange 122c thereon, and a biasing member 124 (e.g., a return compression spring) is disposed on main drive rod 122 and distal of flange 122c, to urge main drive rod 122 to a proximal-most position. Distal end 122b of main drive rod 122 defines a V-shaped cam groove 122d formed therein.

**[0082]** Main drive rod 122 pivotally supports a rocker 126 thereon via a pivot pin 127. Rocker 126 includes a proximal end 126a, and a distal end 126b. Distal end 126b has an enlarged head or piston configuration. A biasing member 128 (e.g., leaf spring) is supported on drive rod 122 and is configured to act on proximal end 126a of rocker 126. A cam ramp 126c (FIG. 29) is provided on or in a surface of rocker 126, and which is adjacent an outer tube 202 of outer tube assembly 200.

**[0083]** With reference to FIGS. 1, 2, and 4-7, outer tube assembly 200 includes a hollow outer tube 202 having a distal end 202a and a proximal end 202b, and an outer collar or knob 204.

**[0084]** A proximal end of outer collar or knob 204 includes two oppositely disposed J-shaped notches 204a formed therein and being configured and dimensioned to selectively receive respective nubs 118c of barrel 118 of handle assembly 110, for selectively securing outer tube assembly 200 to handle assembly 110.

**[0085]** Outer tube assembly 200 further includes an inner collar 206 that is configured and dimensioned for disposition within outer collar 204. Inner collar 206 includes a distal opening 206a configured for selective connection to proximal end 202a of outer tube 202, in a snap-fit and/or bayonet-type connection. Specifically, with reference to FIG. 5, opening 206a includes a first annular array of tabs 206c<sub>1</sub>, and a second annular array of tabs 206c<sub>2</sub> in registration with the tabs of the first annular array 206c<sub>1</sub> and spaced a longitudinal distance from the first annular array of tabs 206c<sub>1</sub> to define an annular channel 206d therebetween. In cooperation therewith, proximal end 202b of outer tube 202 includes a single annular array of tabs 202c that are dimensioned to pass the first annular array of tabs of inner collar 206 and engage the annular channel of inner collar 206.

[0086] In use, when connecting outer tube 202 to inner collar 206, the annular array of tabs 202c of outer tube 202 is first clocked out of radial or annular registration with the first annular array of tabs 206c<sub>1</sub> of inner collar 206 such that the annular array of tabs 202c of outer tube 202 may pass the first annular array of tabs 206c<sub>1</sub> of inner collar 206 during insertion of proximal end 202a of outer tube 202 into opening 206a of inner collar 206. Then, when the annular array of tabs 202c of outer tube 202 are in axial alignment with the annular channel 206d of inner collar 206, outer tube 202 is rotated relative to inner collar 206 such that or until the annular array of tabs 202d of outer tube 202 is in radial registration with the first annular array of tabs 206c<sub>1</sub> of inner collar 206 to secure outer tube 202 and inner collar 206 to one another.

[0087] Outer tube assembly 200 also includes a biasing member 208 interposed between outer collar 204 and inner collar 206.

[0088] Inner collar 206 further includes a longitudinally extending slot or window 206b formed in a side thereof. A lock block 210 is provided for selective insertion into longitudinal slot or window 206b of inner collar 206. In use, when lock block 210 is inserted in slot or window 206b of inner collar 206, lock block 210 seats against or contacts a flat surface 122e of main drive rod 122 (see FIGS. 9, 26 and 27), thereby inhibiting or preventing main drive rod 122 from rotating when disposed within outer tube 202 of outer tube assembly 200.

[0089] Handle assembly 110, as well as outer tube assembly 200, may be made from a biocompatible material, such as, for example, a high grade surgical stainless steel, from titanium, or from a high strength autoclavable polymer, thermoplastic or the like.

[0090] With reference to FIG. 21, assembly of handle assembly 110, main drive assembly 120, and outer tube assembly 200 is described. Outer collar or knob 204 of outer tube assembly 200 is connected to nose 118b of barrel 118 of

handle assembly 110 by aligning an open end of the J-shaped notches 204a of outer collar or knob 204 with nubs 118c of barrel 118 of handle assembly 110, approximating outer tube assembly 200 and handle assembly 110 until nubs 118c are fully received in the J-shaped notches 204a, and then rotating outer tube assembly 200 relative to handle assembly 110 to advance nubs 118c radially around the J-shaped notches 204a, e.g., in the manner of a bayonet-type connection.

**[0091]** With outer tube assembly 200 connected to handle assembly 110, and with end cap 119 removed from barrel 118, trigger 114 is moved or pivoted about pivot shaft 116 until actuating end 114a of trigger 114 does not obstruct bore 118a of barrel 118. With trigger 114 so positioned, distal end 120b of main drive assembly 120 is inserted into bore 118a of barrel 118 via an open proximal end of barrel 118. Main drive assembly 120 is advanced through bore 118a of barrel 118 and through outer tube assembly 200 until flange 122c of main drive assembly 120 is positioned within bore 118a of barrel 118. With flange 122c of main drive assembly 120 positioned within bore 118a of barrel 118, trigger 114 is moved or pivoted about pivot shaft 116 until actuating end 114a of trigger 114 is once again disposed within bore 118a of barrel 118 and disposed adjacent to and in contact with flange 122c of main drive assembly 120. The end cap 119 may then be re-connected to barrel 118 to secure main drive assembly 120 and actuating end 114a of trigger 114 to barrel 118 of handle assembly 110.

**[0092]** Turning now to FIGS. 1, 2, and 10-20, clip cartridge assembly 300 of surgical clip applier 100 is shown. Clip cartridge assembly 300 is configured to be selectively loadable or connectable to distal end of outer tube assembly 200, and to be actuated upon an actuation of trigger 114 of handle assembly 110 to fire and form surgical clips “C” loaded therein onto underlying tissue and/or vessels. Each clip cartridge assembly 300 may be loaded with a particularly

sized set of surgical clips (e.g., relatively small surgical clips, relatively medium surgical clips, or relatively large surgical clips).

**[0093]** Clip cartridge assembly 300 includes a clip tray 302 including base wall 302a and a pair of spaced apart lower side walls or rails 302b<sub>1</sub> supported on base wall 302a. Base wall 302a and lower rails 302b<sub>1</sub> define a clip channel 302c<sub>1</sub> (FIG. 14). Clip channel 302c<sub>1</sub> is configured and dimensioned to slidably support a plurality of surgical clip “C” therein. Clip tray 302 further includes at least a pair of spaced apart upper side walls or rails 302b<sub>2</sub> supported on lower side walls 302b<sub>1</sub>. Lower rails 302b<sub>1</sub> and upper rails 302b<sub>2</sub> define a pusher bar channel 302c<sub>2</sub> (FIG. 14). Pusher bar channel 302c<sub>2</sub> is configured and dimensioned to slidably support a cartridge clip pusher bar 304 therein.

**[0094]** Clip tray 302 includes a linear array of distally extending resilient, deflectable fingers 302d (FIGS. 16, 18 and 20) projecting up from base wall 302a and into lower clip channel 302c<sub>1</sub> at a location between side rails 302b. A distal-most deflectable finger 302d<sub>1</sub> forms a single, rectangular finger configured to engage a backspan or crown of the distal-most clip “C1” and nest between the spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> (FIG. 16) of cartridge clip pusher bar 304, as discussed below. A pair of channels 302f (FIG. 20) are disposed or formed on either side of the distal-most finger 302d<sub>1</sub> and are configured to selectively receive engage each of the spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> of clip pusher bar 304 when all of the surgical clips “C” have been formed, as will be discussed in further detail below. Each of the remaining proximal deflectable fingers 302d define a V-shaped configuration adapted to engage opposing proximal sides of a backspan of each remaining clip of the stack of surgical clips “C”, as illustrated in FIGS. 15, 16, 19 and 20.

**[0095]** As shown in FIGS. 14 and 20, clip tray 302 further includes a pair of spaced apart, distally extending resilient deflectable prongs 302e projecting up

from the proximal end of base wall 302a and into lower clip channel 302c<sub>1</sub> at a location between side rails 302<sub>1</sub>. Each of the prongs 302e is spaced apart such that they are in slidable engagement with a surface of a respective leg of the distal-most clip “C1”. Prongs 302e are dimensioned to engage the legs of the distal-most clip “C1” and frictionally press the distal-most clip “C1” against each side rail 302b<sub>1</sub>, such that prongs 302e help to prevent the distal-most clip “C1”, proximal to the distal-most clip “C1”, from advancing distally past prongs 302e when the distal-most clip “C1” is being loaded into a pair of jaws 320. The biasing force provided by the prongs 302e is overcome when the distal-most clip “C1” is urged distally by the cartridge clip pusher bar 304, and once the distal-most clip “C1” has been loaded into the pair of jaws 320, each of the prongs 302e returns to their initial position to prevent the next clip “C” from advancing any further.

**[0096]** Clip cartridge assembly 300 includes, as shown in FIGS. 11-18, a cartridge clip pusher bar 304 slidably disposed between and within the pair of spaced apart upper side walls or rails 302b<sub>2</sub> (FIG. 14) of clip tray 302. Cartridge clip pusher bar 304 includes a proximal end 304a engagable with or by a distal end of a cartridge pusher rod or shaft 306, as will be described in greater detail below. Cartridge clip pusher bar 304 further includes a distal end portion 304b defining a pusher 304d configured to engage a distal-most clip “C1” of a stack of surgical clips “C” for loading the distal-most clip “C1” into the pair of jaws 320 of clip cartridge assembly 300. Pusher 304d includes, as described above, a pair of spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> configured to engage a backspan of the distal-most clip “C1”, as illustrated in FIGS. 14 and 18.

**[0097]** As illustrated in FIGS. 11, 17 and 18, cartridge clip pusher bar 304 further includes a linear array of distally extending resilient, deflectable fingers 304e, with each finger 304e defining a rectangular profile including a distal

shoulder formed at a distal end thereof. In use, when cartridge clip pusher bar 304 overlays or is disposed between the pair of spaced apart upper rails 302b<sub>2</sub> of clip tray 302, each of the deflectable fingers 302d of clip tray 302 is disposed axially between each deflectable finger 304e of cartridge clip pusher bar 304, such that each of deflectable fingers 302d, 304e are arranged in a tandem configuration when the clip pusher bar 304 is in a proximal position relative to clip tray 302. Additionally, when cartridge clip pusher bar 304 overlays or is disposed between the pair of spaced apart upper rails 302b<sub>2</sub> of clip tray 302, each deflectable finger 304e of cartridge clip pusher bar 304 extends across clip channel 302c<sub>1</sub> of clip tray 302 such that the distal shoulders of deflectable fingers 304e are in registration with the stack of surgical clips “C”.

[0098] In use, the V-shaped configuration of the proximal deflectable fingers 302d of clip tray 302 permits each proximal deflectable finger 304e of the cartridge clip pusher bar 304 to nest within the V-shape of the proximal deflectable fingers 302d such that the distal shoulders of deflectable fingers 304e engage a backspan of each of the remaining surgical clips of the stack of surgical clips “C” as the cartridge clip pusher bar 304 is driven distally.

[0099] As shown in FIGS. 11, and 15-20, clip cartridge assembly 300 further includes a stack of surgical clips “C” interposed between clip tray 302 and cartridge clip pusher bar 304. The stack of surgical clips “C” is supported on or loaded in clip tray 302 such that a crown or backspan of each surgical clip “C” is disposed distal of a respective deflectable finger 302d of clip tray 302. Further, when cartridge clip pusher bar 304 is in a proximal position relative to clip tray 302, each deflectable finger 304e of cartridge clip pusher bar 304 is also disposed proximal of the crown or backspan of a respective clip of the stack of surgical clips “C” as discussed above.

**[00100]** Clip cartridge assembly 300 may be loaded with 10 surgical clips “C”, or, in embodiments, clip cartridge assembly 300 may be loaded with any number of surgical clips “C”. Surgical clips “C” may be fabricated from materials known by those skilled in the art, including and not limited to stainless steel, titanium, or other metal alloys. In an embodiment it is contemplated that at least a final surgical clip of the stack of surgical clips “C” may be dyed a particular color to indicate to the user when a final surgical clip of clip cartridge assembly 300 is loaded into the pair of jaws 320.

**[00101]** Once all of the surgical clips “C” are loaded into the clip tray 302 and cartridge clip pusher bar 304 is placed adjacent thereto, a channel cover 307 (FIG. 11), configured and adapted for connection and support on clip tray 302, or may be snapped into engagement with lower rails 302b<sub>1</sub> of clip tray 302.

**[00102]** With reference to FIGS. 11-13, 17 and 19, clip cartridge assembly 300 includes a cartridge pusher rod or shaft 306 slidably supported within clip tray 302. Cartridge pusher rod 306 includes a distal end connected to proximal end 304a of cartridge clip pusher bar 304, and a proximal end fixedly connected to a drive sled 308 with drive sled 308 being slidably supported within clip tray 302.

**[00103]** Clip cartridge assembly 300 includes a biasing member 310 disposed about cartridge pusher rod 306 and interposed between a distal stop block 312a and drive sled 308. A proximal stop block 312b is provided near proximal end of clip tray 302 to limit movement of drive sled 308. The distal end of cartridge pusher rod 306 extends distally past distal stop block 312a for engagement with the proximal end of cartridge clip pusher bar 304.

**[00104]** In operation, as will be described in greater detail below, as trigger 114 of handle assembly 110 is actuated, trigger 114 effects actuation of main drive rod 122 and rocker 126 of main drive assembly 120 to move rocker 126 in

an axially distal direction. As main drive assembly 120 is moved in a distal direction distal end 126b of rocker 126 engages, abuts or acts on drive sled 308 to move drive sled 308 in a distal direction. As drive sled 308 is moved in a distal direction, drive sled 308 acts on cartridge clip pusher bar 304 to distally advance cartridge clip pusher bar 304, and effectuates compression of biasing member 310 to a biased condition.

**[00105]** With reference to FIGS. 11-13, 17 and 19, clip cartridge assembly 300 includes a jaw blade 320 fixedly supported adjacent clip tray 302, within a lumen 314a of an outer tube 314 of clip cartridge assembly 300. Jaw blade 320 includes a pair of jaws 320a projecting from or extending distally from within outer tube 314, and a proximal stem 320b extending proximally into lumen 314a of outer tube 314. Jaw blade 320 is fabricated from a resilient material, such as, for example, stainless steel, and is formed such that the pair of jaws 320a thereof are spaced apart from one another or are biased apart from one another.

**[00106]** Each jaw 320a includes a cam tooth or wedge 320c projecting therefrom and configured to be engaged by V-shaped cam groove 122d provided at distal end 122b of main drive rod 122 (FIG. 9) when main drive rod 122 of main drive assembly 120 is advanced distally. In operation, as V-shaped cam groove 122d of main drive rod 122 is advanced distally, V-shaped cam groove 122d engages cam teeth 320c of the pair of jaws 320a thereby resulting in a closure or approximation of the pair of jaws 320a.

**[00107]** Jaw blade 320 defines a channel between the pair of jaws 320a for receipt of a surgical clip “C” therein, when jaw blade 320 is in an unapproximated condition.

**[00108]** As briefly mentioned above, and as shown in FIGS. 10 and 11, clip cartridge assembly 300 includes an outer tube 314 defining a lumen 314a therethrough. Outer tube 314 is configured and dimensioned to operatively

house clip tray 302, clip cartridge pusher 304, cover 307, clip pusher rod 306, drive sled 308, biasing member 310, jaw blade 320, and the stack of surgical clips “C” therewithin. A proximal end 314b of outer tube 314 defines a distally extending groove or channel 314c formed therein.

**[00109]** Generally, in operation, as main drive rod 122 of handle assembly 110 is distally advanced, due to an actuation of trigger 114, main drive rod 122 advances rocker 126 to act on drive sled 308 of cartridge assembly 300 to move drive sled 308 in a distal direction. As drive sled 308 is moved in a distal direction, drive sled 308 acts on cartridge pusher rod 306, and in turn, cartridge clip pusher bar 304 to distally advance cartridge clip pusher bar 304 by an amount or distance “X” (e.g., about 12mm), and effectuates compression of biasing member 310 to a biased condition.

**[00110]** As cartridge clip pusher bar 304 of clip cartridge assembly 300 is moved in a distal direction, the spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> of pusher 304d of cartridge clip pusher bar 304 engages the backspan of distal-most clip “C1” and pushes distal-most clip “C1” distally, by the amount or distance “X”, out of clip cartridge assembly 300 and into the pair of jaws 320a.

**[00111]** As mentioned above, the distal movement of the distal-most clip “C1” compresses each of the spaced apart prongs 302e of the clip tray 302, thereby permitting the distal-most clip “C1” to be loaded within the pair of jaws 320a, as described above. Once the distal-most clip “C1” is loaded into the pair of jaws 320a, the prongs 302e return to their initial position and prevent the clips “C”, proximal to the distal-most clip “C1”, from advancing further distally.

**[00112]** Additionally, and simultaneously with a distal movement of the distal-most clip “C1”, as cartridge clip pusher bar 304 of clip cartridge assembly 300 moves in a distal direction, the distal shoulder of each finger 304e of cartridge clip pusher bar 304 abuts against a respective backspan of a respective

surgical clip of the remaining surgical clips “C” to also urge the remaining surgical clips “C” in a distal direction, by the amount or distance “X”. In so doing, fingers 302d of the clip tray 302 are deflected, permitting each of the remaining surgical clips “C” to advance distally to replace each respective surgical clip of the stack of surgical clips “C”. Once distal advancement of cartridge clip pusher bar 304 is completed, distal advancement of the stack of surgical clips “C” is also completed. Once the clips of the remaining stack of surgical clips “C” has distally advanced beyond respective fingers 302d of clip tray 302, fingers 302d of clip tray 302 spring back or return to their original position, thereby preventing each surgical clip “C” from any movement thereafter in a proximal direction.

**[00113]** Cartridge clip pusher bar 304 distally advances the remaining surgical clips “C” until each remaining surgical clip “C” is advanced distally, by the amount or distance “X”, past a next adjacent resilient, deflectable finger 302d of clip tray 302.

**[00114]** Following movement of cartridge clip pusher bar 304, by the amount or distance “X”, to load the distal-most clip “C1” into the pair of jaws 320a, a release or reversing feature 220, e.g., a nub or pin provided in outer tube 202 of outer tube assembly 200 is engaged or contacted by cam ramp 126c (FIG. 29) of rocker 126, to thus disengage piston 126b of rocker 126 from drive sled 308, to effectuate a reversal of the direction of travel of clip cartridge pusher bar 304, from the distal direction to a proximal direction. The actuation of rocker 126 by reversing feature 220 of outer tube 202 causes the distally directed forces acting on cartridge clip pusher bar 304 to be removed, and thus biasing member 310 is free to re-expand. As biasing member 310 is free to re-expand, biasing member 310 urges or moves drive sled 308 proximally to thereby withdraw cartridge clip pusher bar 304 proximally.

**[00115]** As cartridge clip pusher bar 304 is moved in a proximal direction, a proximal surface of fingers 304e thereof abut against a distal surface of the backspans of the remaining surgical clips “C” to also urge the remaining surgical clips “C” in a proximal direction. Fingers 304e of cartridge clip pusher bar 304 proximally retract the remaining surgical clips “C” until each remaining surgical clip “C” is retracted, by an amount or distance less than “X” (e.g., “X – Y”), into contact with a respective distal tip of a respective resilient, deflectable finger 302d of clip tray 302, which blocks or stops further proximal retraction of the remaining surgical clips “C”, while cartridge clip pusher bar 304 continues to move proximally to the proximal-most position thereof, e.g., an amount or distal “X”.

**[00116]** As cartridge clip pusher bar 304 continues to be drawn proximally, concurrently, the spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> of pusher 304d and fingers 304e of cartridge clip pusher bar 304 are deflected up and over each of the remaining surgical clips “C” until cartridge clip pusher bar 304 returns to a proximal-most position.

**[00117]** When clip cartridge assembly 300 is loaded with at least one clip “C”, and when cartridge clip pusher bar 304 is in a proximal-most position, a nose 304g (FIG. 31) disposed on a distal-most end of cartridge clip pusher bar 304 is biased towards, and is supported by, an upper surface of a backspan of the distal-most surgical clip “C1”, preventing each of the spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> of pusher 304d from engaging or entering the pair of channels 302f of clip tray 302.

**[00118]** Turning now to FIGS. 22 and 23, with outer tube assembly 200 connected to handle assembly 110, and with main drive assembly 120 loaded into handle assembly and outer tube assembly 200, as described above, clip

cartridge assembly 300 may be selectively connected to a distal end of main drive assembly 120 and to a distal end of outer tube assembly 200.

**[00119]** Generally, with clip cartridge assembly 300 fully assembled, the distal end of main drive assembly 120 is inserted into proximal end 314b of outer tube 314 of clip cartridge assembly 300, and clip cartridge assembly 300 is approximated toward handle assembly 110 until an alignment rib 202c provided on proximal end 202a of outer tube 202 of outer tube assembly 200 aligns with and enters channel 314c of outer tube 314 of clip cartridge assembly 300.

**[00120]** Clip cartridge assembly 300 may be frictionally retained on or secured to outer tube assembly 200 by a snap-fit connection, or some other connecting arrangement known by one of skill in the art, for example, such as by detents, lips, or wings. In one exemplary embodiment, tabs 202d project from outer sides of outer tube 202 of outer tube assembly 200 and extend into respective windows 314d formed in outer tube 314 of clip cartridge assembly 300 such that clip cartridge assembly 300 is detachably secured to outer tube assembly 200 and to handle assembly 110.

**[00121]** With continued reference to FIGS. 1-23, and with additional specific reference to FIGS. 24-40, an exemplary mode of operation of clip applier 100 is shown and described. As shown in FIGS. 30-33, clip applier 100 is illustrated with clip cartridge assembly 300 connected to distal end of outer tube assembly 200 and to distal end of main drive assembly 122 (as described above).

**[00122]** With reference to FIG. 34, when trigger 114 is squeezed or pivoted in the clockwise direction about pivot shaft 116, actuating end 114a of trigger 114 engages the proximal end of main drive shaft 122 thereby urging main drive shaft distally against the biasing force of spring 124. As trigger 114 is squeezed, actuating end 114a of trigger 114 also compresses return compression spring 124. As main drive rod 122 of handle assembly 110 is distally advanced, due to an

actuation of trigger 114, main drive rod 122 advances rocker 126 to act on drive sled 308 of cartridge assembly 300 to move drive sled 308 in a distal direction and to move cartridge clip pusher bar 304 in a distal direction, as described above.

**[00123]** As cartridge clip pusher bar 304 is moved in a distal direction, pusher 304d thereof engages the backspan of distal-most clip “C1” and pushes distal-most clip “C1” distally, out of clip cartridge assembly 300 and into the pair of jaws 320a.

**[00124]** Additionally, and simultaneously with a distal movement of the distal-most clip “C1”, as cartridge clip pusher bar 304 of clip cartridge assembly 300 moves in a distal direction, the remaining surgical clips “C” as well as main drive rod 122 are also being moved in a distal direction. Following loading of distal-most clip “C1” into the pair of jaws 320a, as shown in FIGS. 36 and 37, cam ramp 126c of rocker 126 abuts or engages release or reversing feature 220 of outer tube assembly 200, to pivot rocker 126 about pivot pin 127, thereby disengaging piston 126b of rocker 126 from drive sled 308, to effectuate a reversal of the direction of travel of clip cartridge pusher bar 304, from the distal direction to a proximal direction.

**[00125]** As cartridge clip pusher bar 304 is moved in a proximal direction, cartridge clip pusher bar 304 acts on the backspans of the remaining surgical clips “C” to also urge the remaining surgical clips “C” in a proximal direction. Specifically, fingers 304e of cartridge clip pusher bar 304 proximally retract the remaining surgical clips “C” until each remaining surgical clip “C” is retracted into contact with a respective distal tip of a respective resilient, deflectable finger 302d of clip tray 302, which blocks or stops further proximal retraction of the remaining surgical clips “C”, while cartridge clip pusher bar 304 continues to move proximally to the proximal-most position thereof.

[00126] With cartridge clip pusher bar 304 returned to the proximal-most position thereof, continued squeezing of trigger 114 continues to advance main drive rod 122 in a distal direction, to a distal-most position thereof (e.g., total distal advancement of about 17mm), until V-shaped cam groove 122d of main drive rod 122 engages cam teeth 320c of the pair of jaws 320a to close the pair of jaws 320a, and form the distal-most clip “C1” loaded therewith.

[00127] Following formation of the distal-most clip “C1”, trigger 114 may be released, whereby return compression spring 124 is permitted to re-expand to act on flange 122c and move main drive rod 122 in a proximal direction until main drive rod 122 is returned to a proximal-most position thereof. When main drive rod 122 is returned to the proximal-most position thereof, cam ramp 126c of rocker 126 is moved proximally of release or reversing feature 220 of outer tube assembly 200, whereby biasing member leaf spring 128, acting on proximal end 126a of rocker 126 pivots rocker 126 such that piston 126b of rocker is brought back into axial registration with drive sled 308 of clip cartridge assembly 300.

[00128] Additionally, as main drive rod 122 is returned to a proximal-most position thereof, V-shaped cam groove 122d of main drive rod 122 is withdrawn from and engages cam teeth 320c of the pair of jaws 320a thereby allowing the pair of jaws 320a to open as a result of their own resilient bias.

[00129] The operations described above can be repeated, as required, until all of the surgical clips “C” have been formed.

[00130] Surgical clip applier 100 may be provided with a lockout mechanism, wherein surgical clip applier 100 cannot be actuated once all of the surgical clips “C” have been fired. By way of example only, one such lockout mechanism may include spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> of pusher 304d entering into and engaging the pair of channels 302f of clip tray 302 (FIG. 32) once the final clip

of the stack of clips “C” is formed and cartridge clip pusher bar 304 is retracted to the proximal-most position. Once the spaced apart prongs 304d<sub>1</sub>, 304d<sub>2</sub> of pusher 304d are engaged with or disposed within the pair of channels 302f of clip tray 302, any distal movement of the cartridge clip pusher bar 304, e.g., upon an actuation of trigger 114, as described above, is inhibited.

**[00131]** In use, surgical clip applier 100, as mentioned above, is capable of loading different surgical clip cartridge assemblies 300 on outer tube assembly 200. Specifically, clip applier 100 may be loaded with a surgical clip cartridge assembly 300 that is loaded with a stack of surgical clips “C” having a first size, or a surgical clip cartridge assembly 300 that is loaded with a stack of surgical clips “C” having a second size different than the first size.

**[00132]** In this manner, the user or surgeon may load a surgical clip cartridge assembly 300, loaded with a particular size of surgical clips, depending on the particular surgical procedure to be performed. Additionally, during a surgical procedure, if the need arises to use a different sized surgical clip, the user or surgeon may eject or unload the surgical clip cartridge assembly 300 that is loaded onto outer tube assembly 200 and then load a new surgical clip cartridge assembly 300 (having a different sized stack of surgical clips loaded therein as compared to the unloaded surgical clip cartridge assembly 300) onto outer tube assembly 200.

**[00133]** Additionally, in accordance with the present disclosure, handle assembly 110 and outer tube assembly 200 may be reused following proper cleaning, sterilizing, autoclaving and the like, and clip cartridge assembly 300 is disposed following a complete and/or partial use thereof.

**[00134]** Also in accordance with the present disclosure, it is further contemplated that a surgical kit may be provided including a surgical clip applier 100 and a plurality of clip cartridge assemblies 300 including at least a first set

of clip cartridge assemblies loaded with a stack of surgical clips having a first size and a second set of clip cartridge assemblies loaded with a stack of surgical clips having a second size different than the first size. The kit may include instructions for the assembly or surgical clip applicator 100, the use of surgical clip applicator 100, and the processing of surgical clip applicator assembly 100 following use, a surgical clip applicator 100 including a single handle assembly 110, a single outer tube assembly 200, a single clip cartridge assembly 300, and a package, container or box configured to retain the same.

**[00135]** It should be understood that the foregoing description is only illustrative of the present disclosure. Various alternatives and modifications can be devised by those skilled in the art without departing from the disclosure. Accordingly, the present disclosure is intended to embrace all such alternatives, modifications and variances. The embodiments described with reference to the attached drawing figures are presented only to demonstrate certain examples of the disclosure. Other elements, steps, methods and techniques that are insubstantially different from those described above and/or in the appended claims are also intended to be within the scope of the disclosure.

## **CLAIMS**

What is claimed is:

1. A reusable surgical clip applier, comprising:

a handle assembly including a housing, a fixed handle, a trigger, and a drive assembly removably supported within the housing and operatively actuatable by the trigger, the drive assembly including:

a drive rod having a proximal end and a distal end, the distal end of the drive rod defining a camming feature; and

a rocker pivotally supported on the drive rod, the rocker including a proximal end extending proximally of a pivot point, and a distal end extending distal of the pivot point;

an outer tube assembly selectively connectable to the housing of the handle assembly, the outer tube assembly including an outer tube defining a lumen therethrough for receiving at least a portion of the drive assembly therein, wherein the distal end of the drive rod of the drive assembly extends distally beyond the outer tube when the drive assembly is loaded into the housing of the handle assembly; and

a clip cartridge assembly selectively connectable to the distal end of the drive rod of the drive assembly of the handle assembly and to a distal end of the outer tube of the outer tube assembly, the clip cartridge assembly including:

an outer tube fixedly supporting a jaw blade therein, wherein a pair of jaws of the jaw blade extend distally beyond the outer tube, wherein the distal end of the drive rod of the drive assembly extends through the outer tube of the clip cartridge assembly when the clip cartridge assembly is connected to the outer tube assembly, and wherein the camming feature of the drive rod is in operative association with a corresponding camming feature of the pair of jaws;

a clip tray disposed within the outer tube of the clip cartridge assembly, the clip tray including a first plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof;

a cartridge clip pusher bar slidably disposed within the clip tray, the cartridge clip pusher bar including a second plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof and extending towards the first plurality of distally oriented, deflectable, resilient fingers, each resilient finger of the cartridge clip pusher bar terminating in a distal shoulder;

a plurality of surgical clips loaded within the clip tray and interposed between the base wall of the clip tray and the base wall of the cartridge clip pusher bar, wherein a surgical clip is disposed distally of each resilient finger of the clip tray and each resilient finger of the cartridge clip pusher bar when the cartridge clip pusher bar is at a proximal-most position relative to the clip tray;

a drive sled slidably disposed within the clip tray, the drive sled being positioned proximal of the plurality of surgical clips, wherein the distal end of the rocker of the drive assembly is in operative contact with the drive sled when the clip cartridge assembly is connected to the outer tube assembly;

a cartridge pusher rod extending distally from the drive sled, the cartridge pusher rod having a distal end connected to a proximal end of the cartridge clip pusher bar; and

a biasing member supported on the cartridge pusher rod and tending to bias the drive sled and the cartridge clip pusher bar to a proximal-most position.

2. The reusable surgical clip applier according to claim 1, wherein the clip tray includes:

a first channel defined by a base wall and a pair of first side rails extending along longitudinal sides of the base wall, wherein the first plurality of distally

oriented, deflectable, resilient fingers project into the first channel, and wherein the plurality of surgical clips are slidably supported in the first channel; and

a second channel, adjacent to the first channel, defined by a pair of second side rails supported on respective ones of the pair of first side rails, wherein the cartridge clip pusher bar is slidably disposed within the second channel, and wherein the second plurality of distally oriented, deflectable, resilient fingers project into the first channel of the clip tray.

3. The reusable surgical clip applier according to claim 1, wherein the housing of the handle assembly is a hollow barrel housing having the fixed handle extending therefrom, the barrel housing defining a bore therethrough, an open proximal end and an open distal end; and

wherein the trigger is pivotally supported on and extends from the barrel housing, the trigger including an actuating end extending into the bore of the barrel housing.

4. The reusable surgical clip applier according to claim 1, wherein upon a distal actuation of the cartridge clip pusher bar, the second plurality of distally oriented, deflectable, resilient fingers thereof contact a proximal surface of a backspan of a respective surgical clip to distally advance all the surgical clip simultaneously.

5. The reusable surgical clip applier according to claim 4, wherein following distal actuation of the cartridge clip pusher bar, upon a proximal actuation of the cartridge clip pusher bar, the second plurality of distally oriented, deflectable, resilient fingers thereof contact a proximal surface of the backspan of a respective remaining one of the surgical clips to proximally move all the remaining surgical clips until the backspans of the remaining surgical clips contact a respective one of the first plurality of distally oriented, deflectable,

resilient fingers of the clip tray to block proximal movement of the remaining surgical clips.

6. The reusable surgical clip applier according to claim 4, wherein distal actuation of the cartridge clip pusher bar results from a distal movement of the drive sled that distally advances the cartridge pusher rod, wherein distal advancement of the drive sled biases the biasing member.

7. The reusable surgical clip applier according to claim 6, wherein an initial actuation of the trigger of the handle assembly results in distal advancement of the drive rod and the rocker of the drive assembly relative to the outer tube of the outer tube assembly and relative to the outer tube of the clip cartridge assembly, wherein a distal end of the rocker of the drive assembly engages the drive sled of the clip cartridge assembly to distally advance the clip cartridge pusher bar, and to compress the biasing member supported on the cartridge pusher rod.

8. The reusable surgical clip applier according to claim 7, wherein during the initial actuation of the trigger, a pusher at the distal end of the clip cartridge pusher bar engages a distal-most clip of the plurality of surgical clips and advances the distal-most clip into the pair of jaws.

9. The reusable surgical clip applier according to claim 8, wherein a further actuation of the trigger of the handle assembly results in further distal advancement of the drive rod and the rocker of the drive assembly relative to the outer tube of the outer tube assembly and relative to the outer tube of the clip cartridge assembly; and

wherein the rocker engages a reversing feature provided in the outer tube of the outer tube assembly, thereby disengaging the distal end of the rocker from the drive sled permitting the biasing member supported on the cartridge pusher rod to expand and withdraw the clip cartridge pusher bar in a proximal direction.

10. The reusable surgical clip applier according to claim 9, wherein the reversing feature includes:

a cam pin extending across an inner lumen of the outer tube of the outer tube assembly; and

a camming surface formed at a proximal end of the rocker of the drive assembly, wherein contact of the camming surface of the rocker with the cam pin of the outer tube of the outer tube assembly causes the rocker to pivot and causes the distal end of the rocker to move out of axial alignment with the drive sled.

11. The reusable surgical clip applier according to claim 9, wherein during the further actuation of the trigger of the handle assembly, the camming feature at the distal end of the drive rod engages the camming feature of the pair of jaws to close the pair of jaws relative to one another.

12. The reusable surgical clip applier according to claim 1, wherein the drive assembly includes a biasing member acting on the rocker to urge the distal end of the rocker into axial alignment with the drive sled of the clip cartridge assembly.

13. The reusable surgical clip applier according to claim 2, wherein the handle assembly includes a biasing member supported on the proximal end of the drive rod, the biasing member is interposed between a flange provided on the proximal end of the drive rod and a distal surface of the barrel housing.

14. The reusable surgical clip applier according to claim 13, wherein the trigger of the handle assembly includes an actuating end, wherein the actuating end of the trigger is disposed proximal of the drive rod and is in operative contact with the drive rod.

15. The reusable surgical clip applier according to claim 14, wherein the handle assembly includes an end cap selectively securable to the proximal end of the barrel housing.

16. The reusable surgical clip applier according to claim 14, wherein the trigger of the handle assembly is pivotable to a position wherein the actuating end of the trigger is not within the bore of the bore housing.

17. The reusable surgical clip applier according to claim 16, wherein, when the actuating end of the trigger is not within the bore of the bore housing, the distal end of the drive assembly is insertable into the proximal end of the barrel housing and advanceable through the barrel housing and through the outer tube assembly.

18. The reusable surgical clip applier according to claim 2, wherein the outer tube assembly includes a knob supporting the outer tube thereof, wherein the barrel housing of the handle assembly and the knob of the outer tube assembly are selectively connectable to one another via a bayonet-type connection.

19. The reusable surgical clip applier according to claim 1, wherein a proximal end of the clip cartridge assembly is selectively connectable to a distal end of the outer tube assembly via a snap-fit connection.

20. A reusable surgical clip applier, comprising:  
a handle assembly including a housing, a fixed handle, a trigger, and a drive assembly removably supported within the housing and operatively actuatable by the trigger, the drive assembly including a drive rod having a distal end defining a camming feature, and a rocker pivotally supported on the drive rod, the rocker including a proximal end extending proximally of a pivot point, and a distal end extending distal of the pivot point;

an outer tube assembly selectively connectable to the housing of the handle assembly, the outer tube assembly being configured to receive at least a portion of the drive assembly therein, wherein the distal end of the drive rod of the drive assembly extends distally beyond the outer tube when the drive assembly is loaded into the housing of the handle assembly; and

a clip cartridge assembly selectively connectable to the distal end of the drive rod of the drive assembly of the handle assembly and to a distal end of the outer tube assembly, the clip cartridge assembly including:

a clip tray having a first plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof;

a cartridge clip pusher bar slidably disposed adjacent the clip tray, the cartridge clip pusher bar including a second plurality of distally oriented, deflectable, resilient fingers projecting from a base wall thereof and extending towards the first plurality of distally oriented, deflectable, resilient fingers;

a plurality of surgical clips loaded within the clip tray and interposed between the base wall of the clip tray and the base wall of the cartridge clip pusher bar, wherein a surgical clip is disposed distally of each resilient finger of the clip tray and each resilient finger of the cartridge clip pusher bar when the cartridge clip pusher bar is at a proximal-most position relative to the clip tray;

a drive sled slidably disposed proximal of the plurality of surgical clips, wherein the distal end of the rocker of the drive assembly is in operative contact with the drive sled when the clip cartridge assembly is connected to the outer tube assembly;

a cartridge pusher rod extending distally from the drive sled, the cartridge pusher rod having a distal end connected to a proximal end of the cartridge clip pusher bar; and

a biasing member supported on the cartridge pusher rod and tending to bias the drive sled and the cartridge clip pusher bar to a proximal-most position.

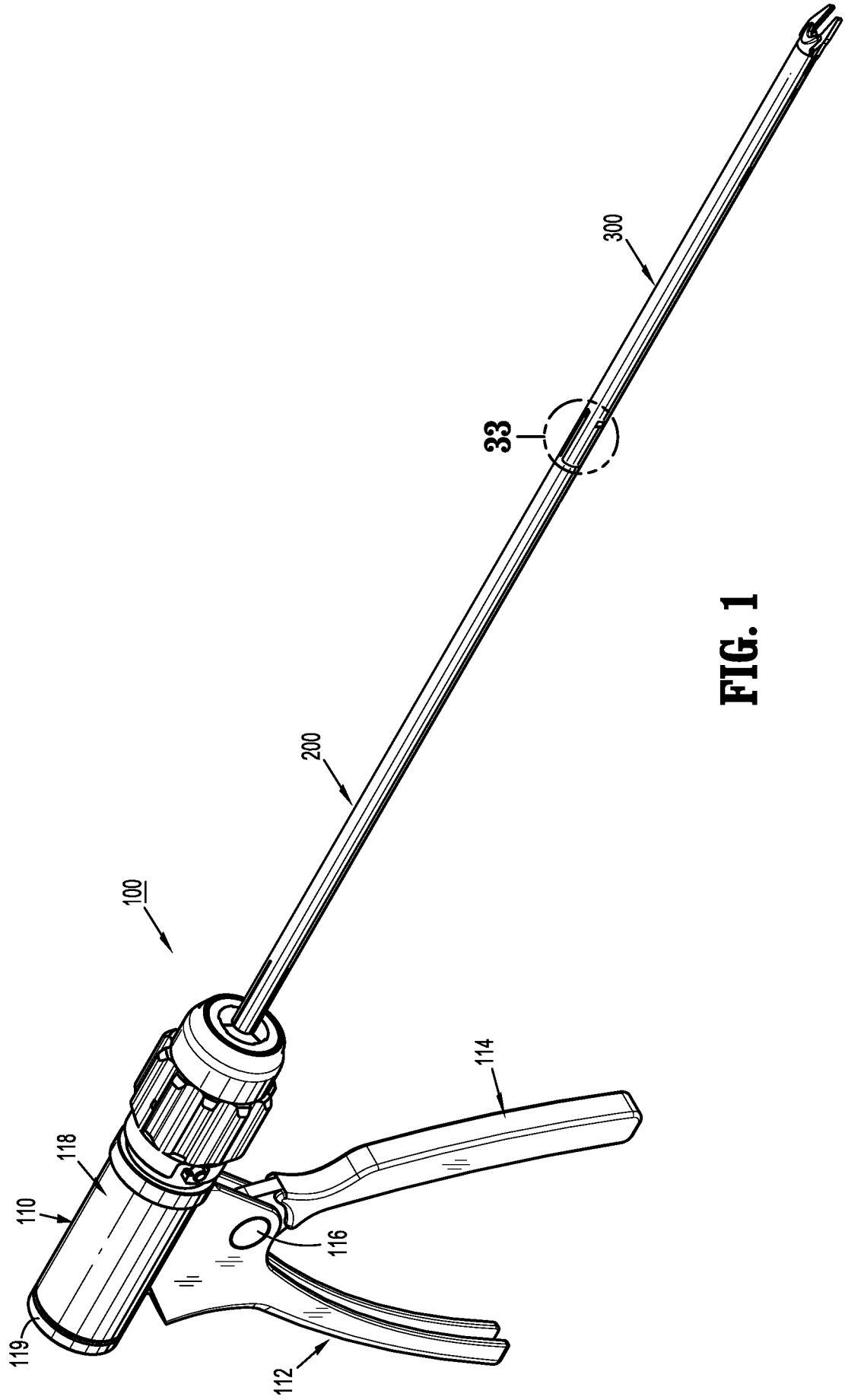
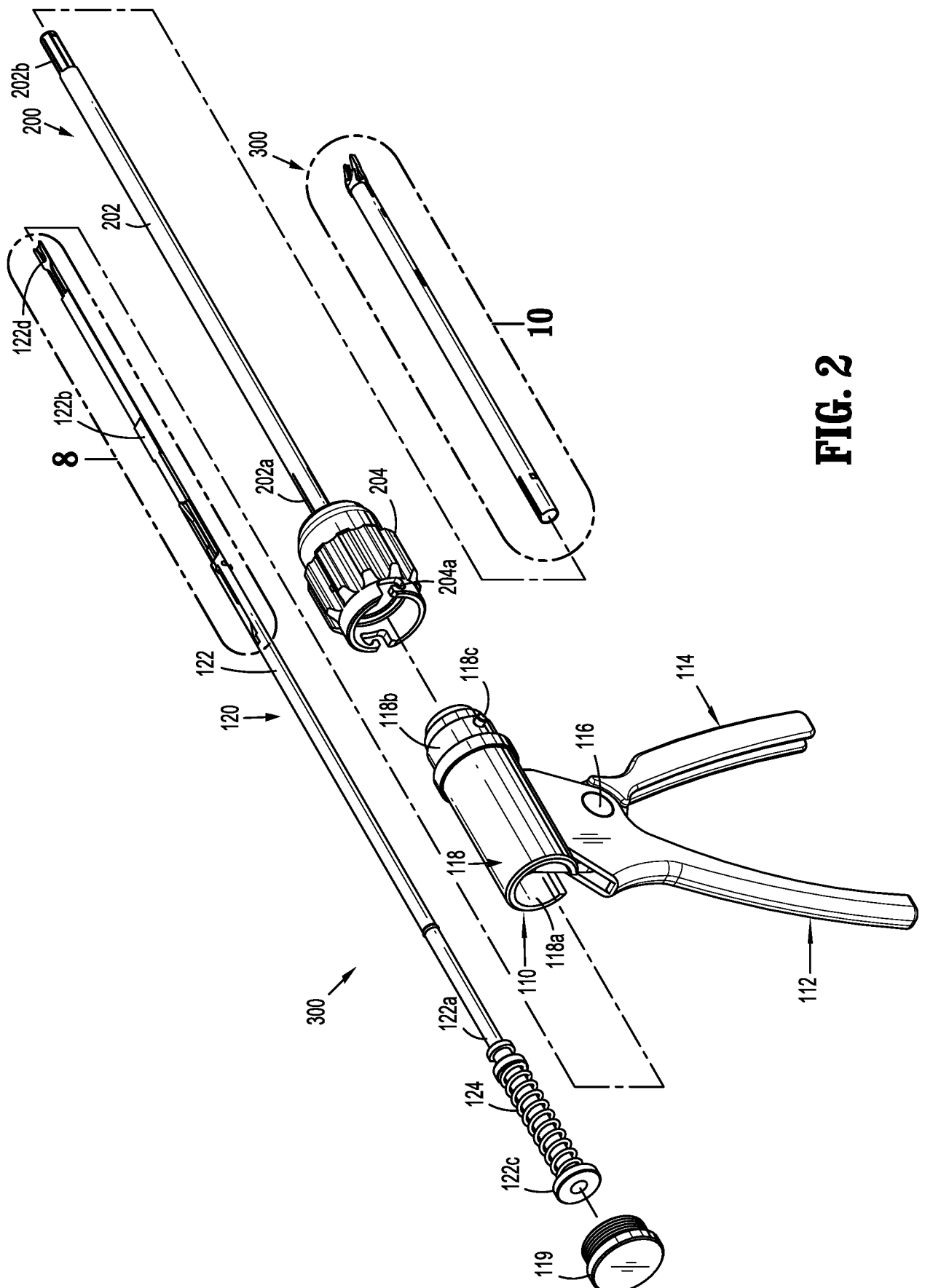
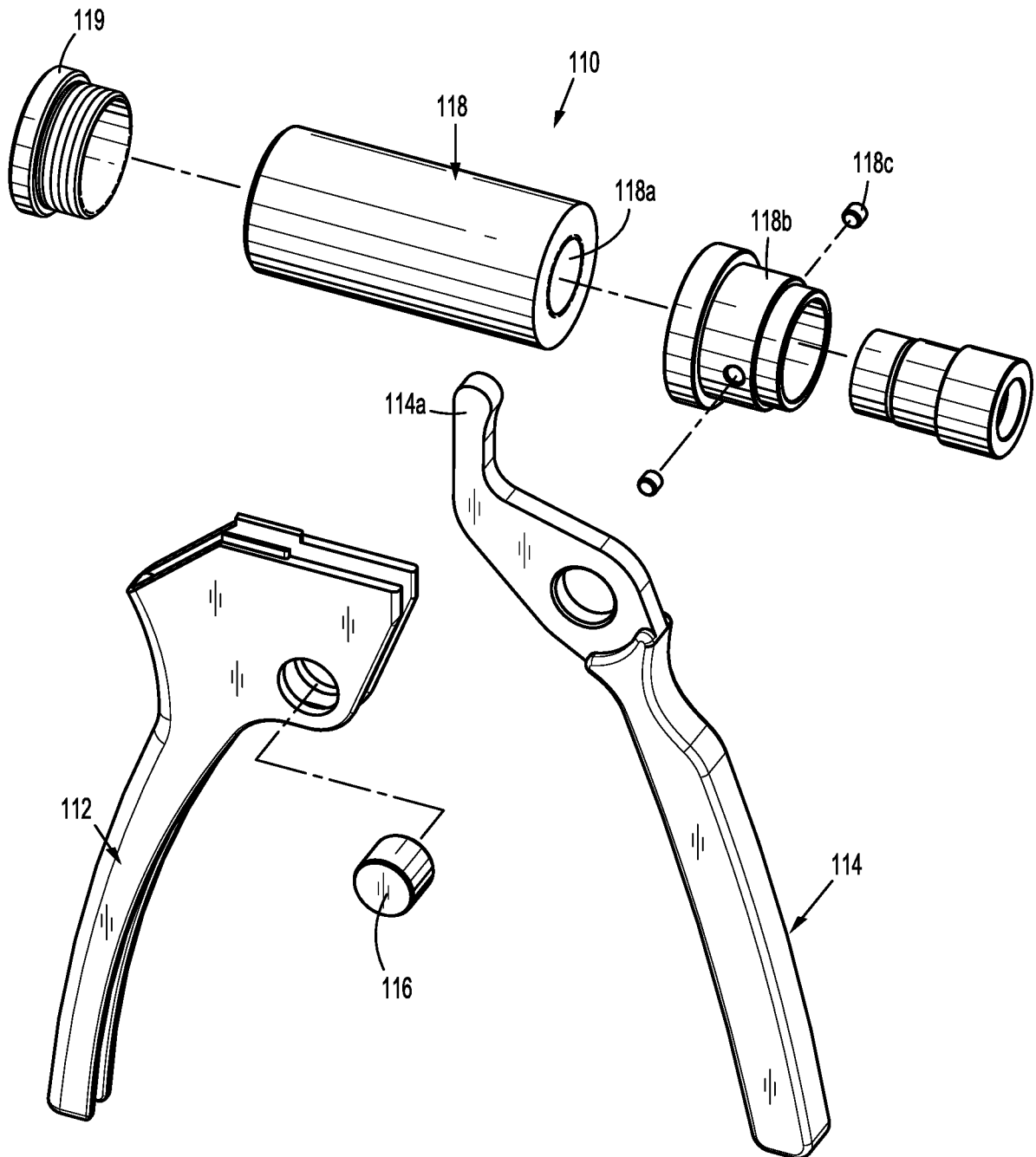


FIG. 1



**FIG. 2**

3/21



**FIG. 3**

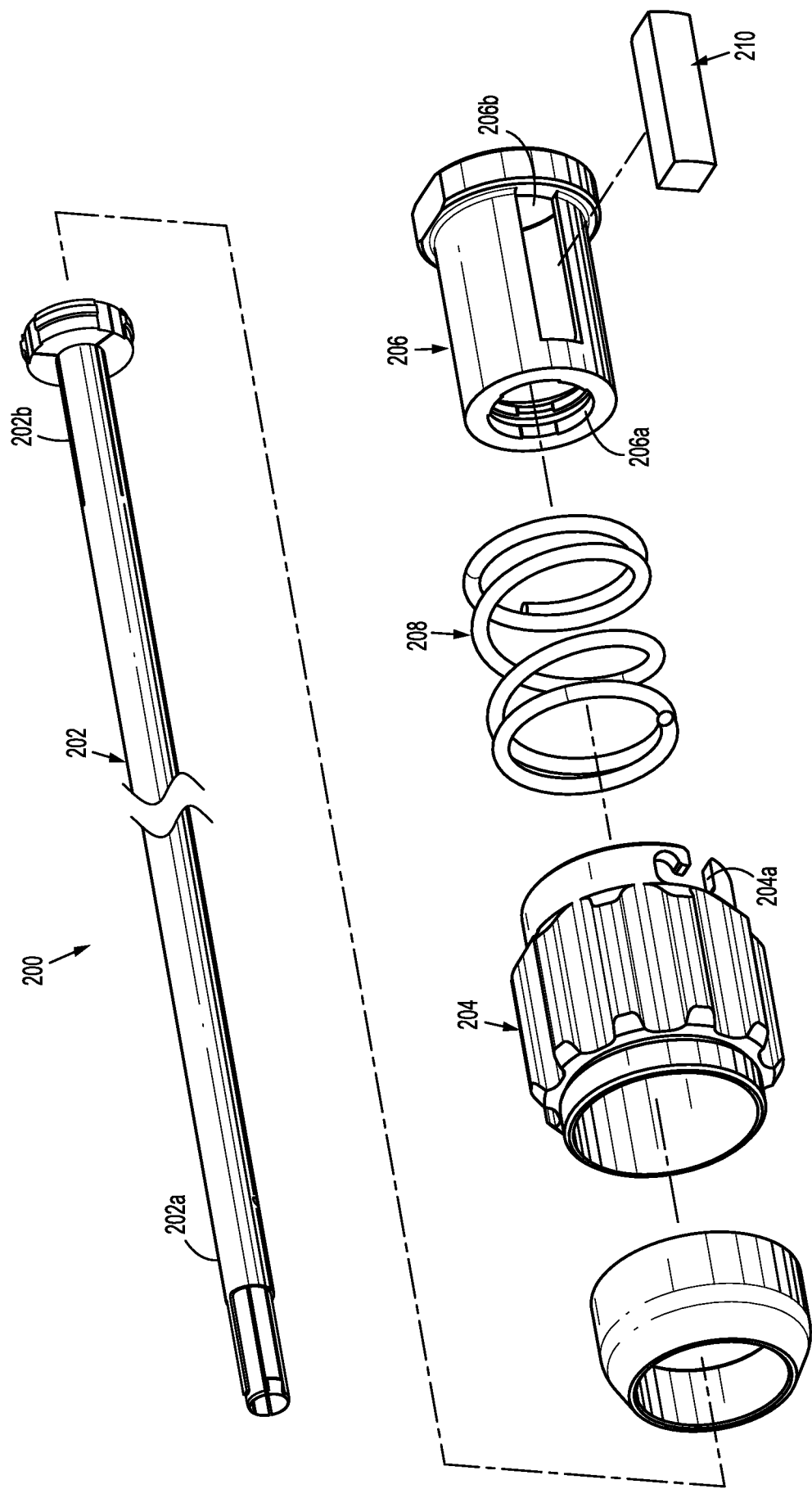
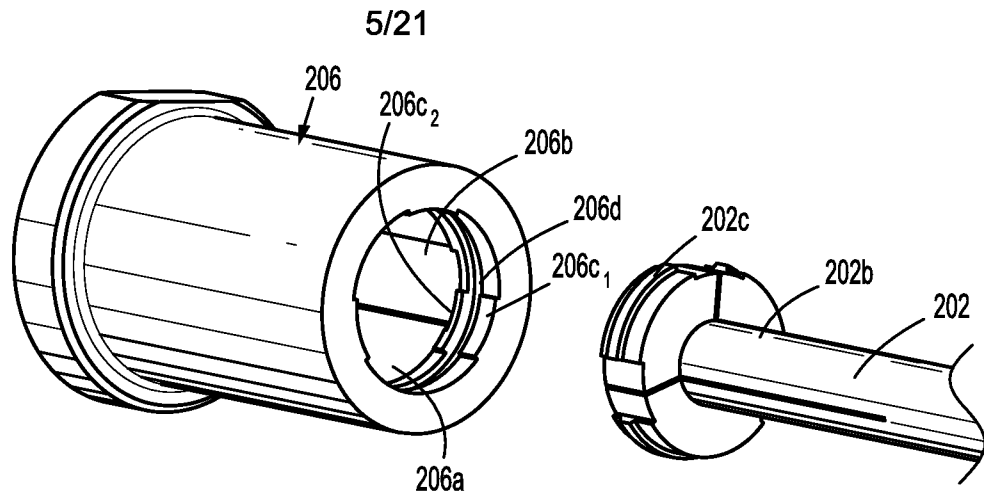
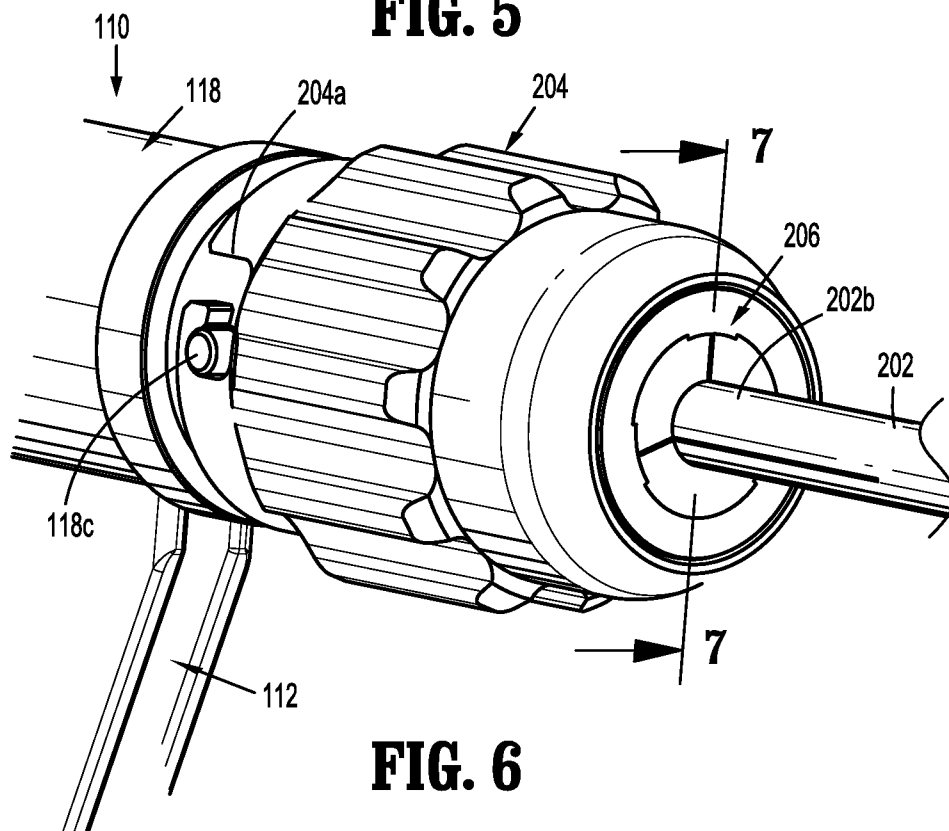


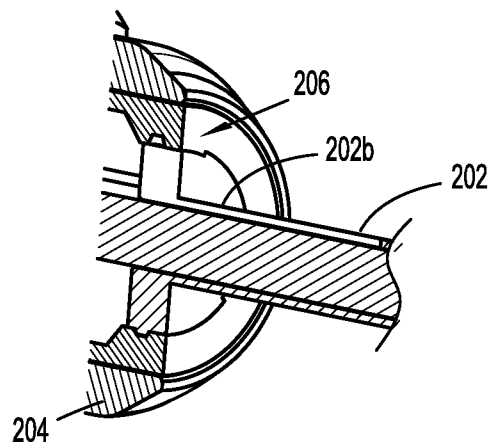
FIG. 4



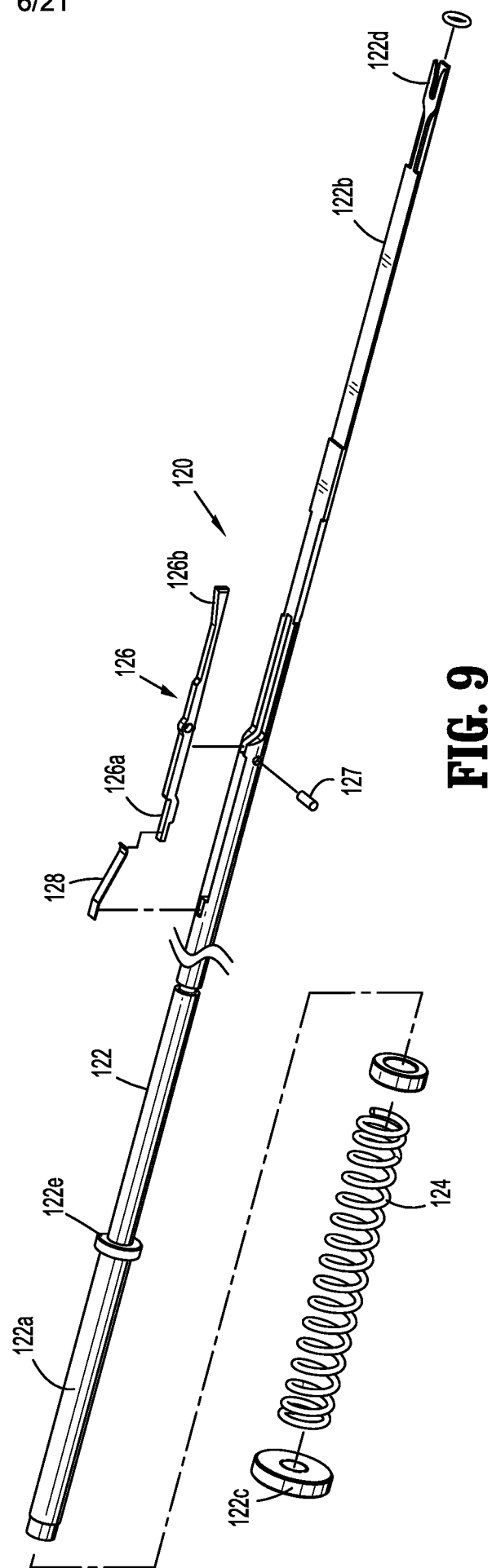
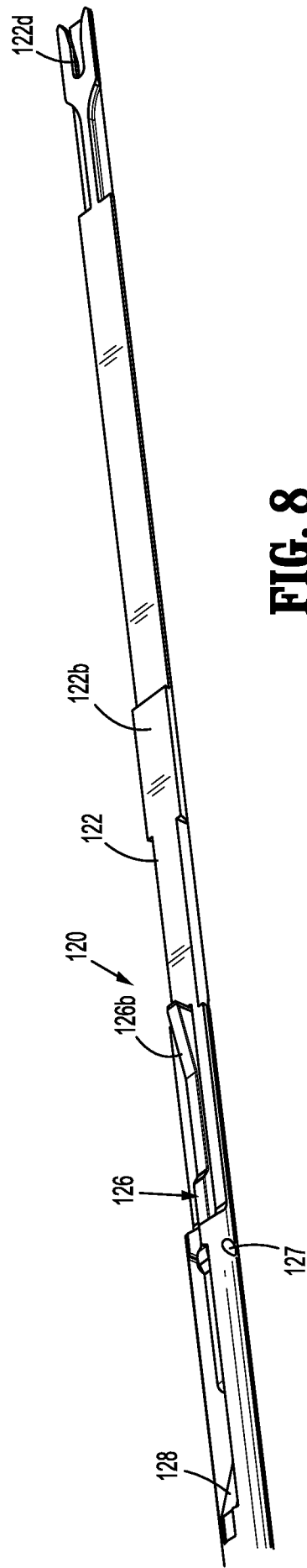
**FIG. 5**



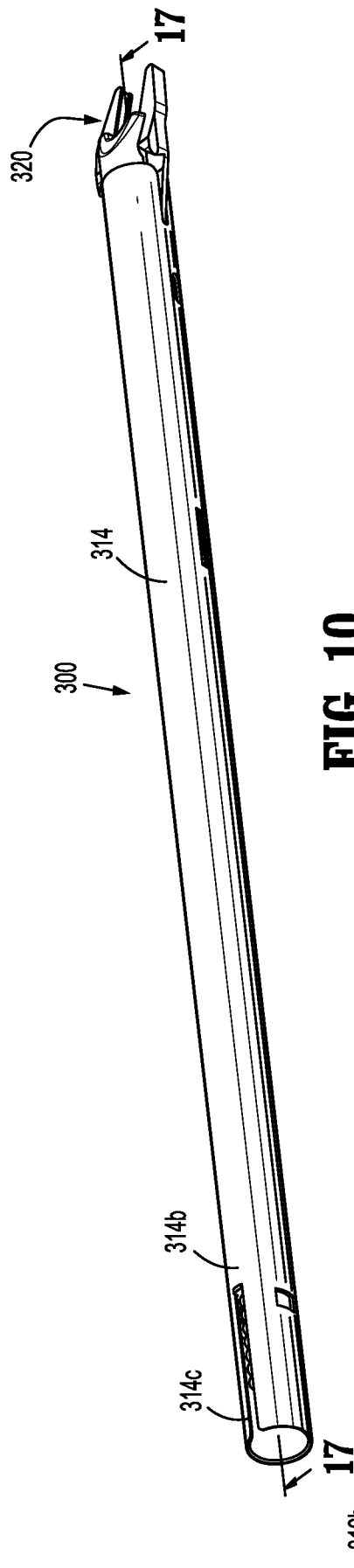
**FIG. 6**



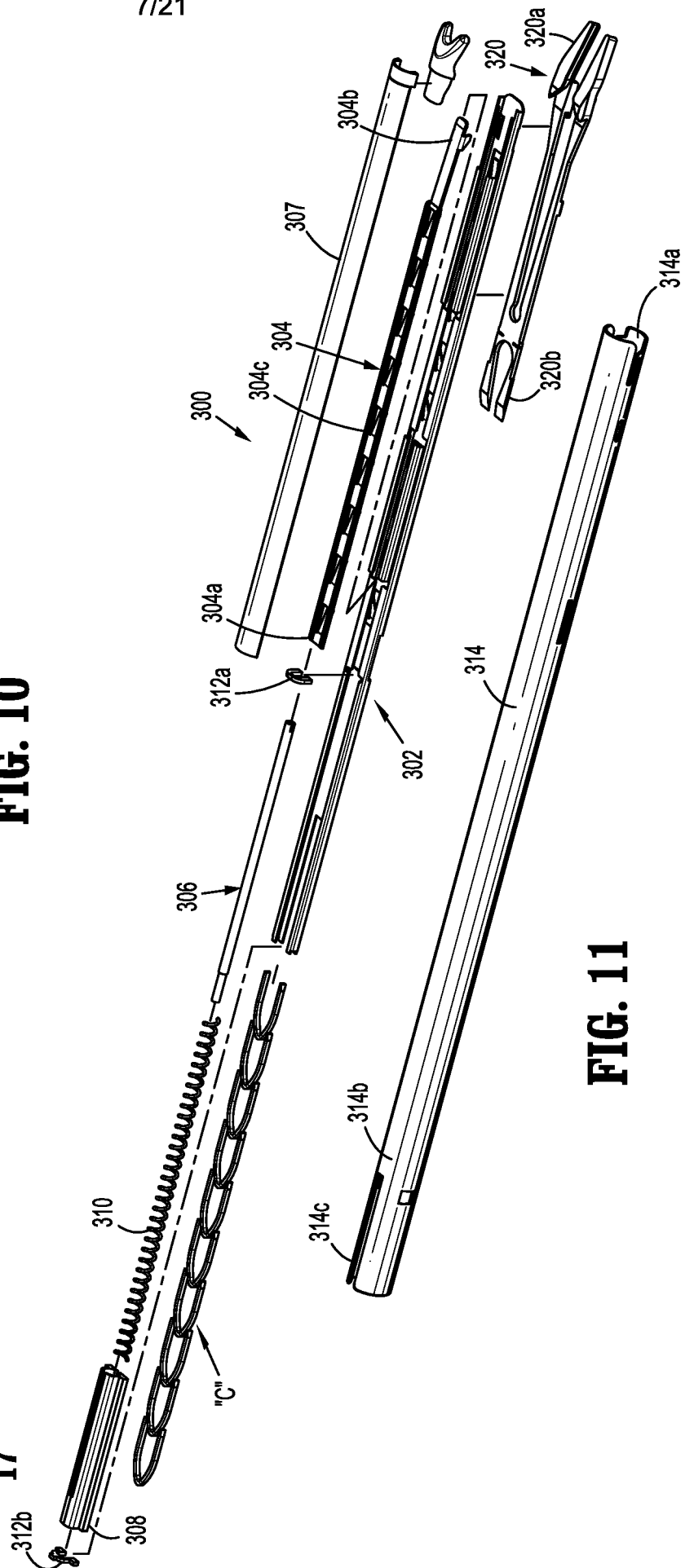
**FIG. 7**



7/21



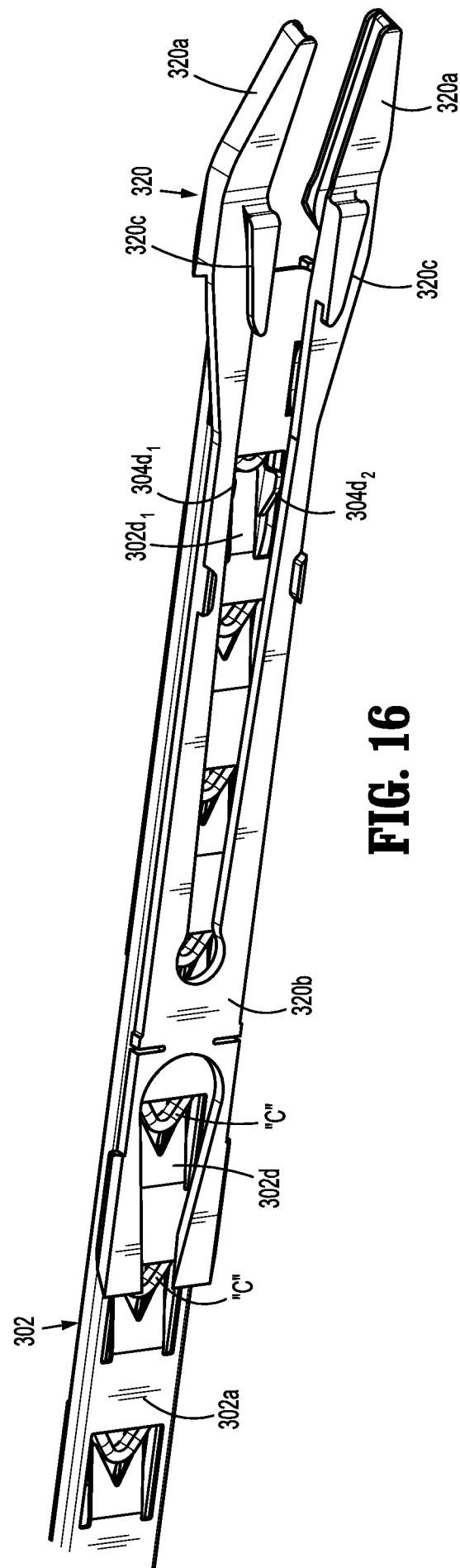
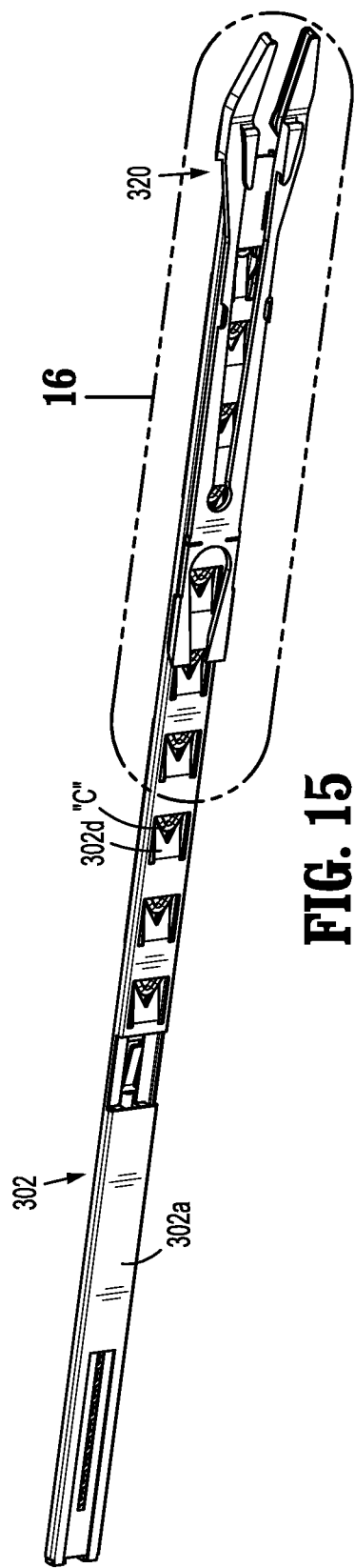
**FIG. 10**



**FIG. 11**



9/21



10/21

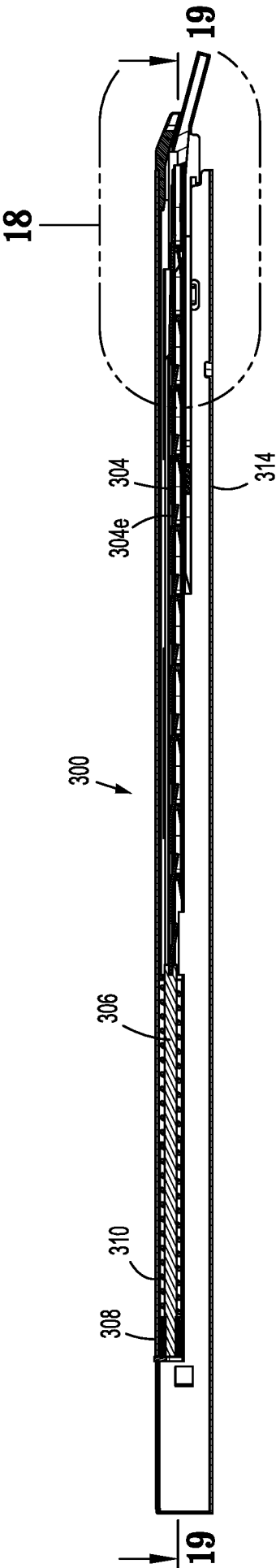


FIG. 17

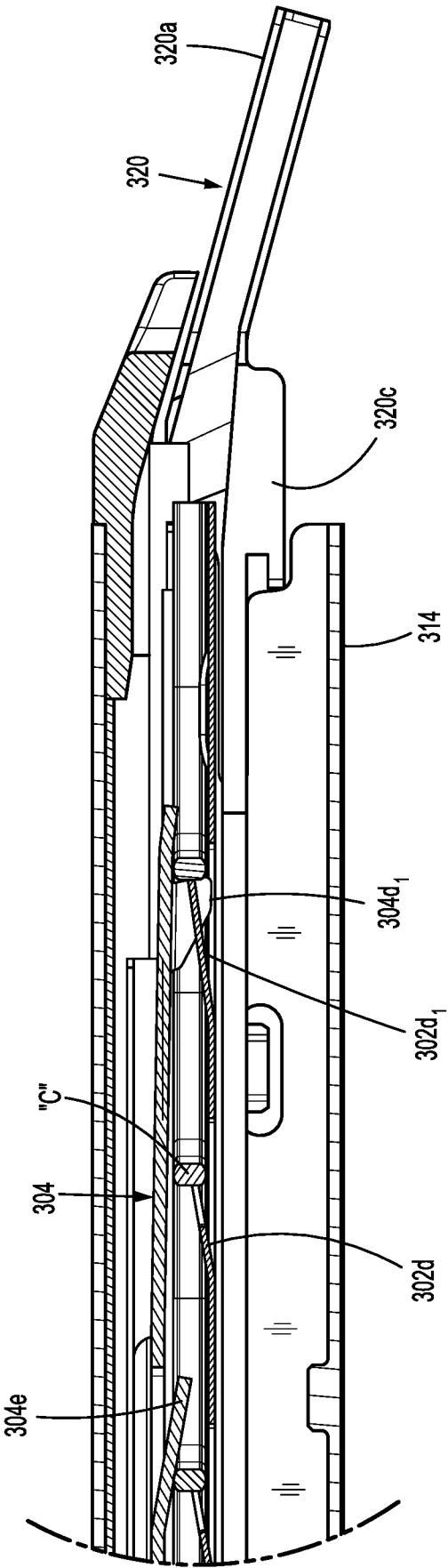


FIG. 18

11/21

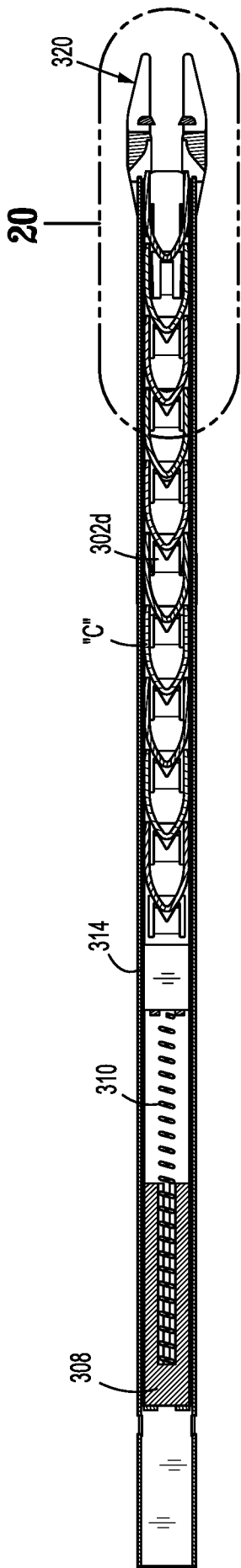


FIG. 19

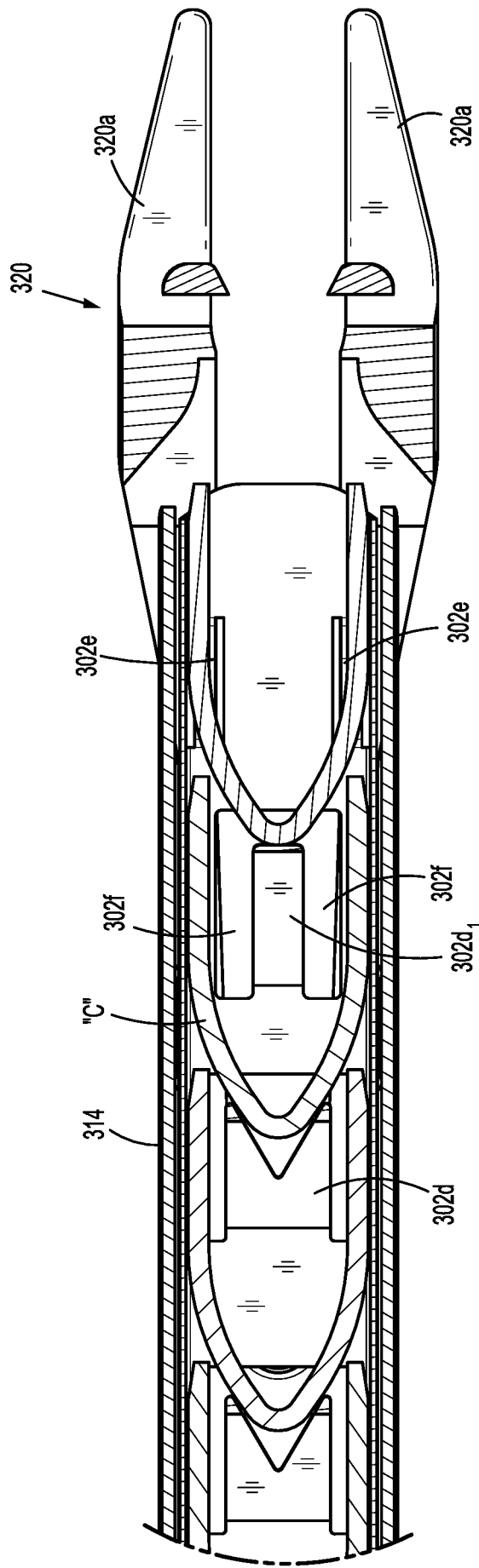
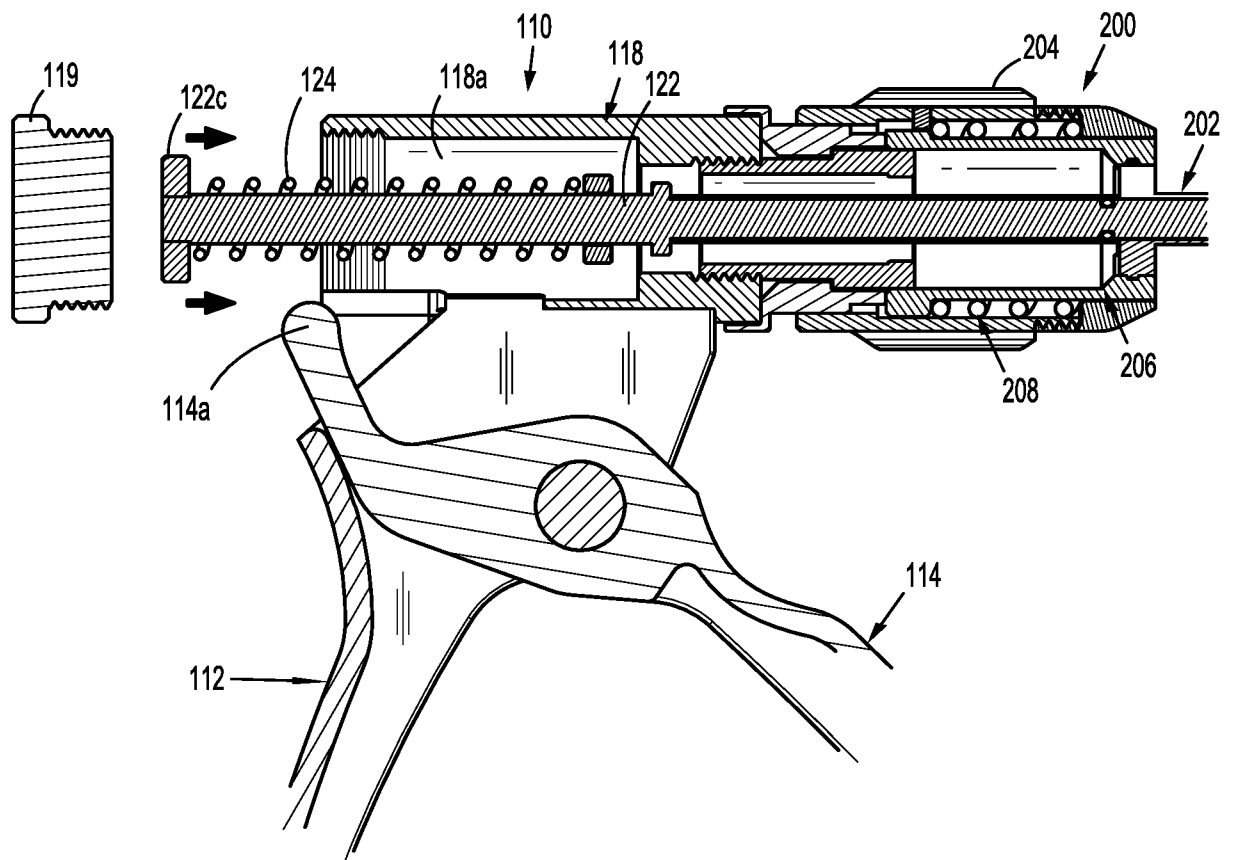


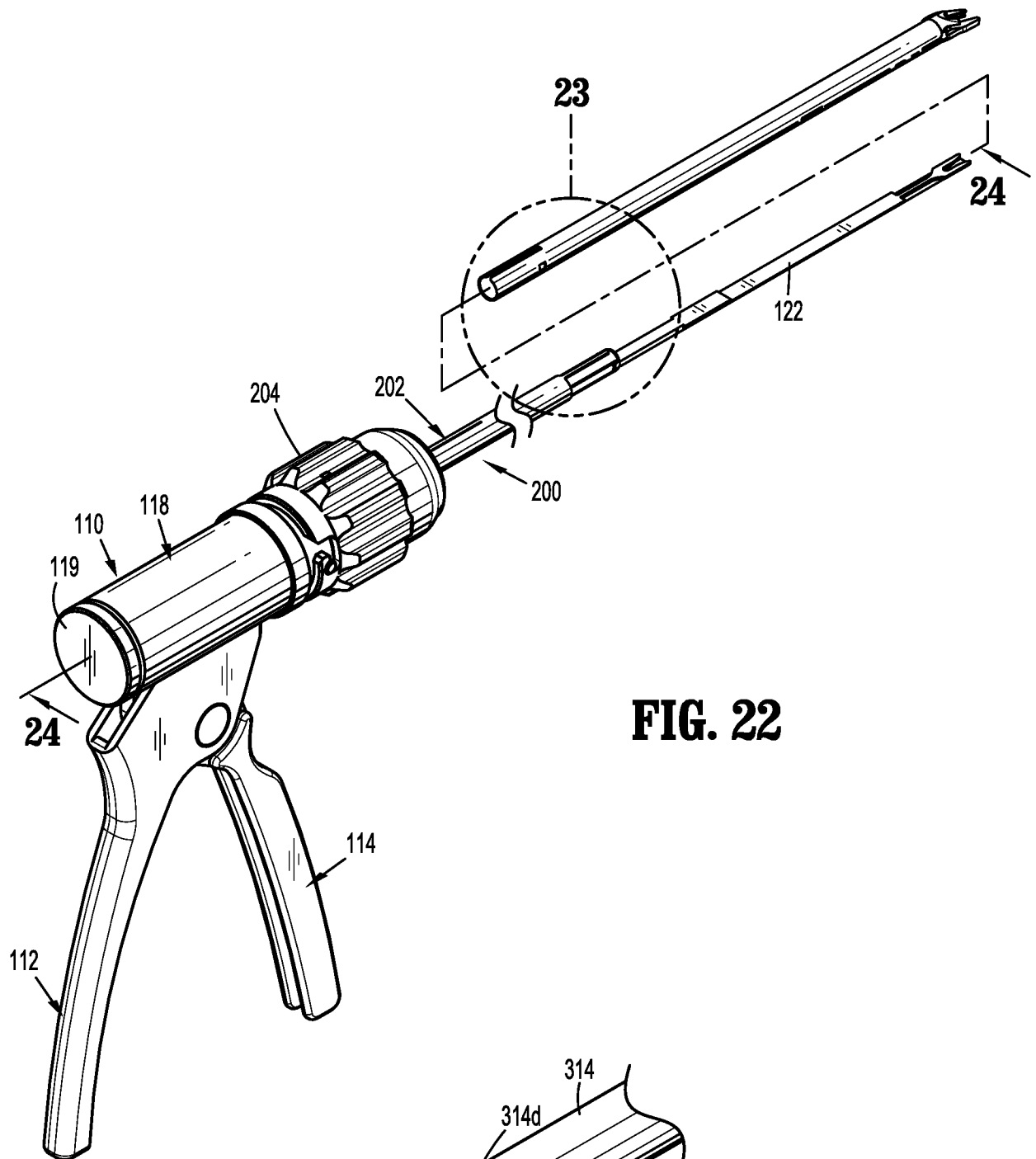
FIG. 20

12/21

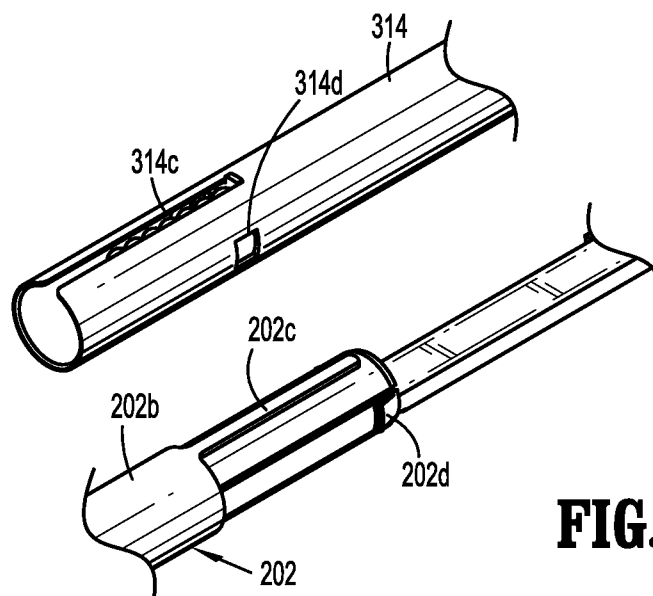


**FIG. 21**

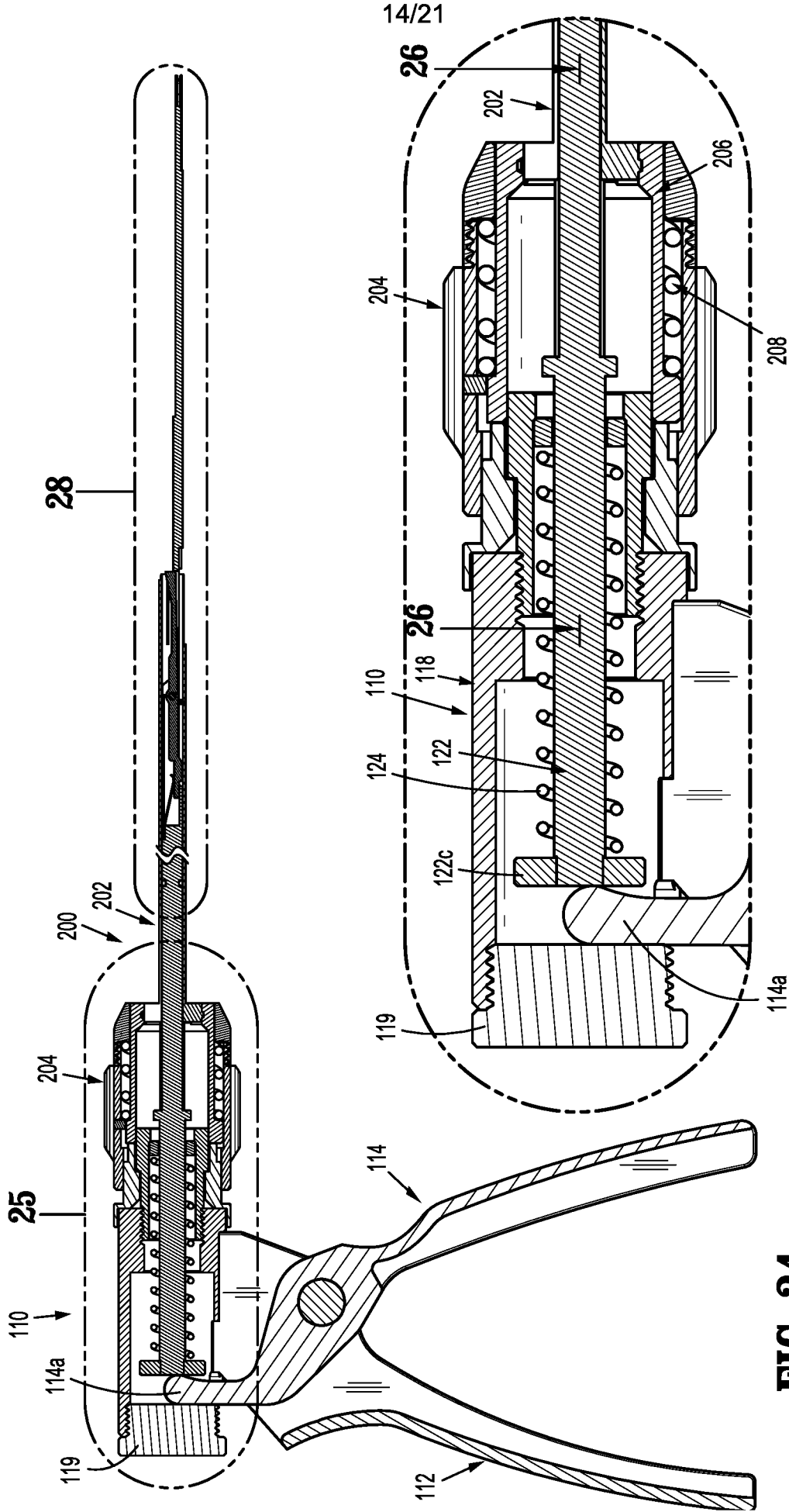
13/21



**FIG. 22**



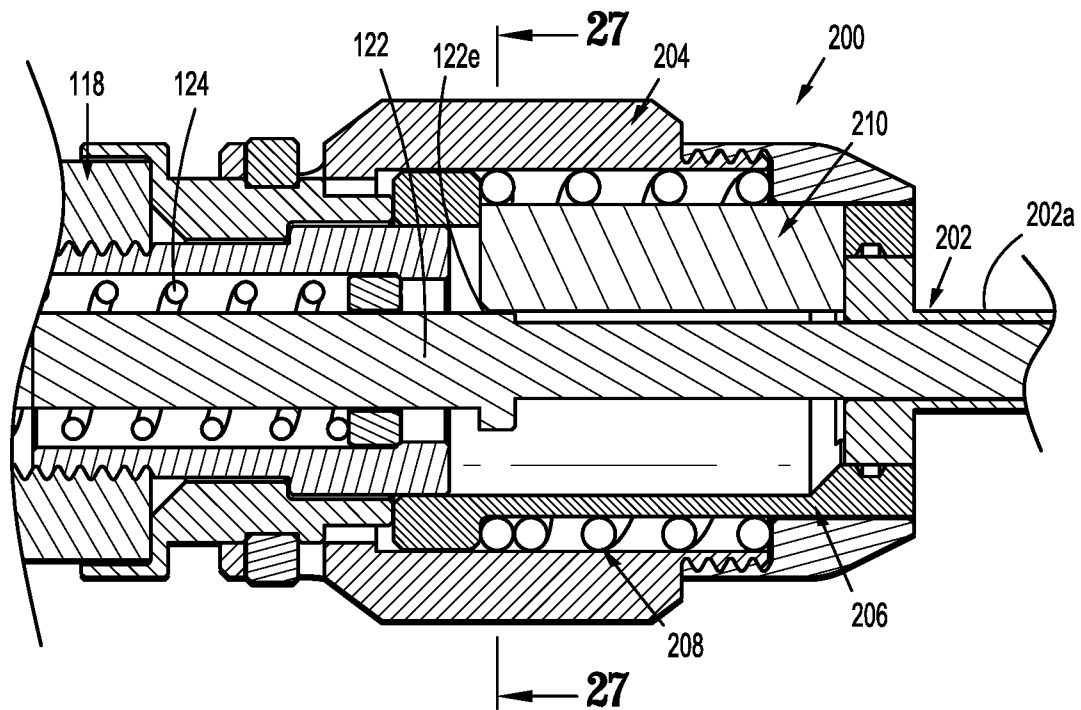
**FIG. 23**



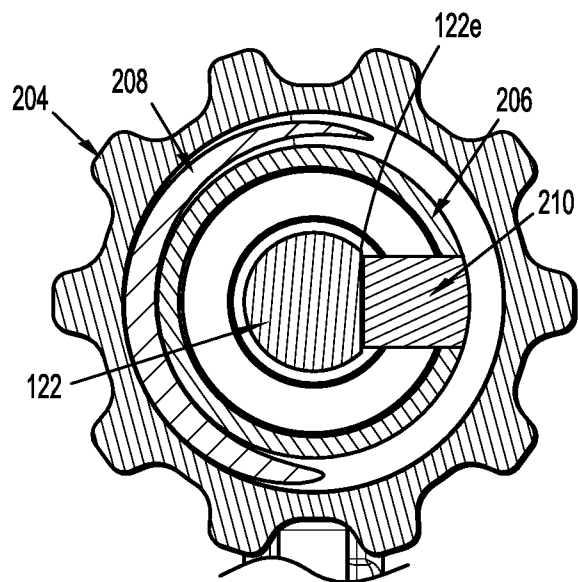
**FIG. 24**

**FIG. 25**

15/21



**FIG. 26**



**FIG. 27**

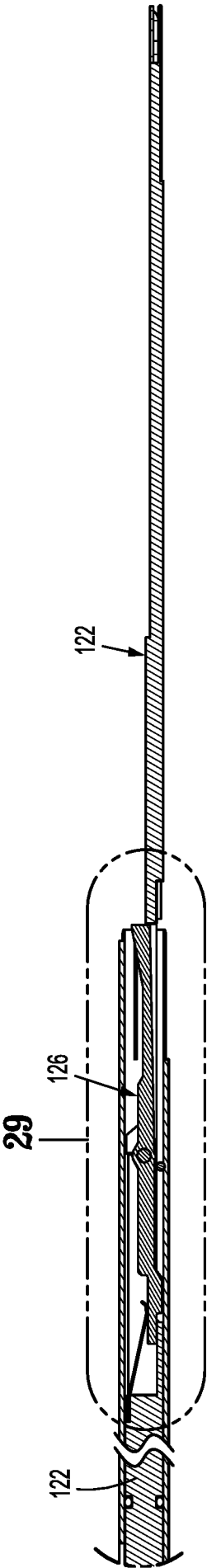


FIG. 28

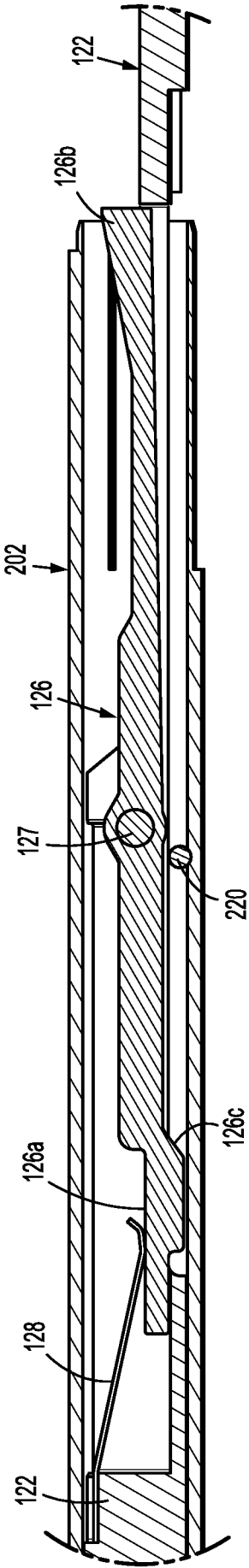
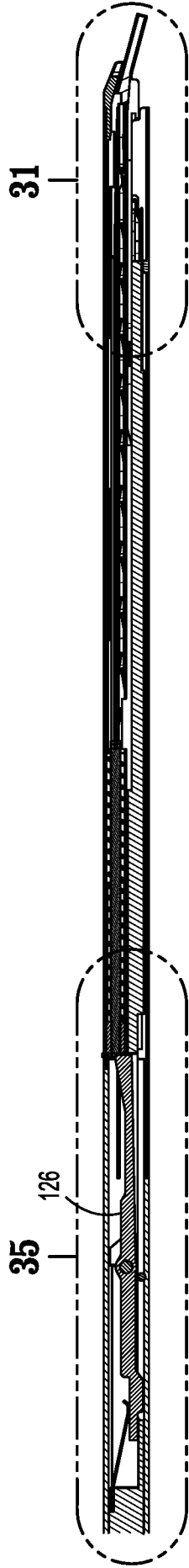
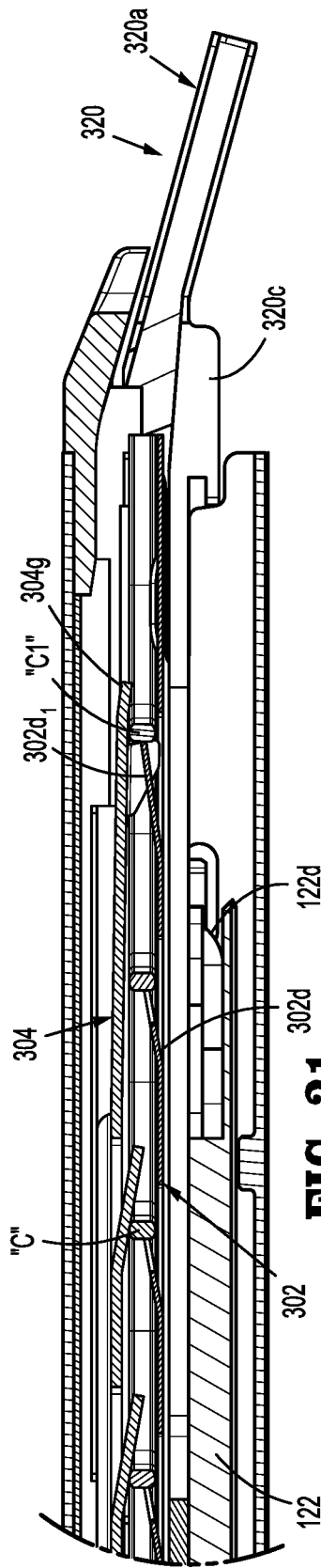


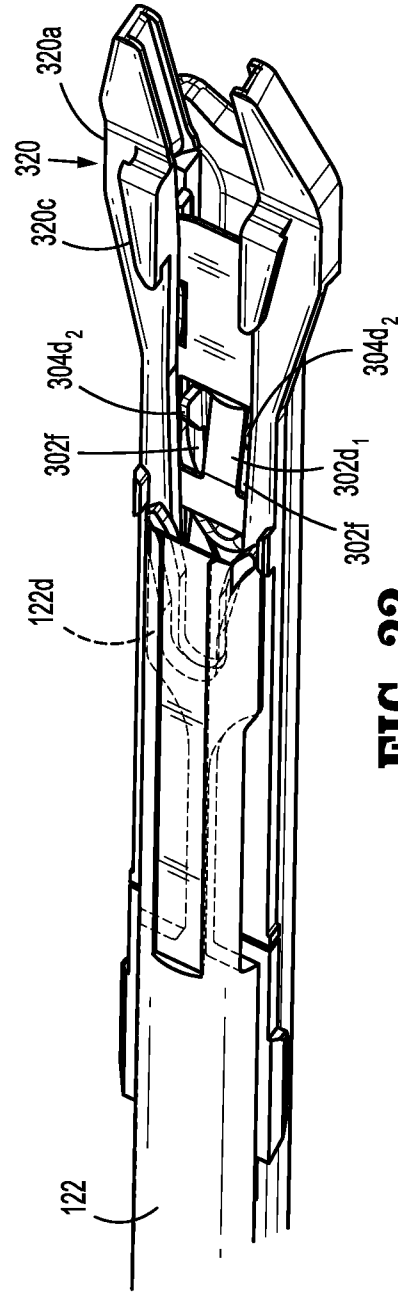
FIG. 29



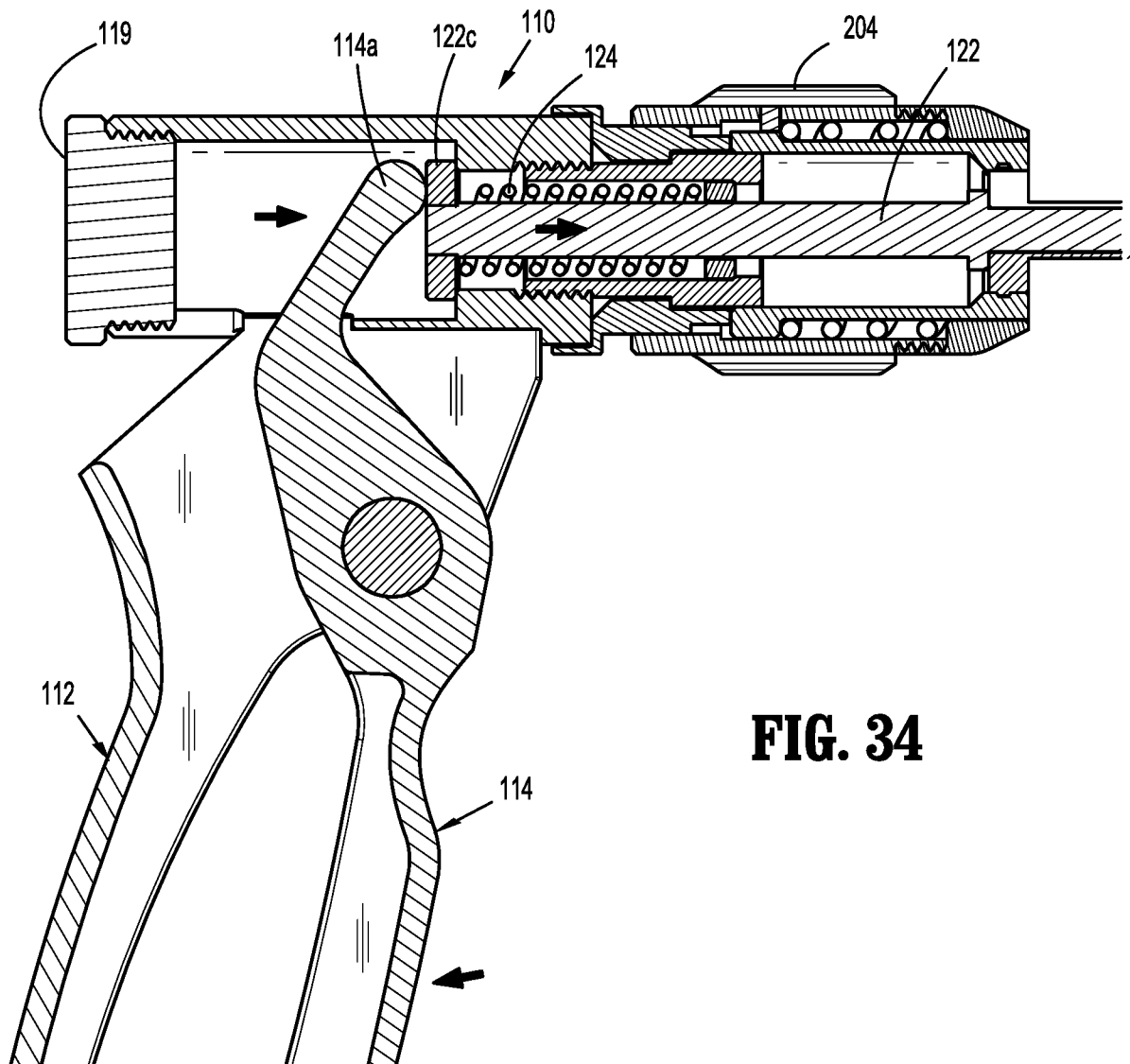
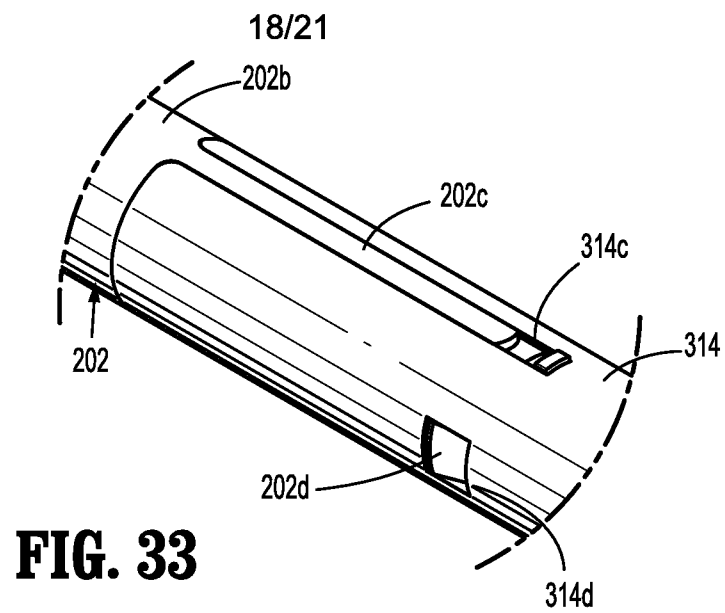
**FIG. 30**

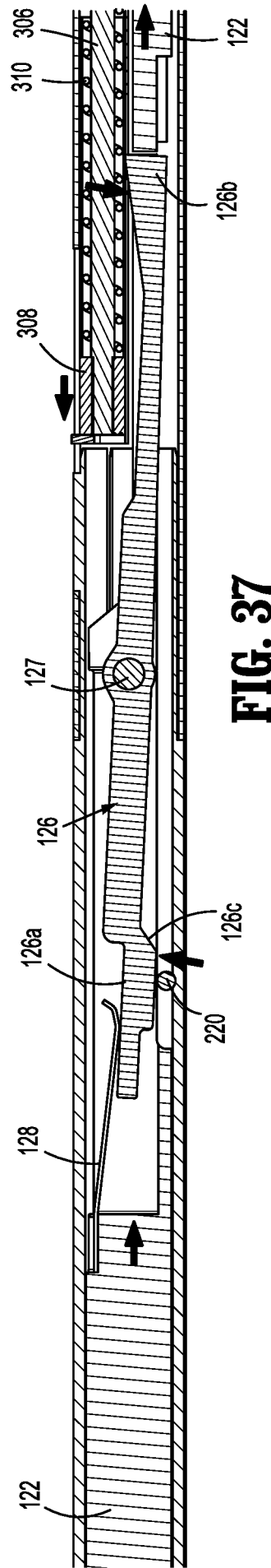
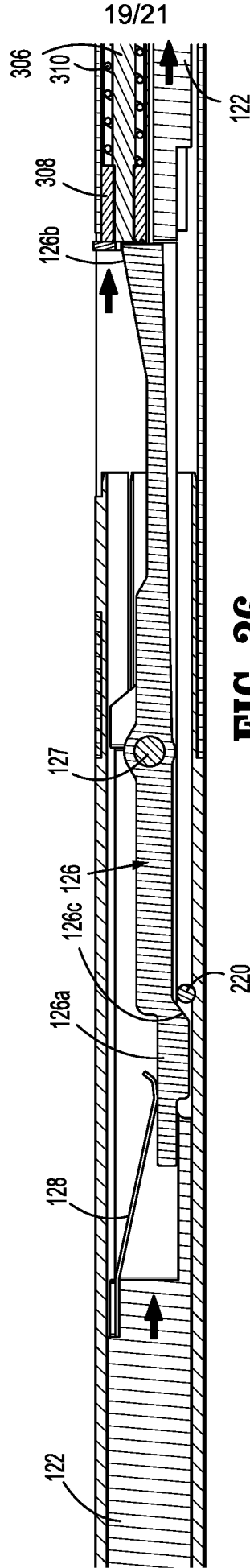
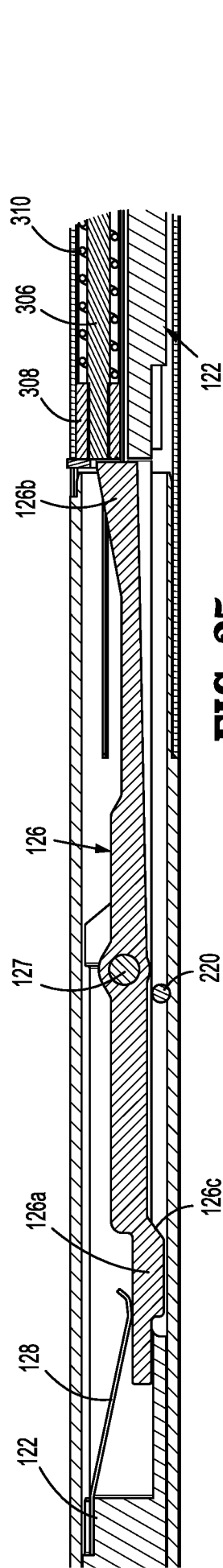


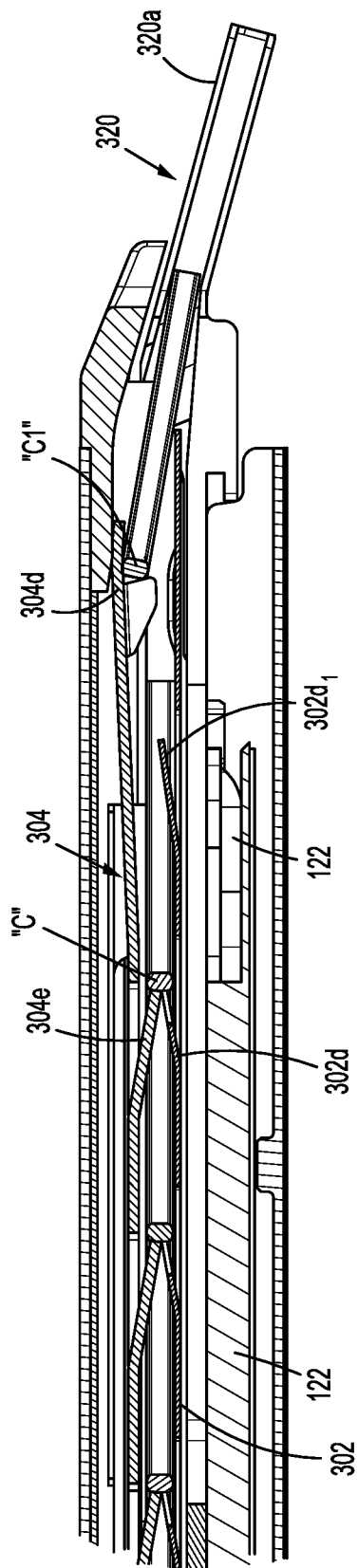
**FIG. 31**



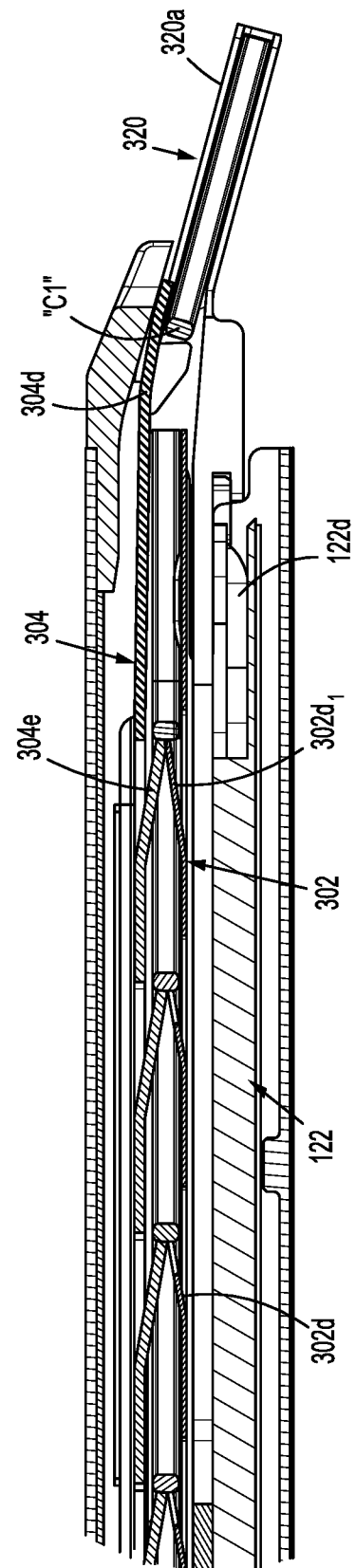
**FIG. 32**





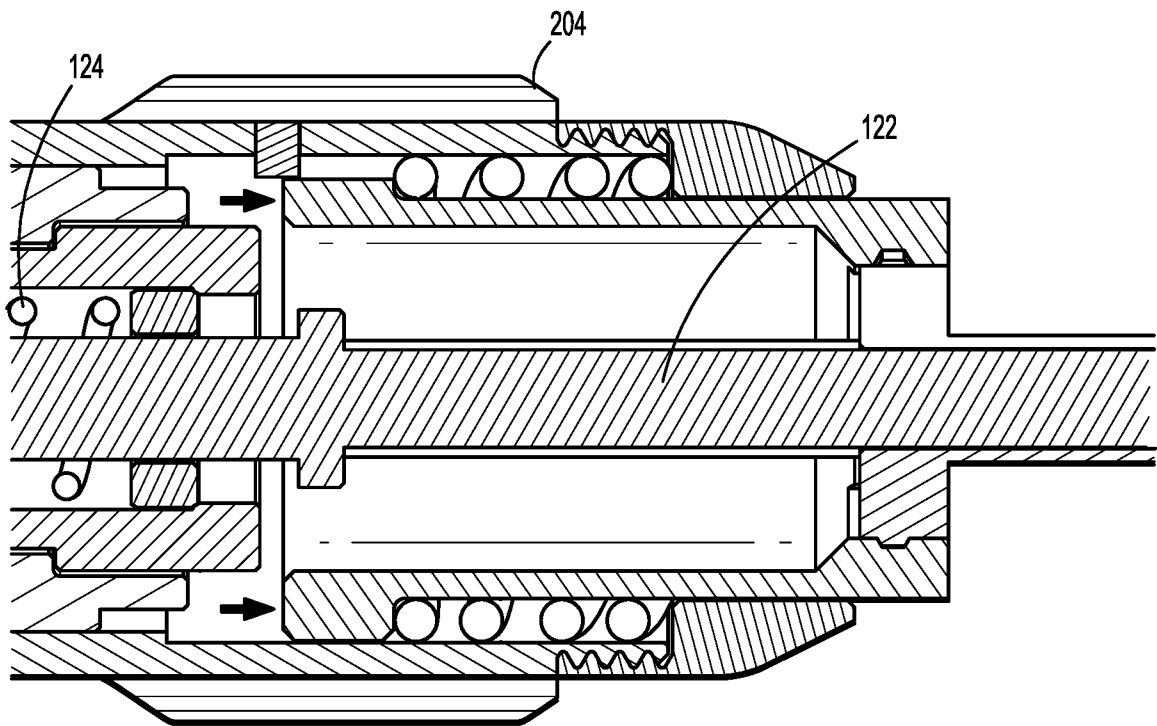


**FIG. 38**



**FIG. 39**

21/21



**FIG. 40**

## INTERNATIONAL SEARCH REPORT

International application No.

**PCT/CN2015/081214****A. CLASSIFICATION OF SUBJECT MATTER**

A61B 17/128(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)

EPODOC, WPI, CNPAT: RESTERILIZE, REUSEABLE, REUSED, REMOVABLE, DISPOSABLE, CLIP, ROCKER, TRIP LEVER, TRIGGER, CARTRIDGE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                    | Relevant to claim No. |
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Date of the actual completion of the international search

**29 February 2016**

Date of mailing of the international search report

**07 March 2016**

Name and mailing address of the ISA/CN

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Authorized officer

**WANG,Rui**

Facsimile No. (86-10)62019451

Telephone No. (86-10)62414320

**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2015/081214**

| Patent document<br>cited in search report |            |    | Publication date<br>(day/month/year) | Patent family member(s) |            |    | Publication date<br>(day/month/year) |
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|                                           |            |    |                                      | CA                      | 2679523    | A1 | 02 October 2008                      |
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|                                           |            |    |                                      | US                      | 2013190779 | A1 | 25 July 2013                         |
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|                                           |            |    |                                      | AU                      | 2011200388 | A1 | 08 September 2011                    |
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|                                           |            |    |                                      | CN                      | 102166129  | B  | 25 March 2015                        |
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|                                           |            |    |                                      | JP                      | 2015119980 | A  | 02 July 2015                         |
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| US                                        | 5700271    | A  | 23 December 1997                     | AU                      | 7032896    | A  | 24 April 1997                        |
|                                           |            |    |                                      | JP                      | 3242338    | B2 | 25 December 2001                     |
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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.

**PCT/CN2015/081214**

| Patent document<br>cited in search report |         |   | Publication date<br>(day/month/year) | Patent family member(s) |             | Publication date<br>(day/month/year) |
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|                                           |         |   |                                      | EP                      | 1317905 A3  | 26 November 2003                     |
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|                                           |         |   |                                      | EP                      | 0793944 B1  | 08 September 1999                    |
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