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(73) Proprietor: **Miret Surgical, Inc.**
Elmhurst IL 60126 (US)

(72) Inventors:
• **PELL, Christopher**
San Francisco, California 94117 (US)
• **ROOP, John**
Oak Park, Illinois 60302 (US)

• **DUGGAN, Bryan**
San Fransisco, California 94117 (US)

(74) Representative: **Boult Wade Tennant LLP**
5th Floor, Salisbury Square House
8, Salisbury Square
London EC4Y 8AP (GB)

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Description

TECHNICAL FIELD

[0001] The disclosed surgical devices, systems, and methods relate generally to performing surgery, e.g., laparoscopic surgery, and more particularly, to laparoscopic surgical tools and to systems and methods including such tools.

BACKGROUND

[0002] Surgery has become increasingly less invasive thanks to advances in medical technology. Laparoscopy is the dominant minimally invasive surgical (MIS) approach used today and has replaced many traditional "open" approaches.

[0003] Minimally Invasive Surgery (MIS) offers several advantages compared to open surgical procedures including minimal trauma to the abdominal wall and hence less postoperative pain, fewer wound complications, earlier patient mobilization, and shorter length of stay. Laparoscopic access to the peritoneal space is the dominant MIS approach when performing minimally invasive abdominal operations.

[0004] Recent clinical studies show that further reduction of the size and/or number of incisions may offer added benefits such as faster recovery, less pain, reduced operative time, and improved cosmetic result. Such benefits may have physical and psychological impact. However, the size of the tool tips on conventional instruments used in laparoscopic procedures generally limit the ability to reduce the size of the incisions and trocars needed for such procedures.

[0005] Single-port surgery involves a multi-channel port that is typically placed in the belly button. This results in a hidden post-operative scar. Through these channels, standard laparoscopic tools can be inserted. However, manipulation is more challenging because the tight aperture of the belly button and strong connective tissue in the abdominal wall forces all the instruments to move dependent on one another. In addition, the surgeon's hands are crowded together because of these constraints. Triangulation is largely lost. This makes the procedure frustrating and often more time consuming to perform compared to other approaches.

[0006] A number of commercially available tools have been designed to circumvent some of these limitations. Some are variations of standard laparoscopic instruments but have articulating toolheads. Such designs are intended for re-enabling triangulation. However, constraints of the belly button port may force these articulating tools to cross, thus reversing the left-right motion between what the surgeon does with his hands and what he sees on the video monitor. Also, the complex mechanics behind the articulation may drive the cost up significantly.

[0007] US 2008/287926 A1 discloses a multi-purpose

minimally invasive instrument. This document discloses a medical introduction system, comprising an elongate trocar tube, a laparoscope, an introduction component configured to be positioned through the trocar, an end effector operably coupled to a distal end of the introduction tube, wherein the introduction component is configured to allow the introduction component and laparoscope to be introduced through the trocar simultaneously and a handle tool configured to be positioned through a separate entry site, the handle tool comprising: a control shaft configured to be coupleable to the end effector.

[0008] US 2003/130559 A1 discloses an anoscope for use with a medical instrument

[0009] There is a need in the art for improved laparoscopic tools and techniques.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a perspective view of one example of a surgical device.

FIG. 2 is a side view of another example of a surgical device showing multiple possible end effectors.

FIG. 3A is a perspective exploded view of a clip applicator end effector comprising a plurality of deformable clips according to one example.

FIG. 3B is a perspective exploded view of a grasper end effector according to one example.

FIG. 3C is a perspective exploded view of a hemolock jaw end effector according to one example.

FIG. 4A is an exploded perspective view of one example of the handle of a device.

FIG. 4B is an exploded perspective view of an alternate example of the handle of a device.

FIG. 5A is a perspective view of a cannula being inserted into an end effector, wherein the cannula has a visual indicator for assisting insertion, according to one example.

FIG. 5B is a perspective view of a cannula being inserted into an end effector, wherein the cannula has a visual indicator for assisting insertion, according to one example.

FIG. 5C is a perspective view of a cannula being inserted into an end effector, wherein the cannula has a visual indicator for assisting insertion, according to one example.

FIG. 5D is a perspective view of a cannula being inserted into an end effector, wherein the cannula has a visual indicator for assisting insertion, according to one example.

FIG. 5E is a perspective view of a cannula being inserted into an end effector, wherein the cannula has a visual indicator for assisting insertion, according to one example.

FIG. 6 depicts various perspective views of examples of a surgical device comprising a cannula locking mechanism further having a visual indicator.

FIG. 7A depicts a perspective front view of a cannula guide cap having a locking ring, according to one example.

FIG. 7B depicts a perspective front view of a cannula guide cap having a locking ring and visual indicator, according to one example.

FIG. 7C depicts a perspective front view of a cannula guide cap having a locking ring and visual indicator, according to an alternative example.

FIG. 7D depicts a front perspective view of the surgical device showing a colored locking ring, not fully inserted and fully inserted, according to an example.

FIG. 8A depicts a cross-sectional view of the locking ring further comprising an integral detent in operational communication with the end effector integral housing, as is depicted elsewhere in relation to FIGS. 3A-3B.

FIG. 8B depicts a further front perspective view of the surgical device further comprising a slot free design, according to certain implementations.

FIG. 9A depicts various exploded views of various examples and implementations of the surgical device which address improvements to the drive mechanism.

FIG. 9B depicts various exploded views of various examples and implementations of the surgical device which address improvements to the drive mechanism.

FIG. 9C depicts various exploded views of various examples and implementations of the surgical device which address improvements to the drive mechanism.

FIG. 9D shows an implementation of the surgical device comprising a non-tubular actuating link design.

FIG. 10A depicts top and side views of a prior art surgical device.

FIG. 10B depicts examples of the surgical device having sterilizable improvements to the end effector and access ports in the housing for comparison with the views of FIG. 10A.

FIG. 11A depicts various views of certain implementations of the surgical device comprising further improvements in the introduction process embodied in improved introducers, according to one example.

FIG. 1BA depicts various views of certain implementations of the surgical device comprising further improvements in the introduction process embodied in improved introducers, according to one example.

FIG. 12A depicts a side view of an example of the handleset according to one implementation.

FIG. 12B depicts a side view of an example of the handleset according to one implementation.

FIG. 13 depicts a cross-sectional view of the handleset in an "overthrow" position, according to an example.

FIG. 14A depicts a cross-sectional view of an example of the handleset in the "closed" position.

FIG. 14B depicts a cross-sectional view of an exam-

ple of the handleset in the "open" position.

FIG. 14C depicts a cross-sectional view of an example of the handleset in the "overthrow" position.

FIG. 15A depicts a side-view of an example of the handleset according to one implementation wherein the toggle switch is in a down position.

FIG. 15A depicts a cross sectional view of an example of the handleset according to one implementation wherein the toggle switch is in a down position.

FIG. 16A depicts a cross-sectional end of the cannula tip according to one example, wherein the tip is in the closed position.

FIG. 16B depicts a cross-sectional end of the cannula tip according to one example, wherein the tip is in the open position.

FIG. 16C depicts a cross-sectional end of the cannula tip according to one example, wherein the tip is in the overthrow position.

FIG. 16D depicts a cross-sectional end of the cannula tip according to one example, wherein the tip has returned to the closed the position.

FIG. 17A depicts a side view of the perpetration for insertion of the introduction device into a trocar, according to one example.

FIG. 17B depicts a side view of the insertion of the introduction device into a trocar, according to the example of FIG. 17B.

FIG. 18A shows a perspective cutaway view of the insertion of FIG. 17B.

FIG. 18B shows a perspective cutaway view of the rotation of the camera and introduction device relative to the trocar, according to the example of FIG. 17A.

FIG. 18C depicts a perspective cutaway view of the example of FIG. 18B, wherein the end effector is moving relative to the force of gravity.

FIG. 19 depicts a perspective cutaway view of the camera and introduction device having been returned to their original orientation, according to one example of the system.

FIG. 20 depicts a perspective cutaway view of an embodiment of the system with the scope displaced and the beveled end of the scope oriented in the direction of the desired entry site of a handle tool.

FIG. 21A shows a side view of the insertion of a cannula shaft for mating with an end effector, according to an embodiment.

FIG. 21A shows a further side view of the insertion of a cannula shaft for mating with an end effector, according to an embodiment.

FIG. 22A depicts a perspective view of the camera and proximal operation handle operating with the introduction device, according to one example.

FIG. 22B depicts a perspective view of the camera and proximal operation handle in mid-rotation, according to one example.

FIG. 22C depicts a perspective view of the camera and proximal operation handle following rotation rel-

ative to the camera, according to one example.

FIG. 23A shows a side view of the insertion of a cannula shaft for mating with an end effector, wherein the camera shaft is in a deflected position, according to an embodiment.

FIG. 23B shows a further side view of the insertion of a cannula shaft for mating with an end effector, according to the embodiment of FIG. 23A.

FIG. 23C shows a side view of the successful mating of the cannula shaft with an end effector, wherein the camera shaft is in a deflected position, according to the embodiment of FIG. 23A.

FIG. 23D shows a further side view of the embodiment of FIG. 23A, wherein the camera shaft has been rotated.

FIG. 23E shows a further side view of the embodiment of FIG. 23A, wherein the camera shaft has been returned to a coaxial position.

FIG. 23F shows a further side view of the embodiment of FIG. 23E, wherein the camera shaft has been extended distally through the end effector region.

FIG. 24A depicts a perspective view of a grasper capable of holding a plurality of clips on its proximal portion for retrieval by a second surgical device having a clip applier, according to an example of the surgical system.

FIG. 24B depicts a perspective view of the clip applier initiating coupling with a clip from the clip storage portion of the first end effector, according to the example of FIG. 24A.

FIG. 24C depicts a perspective view of the clip applier fully coupling with a clip from the clip storage portion of the first end effector, according to the example of FIG. 24A.

FIG. 24D depicts a perspective view of the clip applier withdrawing with a clip from the clip storage portion of the first end effector, according to the example of FIG. 24A.

FIG. 24E depicts a perspective view of the clip applier fully withdrawn with a clip from the clip storage portion of the first end effector, according to the example of FIG. 24A.

FIG. 25A depicts a perspective view of the clip applier approaching a target location, according to an example of the surgical system.

FIG. 25B depicts a perspective view of the clip applier of FIG. 25A substantially surrounding a target location, according to an example of the surgical system.

FIG. 25C depicts a perspective view of the clip applier of FIG. 25A applying a clip to a target location, according to an example of the surgical system.

FIG. 25D depicts a perspective view of the clip applier of FIG. 25A opening the applier jaws and leaving the applied clip, according to an example of the surgical system.

FIG. 25E depicts a perspective view of the clip applier of FIG. 25A withdrawing from the affixed clip, according to an example of the surgical system.

FIG. 26A shows an exterior perspective view of the surgical device comprising a single use, reloadable clip applier, according to one example.

FIG. 26B shows an interior top-view view of the surgical device comprising a single use, reloadable clip applier, according to one example.

FIG. 26C shows an interior perspective view of the surgical device comprising a single use, reloadable clip applier, according to the example of FIG. 26A.

FIG. 27A depicts a perspective view of the surgical device comprising a single use, reloadable clip applier approaching a target location, according to an example of the surgical system.

FIG. 27B depicts a perspective view of the clip applier of FIG. 27A loading a clip into the jaws, according to an example.

FIG. 27C depicts a perspective view of the clip applier of FIG. 27A loading a clip into the jaws, according to an example.

FIG. 27E depicts a perspective view of the clip applier of FIG. 27A applying a clip to a target location, according to an example of the surgical system.

FIG. 27F depicts a perspective view of the clip applier of FIG. 27A opening the applier jaws and leaving the applied clip, according to an example of the surgical system.

FIG. 27G depicts a perspective view of the clip applier of FIG. 27A withdrawing from the affixed clip and reloading the jaws, according to an example of the surgical system.

FIG. 28A depicts an interior top-view of an example of the system comprising a single use, reloadable clip applier in the closed position.

FIG. 28B depicts an interior top-view of an example of the system comprising a single use, reloadable clip applier wherein the advancement slide is moving forward.

FIG. 28C depicts an interior top-view of an example of the system comprising a single use, reloadable clip applier wherein the clip has reached the distal end of the jaws.

FIG. 28D depicts an interior top-view of an example of the system comprising a single use, reloadable clip applier wherein the advancement slide has begun to retract.

FIG. 28E depicts an interior top-view of an example of the system comprising a single use, reloadable clip applier during reloading of a subsequent clip.

FIG. 29A depicts a top view of an example of the system comprising a single use, reloadable clip applier further comprising clip tabs, wherein the jaws are open.

FIG. 29B is a side-view of the example of FIG. 29A, wherein the jaws are open.

FIG. 29C depicts a top view of an example of the system comprising a single use, reloadable clip applier further comprising clip tabs, wherein the jaws are closed.

FIG. 29D is a side-view of the example of FIG. 29B, wherein the jaws are closed.

FIG. 30A is a side-view of an example of a Hemo-Lock clip.

FIG. 30B is a perspective view of a Hemo-Lock clip.

FIG. 31A is a perspective view of one example of a clip applier end effector with open jaws and comprising an open Hemo-Lock clip.

FIG. 31B is a perspective view of one example of a clip applier end effector with substantially closed jaws and comprising an unlocked Hemo-Lock clip.

FIG. 31C is a perspective view of one example of a clip applier end effector with substantially closed jaws and comprising an unlocked Hemo-Lock clip wherein the locking ring has been engaged.

FIG. 31D is a perspective view of the example of FIG. 31C, wherein a cannula has been inserted into the end effector.

FIG. 32A is a perspective view of one example of a clip applier end effector with open jaws and comprising an open Hemo-Lock clip approaching a target site.

FIG. 32B is a perspective view of one example of a clip applier end effector with substantially closed jaws around the target site and comprising and locked Hemo-Lock clip on the target site.

FIG. 32C is a perspective view of the end effector of FIG. 32B, wherein the jaws have opened and the Hemo-Lock clip remains locked on the target site.

FIG. 32D is a perspective view of the example of FIG. 32C, wherein the end effector is being retracted from the target site.

SUMMARY

[0011] A medical introduction system according to the present invention is provided according to claim 1.

[0012] The disclosed surgical device is directed to apparatus, systems, and methods for performing surgery, e.g., laparoscopic surgery. More particularly, the disclosed surgical device is directed to laparoscopic surgical tools and to systems and methods including such tools, e.g., designed to facilitate surgery while minimizing the number and/or size of access sites used and/or minimizing visible scars.

[0013] The present disclosure relates to methods and equipment necessary to perform an elective surgical procedure to remove the gall bladder (Laparoscopic Cholecystectomy) with no visible scarring to the patient. The systems, methods and devices described here achieve a no-scar result by using detachable instruments that result in only a needle point puncture through the abdomen.

DETAILED DESCRIPTION

[0014] The various systems and devices disclosed herein relate to devices for use in medical procedures and systems. More specifically, various examples relate

to various medical devices, including laparoscopic and endoscopic devices and related methods and systems.

[0015] It is understood that the various examples of the disclosed devices and related methods and systems disclosed herein can be incorporated into or used with any other known medical devices, systems, and methods.

[0016] For example, the various examples disclosed herein may be incorporated into or used with any of the medical devices and systems disclosed in copending international Applications WO 2010/114634 A1, published on 7 October 2010 and entitled "*Surgical Device And Method*," and WO 2012/112622 A2, published on 23 August 2012 and entitled "*Apparatus, Systems, and Methods for Performing Laparoscopic Surgery*".

[0017] Certain device and system implementations disclosed in the applications listed above can be positioned into a body cavity of a patient in combination with a support component similar to those disclosed herein.

[0018] Existing scar-free options are often complex, frustrating and time consuming for surgeons. These disadvantages limit the user base of surgeons as most surgeons are not willing to sacrifice time, potential complications and frustration. Therefore, for a scar-free surgical system to be successful, ease-of-use must be addressed.

[0019] As described elsewhere in our previous applications, a modular system that attaches a standard sized toolhead to a narrow shafted handleset across the abdominal wall at any desired point can preserve the triangulation and visualization surgeons are used to and because the toolhead is of a standard size, the manipulations and forces available to the surgeon are comparable. In summation, once the tools are built the surgeon can proceed like a standard laparoscopic procedure. This means that the only non-standard parts of the procedure are the toolhead attachment and/or removal process and addressing more complex procedure that require specialized tools. A principle aspect of the present disclosure relates to making these processes and tools as easy to use as possible. Improving the user experience can be done through the simple addition of haptic and or visual indicators to make the current state of the tool readily apparent to the operator and help eliminate uncertainty in the assembly or operational steps.

[0020] Further, making the system more durable and easier to clean will make it more suitable for a wider range of procedures and facility ecosystems, alleviating concern from the user.

[0021] By adding simple and ergonomic controls to the handleset used to properly align the internal attachment features can help the surgeon more quickly and effectively maintain the proper positioning of the handle during attachment/detachment.

[0022] Introducing the toolhead with the laparoscopic device (also referred to herein as a "scope") through a single port eliminates the need for a second port, further reducing the number of ports required and freeing up the

surgical space near the scope insertion point. By providing an introduction tool that holds the toolhead and the laparoscopic device in a controlled manner the proper visualization and positioning can be provided with minimal effort on the surgeon.

[0023] Complex procedures require specialized tools. One of the most commonly required complex tools is a clip applier to provide ligation. Due to the limitations in toolhead size associated with a modular system, certain clips cannot be provided in the standard laparoscopic way so alternative means must be offered to provide the surgeon with the tools they need. Accordingly, the presently disclosed systems, methods and apparatus aim to provide substantial improvements to the art.

[0024] Turning to the figures in detail, FIGS. 1-32D illustrate examples of various laparoscopic and endoscopic surgical devices and instruments. In endoscopic and laparoscopic surgical procedures, a trocar is used to puncture the patient's body in order to provide an access port through the abdominal wall to allow for the introduction of surgical instruments. A typical trocar requires a one centimeter incision. Typically, a first trocar is placed above the umbilicus to introduce a camera to allow the surgeons to view the surgical site. The camera view is projected on a screen outside the body, which the surgeon and his or her assistants watch in order to appropriately manipulate the instruments inside the body cavity. Additional trocars are used to introduce surgical instruments, such as grasping tools, scissors, clips, and electrosurgical instruments. Typically, the laparoscopic instruments extend toward the surgical target from either side of the video camera. This "triangulation" of the instruments provides the most ergonomic and intuitive set up for the surgeon.

[0025] The disclosed surgical devices relate to laparoscopic surgical tools designed to not leave a visible scar. These laparoscopic surgical tools generally comprise two categories, handle tools and laparoscopic devices (or "scopes"). Handle tools are comprised of a handle, a trans abdominal drive system and a toolhead/tip. The trans abdominal drive system is intended to transmit motion, energy, and/or data across a patient's body cavity wall without leaving a permanent scar. The trans abdominal drive system can be applied to laparoscopic surgical procedures including but not limited to appendix removal, gall bladder removal, hernia repair and uterus removal. Current laparoscopic tools require a port or trocar to be placed across the patient's body cavity wall. Said ports or trocars are large and leave a scar. The trans abdominal drive portion of the laparoscopic tool allows the surgeon to use laparoscopic tools across a body cavity wall without leaving a scar.

[0026] A modular surgical instrument that enables standard laparoscopic techniques through small puncture holes in the body wall and methods of using the same are disclosed. The assembled modular instrument has a handle, a small diameter needle-like cannular shaft (e.g., less than or equal to about 2.5mm diameter), and a tool-

head. The toolhead is initially inserted through a trocar port at a separate location (such as the umbilicus). This step relies on a secondary introducer device. The cannular shaft unit is actually two coaxial shafts that move relative to one another. It is pierced through the body wall into the body cavity. The cannular shaft attaches to the toolhead inside the body. The handle is attached to the external part of the cannular shaft. This step can be done before or after insertion of the cannular shaft into the body cavity. The toolhead or end effector is the attached to the cannular shaft and removed from the introducer tool. Once the modular instrument is fully assembled, the toolhead is manipulatable through the puncture hole at any desired site. There is a coaxial locking mechanism between the cannular shaft and the toolhead that locks both the external shaft and the internal "active" shaft. The locking mechanism utilizes a series of channels and keyways so that the tool tip is fully constrained to the cannular shaft with redundant locking for toolhead retention. The toolhead can only be unlocked from the cannular shaft using a complementary/corresponding component attached to an introducer or remover device tool. The toolhead may have a variety of forms and functions, selected by the operator specifically for the task relevant to the procedure. The mechanisms used to drive the toolhead may be simple mechanical (e.g., through coaxial movement), powered (e.g., torquing power drill), energized (e.g., electrocautery), pneumatized (e.g., vacuum suction), or combinations thereof.

[0027] The disclosed devices, systems and methods relate to improved surgical devices, systems and methods which relate to improvements relating to both handleset tools 1 (such as that in FIG. 1) and scopes 2 (discussed in relation to FIGS. 11A-B and 17A-23F). FIG. 1 depicts an example of a handle device 1 comprising an end effector 100, a cannula or control shaft 200 and a handleset 300. Introduction of the cannula 200 into the abdomen is well-established in the art. The distal end of the cannula adjacent to the handleset can have a twist control knob 312. Rotating the twist control knob 312 can calibrate and/or attach and lock, or detach and unlock the end effector 100 from the control shaft 200 (e.g., and concurrently attach and lock the end effector 100), and/or rotate the tool 100 during use. In certain examples, the handleset 300 is in operational communication with the cannula 200 and end effector 100 so as to actuate the end effector, as described elsewhere herein.

[0028] As shown in FIG. 2, examples of one aspect of the system comprise a handle tool device further comprising an end effector 100, a cannula shaft 200, and handleset 300. An example of a surgical device showing multiple optional end effectors 100 is depicted in FIG. 2. FIG. 2 depicts the various end effectors 100, including (from top to bottom) a metal clip applier 102, a grasper 104, and a hemo-lock clip applier 106, each of which may be fitted as the end effector 100 depending on the configuration desired.

[0029] FIG. 3A shows an exploded view of an example

of one aspect of a surgical device comprising a clip applier end effector assembly 102. In this implementation, the clip applier 102 comprises a housing 110, a plurality of deformable clips 150 (use of which is described further herein in relation to FIGS. 24A-25E), a cannula guide cap further having a clip rack 160, a clip applier jaw 120, an actuating link 130, and a locking ring 140.

[0030] Various examples of the surgical device grasper end effector assembly 104 are represented in FIG. 3B. In these examples, the surgical device comprises an integral housing 110, an actuating link 130, a locking ring 140, first and second grasper jaws 122, 123, and a cannula guide cap 162. In certain examples, and as shown in FIGS. 3B-3C, a mounting pin is also provided for connection of the housing and jaws 122 and 123 such that they can pivot around the pin.

[0031] FIG. 3C shows various examples of the surgical device in an exploded view of the hemo-lock end effector assembly 106, use of which is described in detail herein in relation to FIGS. 30A-32D). In these examples, the surgical device comprises an integral housing 110, an actuating link 130, a locking ring 140, a cannula guide cap 162. This example further comprises a hemo-lock jaw 124 and a hemo-lock clip 159.

[0032] FIG. 4A depicts an exploded view of an exemplary implementation of the handleset 300. In this example, the surgical device further comprises a distal handle 302, a distal handle cover 304, a proximal handle 306, a proximal handle adjuster 308, a locking slide 310, a rotation knob 312, a detent spring 314, and a toggle switch 316. In these examples, a plurality of threaded fasteners 301 may be utilized to couple the distal handle 302 cover so as to partially surround the proximal handle 306 and rotation knob 312. In further examples, the rotation knob 312 also comprises multiple rotation knob portions 312A, 312B, coupled by one or more threaded fasteners 301. FIG. 4B depicts an alternate example of the handleset 300A, comprising an O-ring retainer 320 a threaded proximal rotation knob 322 and internally threaded distal rotation knob 324.

[0033] Examples of the surgical device and system comprise various tactile and visual systems to provide additional user stimuli and improve insertion. FIG. 5A-5E illustrate examples of the surgical device and system having improvements to the insertion of the control shaft-shown in this example as a cannula 200-into the end effector 100 for the surgical device. In certain prior art examples, alignment of the cannula 200 with the end effector could be difficult and cumbersome. In these examples, user frustration can be reduced by using visual and tactile indicators. In the example shown in FIG. 5A, a colored stripe 202 is used to clearly indicate to a user that the locking components are in the proper position and orientation. Such visual and tactile indicators can be used independently or in conjunction with each other. As is apparent to one of skill in the art, various examples are possible.

[0034] FIGS. 5B-5E depict further examples of the use

of visual indicators in the surgical device. In examples, the tip of the outer cannula shaft can be colored using paint, chemical or laser etching, anodization, or printing to create a colored section of the shaft that is only visible when the shaft is not fully seated in the end effector 14. FIG. 5B depicts a colored cannula tip 12A, prior to insertion into the end effector. FIG. 5D depicts the colored cannula tip having been fully inserted into the end effector 14. In another example, the entire outer cannula shaft can be colored or covered leaving the tip of the cannula shaft exposed as the base material. When the outer cannula needle is fully seated in the end effector, the exposed material is no longer visible. This coloring could be created using other functional components of the cannula assembly such as the insulation necessary for cautery applications. FIG. 5C depicts an example comprising a colored cannula needle 12B prior to insertion into the end effector 14, while FIG. 5E depicts the colored cannula needle 12B following insertion.

[0035] In further examples of the surgical device-as depicted in FIG. 6 - a locking mechanism is utilized to place the surgical device into a "locked state." This "locked state" may be utilized to convey to users of the surgical device that the inner cannula shaft 12C is correctly positioned relative to the outer cannula shaft 12F. In these examples, the end effector 14 (not shown) further comprises a locking ring 140 which rotates the inner cannula shaft 12C to engage an actuating link 130 (not shown). The only components that rotate during the locking action are the inner cannula shaft and locking ring (not pictured), so there are many locations where their orientation relative to the other components can be exploited to create a visual indicator. By adding alignment markings 12D to the inner cannula shaft and creating cut-outs 12E on the outer cannula shaft, in these examples, the relative rotation exposes distinct markings on the inner cannula shaft 12C. By way of example, the inner cannula shaft can have adjacent colored regions 12D with different colors such as red to represent "unlocked" and green to represent "locked." In certain examples, the locking ring is rotated to the locked position it reveals the green indicator and the red indicator when it is unlocked. In other examples, additional indication components can be attached to the inner or outer cannula. In alternate examples, the rotation between the inner and outer shaft components and proper orientation can be signaled to a user by way of a variety of devices, wherein said rotation can drive levers, turn wheels, or provide tactile or other feedback to the user with devices such as detents, create audible sounds, activate magnetic sensors, and other devices that could be used to signal that the inner shaft has been rotated to the correct position to begin tool operation.

[0036] In certain examples, the rotational position of a locking ring 140 communicates to the user the inner and outer cannula components are properly aligned, certain examples of which are depicted in FIG. 7A-7D. FIG. 7A depicts an implementation showing locked (A) and un-

locked (B) positions for the locking ring 140 and the cannula guide cap 162. FIG. 7B depicts an implementation showing an alignment line to show locking ring 140 position in locked (A) and unlocked (B) implementations. FIG. 7C depicts an implementation showing alignment line 141 on the introduction device in the unseated (A), seated (B) and seated and locked (C) positions for the locking ring 140. FIG. 7D depicts an implementation showing a colored locking ring 140, not fully inserted (A) and fully inserted (B). As such, in certain implementations, the rotation of the locking ring 140 relative to the integral housing and guide cap 162 is used as a visual indicator of rotation.

[0037] In further examples, the faces of the locking ring are colored or otherwise marked so as to be readily apparent to a user. In such examples, if the ring is in the unlocked state, the colored ring face is visible to the user. If the ring is in the locked position, the guide cap and integral housing act to cover the colored faces, thus obscuring the unlocked indication from view. A further example comprises alignment marks 141 festooned to the locking ring so as to align with accompanying marks on the integral housing and/or the guide cap. When the marks 141 are aligned, the user is made aware that the end effector is locked to the cannula assembly.

[0038] Because the times when knowledge of the relative alignment between the locking ring and integral housing or endcap correspond to the moments when the end effector is either being inserted or removed from the introduction device, the view of the locking ring 140 may be partially or completely blocked. To address this, a visual indicator 141 for the locking ring can be replaced by an indicator on the introduction device. In certain implementations, a certain number of possible orientations are given for the end effector in the introduction device. As is shown in FIG. 7C, by placing an identical number of visual indicators on the end effector and one or more on the introduction device, a user may be assured that at least one indicator combination can be used to assess the alignment of the locking ring 140 relative to the integral housing and/or the guide cap 162.

[0039] FIG. 8A depicts a side view of the locking ring 140 further comprising an integral detent 140A in operational communication with the end effector integral housing 110, as is depicted elsewhere in relation to FIGS. 3A-3B. In certain examples, user feedback can be enhanced and the locking mechanism further secured with the addition of a detent mechanism between the locking ring and the end effector assembly. The addition of an integral detent 140A provides a further tactile indicator for a user when locking the end effector assembly to the cannula shaft. It also increases the amount of force required to rotate the locking ring, making it more difficult for incidental contact with the locking ring to unlock the end effector assembly, thereby preventing "drift," or other unintentional rotation.

[0040] Because the rotational position of the inner shaft is matched to that of the locking ring 140 the same out-

come could be achieved by placing a detent feature between the inner and outer shafts such that when the end effector is engaged by the shafts and is rotated the detent feature "snaps" into place. Placement of the integral detent between the shafts also allows placement of the mechanism in the handle set, which may provide additional manufacturing space. The same detent could also be used to hold the shafts rotationally in the "unlocked" position which could reduce the time used to align the shafts when inserting the shafts into the end effector. In further or alternative examples the detent 140A could be replaced by a frictional element such as an O-ring. This would accomplish the "drift" prevention aspects by increasing the force needed to displace the shaft position but may not provide the same haptic feedback to the user.

[0041] Prior implementations of the surgical device locking mechanism converted linear motion between the inner and outer cannula shafts into rotational motion of the end effectors. However, certain examples of the locking mechanism of the current system involves transferring rotational motion in the inner shaft to an end effector or other device requiring rotational motion such as a rotational cutting tool. As shown in FIG. 8A, these examples of the locking mechanism are similar to the locking mechanism examples previously described herein, having a locking ring 140, or outer shaft that can be engaged to end effector via rotation or other described means. Because the rotation-rather than the linear position-of the inner shaft is being transmitted, the coupling between the inner shaft and the working tool may be engaged. By way of example, and described elsewhere herein, in certain examples the surgical device further comprises a clutch mechanism that translates the rotation from the face of a rotating shaft to that of another shaft that is connected to the end effector.

[0042] In certain implementations, the surgical device further comprises a slot free design, as is depicted in FIG. 8B. In these implementations, the interface between the locking ring 140 and the cannula guide cap 162 comprises a non-cylindrical locking ring 140B so as to create an overlap 140C between the locking ring 140B and the corresponding feature on the introduction device with the other components in the end effector assembly. In these examples, when the end effector is secured in the introduction device, the end effector is rotated to make it impossible for the end effector to slide out of the introduction device. When the end effector is rotated in the introduction device, the surfaces inside the introduction device align with the surfaces on the end effector to allow the end effector to move freely. In the latest prototype components, this can easily be accomplished with the substantially rectangular locking ring having rounded corners. In other examples other non-cylindrical shapes can be employed, as would be apparent to one of skill in the art.

[0043] FIGS. 9A-9C depict exploded views of various examples and implementations of the surgical device which address improvements to the drive mechanism

130. To address problems with stress failure in the actuating link observed in prior art devices, examples of the surgical device comprise an actuating link tooth 132 with an extended spine 132A that is welded into a hypodermic tube 134 that has a slot 134A that fits the spine. The tube 134 and tooth are welded together (as shown by 135) along the length of the spine 132A. As shown in FIG. 9A, in certain examples, the material used along the spine 132A is extremely thin and the available weld area is limited. By raising and increasing the thickness of the external spinal portion (132B) the spine is structurally more robust and the available weld area is increased, as is depicted at 137 in FIG. 9B. These examples require altering the actuating link such that deep channels 134 are made to correspond to the raised and thickened spine. As a by-product of this the spine 132 of the actuating link and the channel 134 of the actuating link begin to act as additional rotational alignment features for the actuating link, as would be apparent to one of skill in the art. In the example of FIG. 9C, as with FIG. 9A, the extended spine 132A is recessed 133, such that it is configured to fit into the hypodermic tube by way of a "key-hole" configuration, as is known in the art.

[0044] FIG. 9D shows an implementation of the surgical device comprising a non-tubular actuating link 130 design. In these examples, the actuating link tube is eliminated. Eliminating the actuating link tube greatly reduces the manufacturing effort required to make the actuating link because aligning and welding the actuating link is no longer be required. Additionally, the inner diameter of the integral housing can then be reduced to correspond to the outer diameter of the cannula needle. Reduction of the inner diameter of the integral housing allows for a reduction of the outer integral housing dimensions without compromising the material thickness.

[0045] FIGS. 10A-B show examples of the surgical device having sterilizable improvements to the end effector 110 and access ports in the housing. Reusable tools are increasingly attractive to medical facilities due to the cost sensitive point of care economics associated with them. As shown in FIG. 10A, the internal components of previous end effectors 110 may be difficult to access and clear of bioburden during the cleaning and re-sterilization process. As depicted in FIG. 10B, the present improvements to the end effector 110 housing allow for more access and greater ease of clearing bioburden. As is apparent in FIG. 10B, in these examples the surgical device has additional ports 110A, 110B in the end effector integral housing 110 to allow a cleaning agent to pass through to the inner components.

[0046] Certain implementations of the surgical device comprise further improvements in the introduction process embodied in improved introducers, as depicted in FIGS. 11A-11B. FIG. 11A depicts one example including an introduction device 450 and a laparoscopic device 454 having a camera (also referred to herein as a "scope" or "camera scope"), both of which are positioned through a trocar (also referred to as a "port") 452. That is, as

described in detail below, the introduction device 450 and camera scope 454 are configured such that both can fit through the trocar 452 and are sufficiently moveable in relation to each other while positioned through the trocar 452 to allow for performance of the desired surgical procedures as described herein.

[0047] Typically, fitting both a camera and a surgical device through a trocar forces surgeons to use a larger or multiple ports/trocars, which may inhibit motion and may cause collisions between the introduction and camera devices within the surgical cavity.

[0048] In contrast, the over camera introducer 450 implementation variously shown in FIG. 11A utilizes a single port/trocar 452 in the umbilicus for the camera scope 454 as well as the introduction device 450, thereby reducing the total number of ports required and reducing the complications inherent therein. To alleviate the various issues encountered by larger or multiple ports, the examples depicted in FIGS. 11A and 11B comprise an over-the-camera introducer 450 configured to allow a camera or laparoscopic device (such as camera scope 454) to pass through a trocar 452 of minimal size along with one or more toolheads while maintaining the ability to move both devices independently. In these embodiments, the introducer 450 is inserted into the trocar 452 and, as best shown in FIGS. 11A, 20, 22A-22C, and 23A-23C, comprises complementary slots, or receiving channels 450A, 450B which are defined within the introducer 450 and extend substantially past the opposing ends of the trocar 452. In these embodiments, the receiving slots 450A, 450B are configured so as to allow passage of the scope 454 through the center axis of the trocar 452 and to cradle the scope 454 when it is at the offset, rather than coaxial, position, as shown in detail in FIGS. 17A-21B. That is, the receiving slots 450A, 450B are configured to receive portions of the scope 454 when both the introducer 450 and scope 454 are positioned through the trocar 452. In such embodiments, these slots 450A, 450B are thus aligned to allow for the cylindrical camera scope tube 454A, 454B to be concentric or coaxial with the introduction device shaft 450, 450A, 450B and extend outwardly from the proximal 454A and distal 454B ends. In these applications, the scope tube 454 can deflect in plane with the introduction shaft 450, such that the scope 454 is coaxial with the introduction shaft 450 during introduction, and then be deflected during operation by the user during use.

[0049] In use, as further described in FIGS. 19-20, scope movement is constrained by the overlapping channels 450A, 450B and the diameter of the trocar 452. In certain embodiments, the openings 452A, 452B on opposite sides of the shaft 452 allow the camera scope 454 to be rotated about a moving point in the central shaft of the introducer 450 at the location wherein the slots 450A, 450B are connected. In various embodiments, the length of the overlap between the two slots 450A, 450B determines how the range of motion wherein the introduction device 450 can translate in and out of the trocar 452 when

the camera shaft 454 and introduction device 450 are not concentrically aligned. The camera 454 and the introduction device 450 can be moved completely independently of each other, with the camera 454 movement primarily limited by contact with the trocar 452 and introduction device channels 450A, 450B.

[0050] Certain further examples of the surgical device comprise additional improvements to further address constrained introducer and camera orientations. Certain prior art examples require that the rotational, axial and separation orientations for the introduction device, laparoscopic device, and camera all be controlled and maintained simultaneously by the user. Implementing a system that can selectively alleviate such constraints can reduce the operator burden and simplify surgical procedures. The system of FIG. 11A maintains the vertical plane of the camera view with that of the introducer shaft 450. Thereby the primary axis of both camera and scope is maintained such that the scope can be displaced from the introducer shaft in a controlled fashion. In various examples, the scope may also be controllably rotated relative to the camera view to change the orientation of the scope bevel, changing the angle of the camera view. Thus, in these implementations, the entire system is designed so that it can be placed through a single trocar.

[0051] According to another example, depicted from various perspectives in FIG. 11B, the surgical device comprises a deformable introduction device 460 similar to the over-the-camera example described in reference to FIG. 11A. In these examples, the deformable introduction device 460 is configured to accommodate a camera and scope and reduce the size of the port required to accommodate both devices. It is understood that in these examples, the deformable introduction device can be substituted for other introduction devices described herein. In these examples of the introduction device may further comprise an interface which supports the end effector assembly at one end, and a handle assembly to allow the manipulation of the device from the exterior of the patient, as described variously elsewhere herein. In these examples, the tube of the introduction device has a region 462 designed to be selectively deformed away from the central axis of the introducer by the application of user force. In examples, deformation is only possible in a designated direction as a means of reducing errors. When the introduction device 460 is inserted and the end effector is presented into the body, the compliant portion of the introduction device tube is deformed to move the end effector assembly away from the camera and the centerline of the introduction device. This offset between the camera and the end effector creates the triangulation necessary for a surgeon to perceive depth and to reposition the end effector easily.

[0052] FIGS. 12A-15B show various examples of the handleset 300 that provide the operator with the ability to place and hold the locking features of the inner and outer cannula shafts in the "alignment position" or "closed position" as shown in FIG. 16A-16D. In these examples,

and by way of reference, the surgical device further comprises a distal handle 302, a distal handle cover 304, a proximal handle 306, a proximal handle adjuster 308, a locking slide 310, a rotation knob 312, a detent spring 314, and a toggle switch 316.

[0053] Certain examples of the surgical device have an "alignment position" or "closed position," described further herein and depicted in FIGS. 16A-16D. In examples in this position, (or "state"), the distal channel features of the inner (or "active") cannula shaft 1000 and the outer cannular shaft 1002 ("cannula shaft") correspond to the position of the engaging features of the end effector 100. In these states, the control shaft can be engaged properly to the end effector 100. If the distal channel features of the inner and outer shafts are not in the proper alignment engagement between the control shaft and the end effector can be difficult or possibly damaging to the interfacing components. Therefore it is important that the "alignment position" be easily and reliably achieved and maintained.

[0054] FIGS. 12A and 12B show a side view of the handle assembly various configurations. FIG. 12A depicts the handle in the "closed" position (designated with reference letter A, and shown in the end effector in FIG. 16A). In this position, the distal end of the active shaft 1000 is aligned with the distal end of the outer shaft 1002. FIG. 12B depicts the "open" position (designated with B, shown in FIG. 16B, wherein the active shaft 1000 slides distally relative to, and extends beyond the outer shaft 1002). FIGS. 12C and 12D show a cross-sectional view of the handleset assembly in the same states.

[0055] With the toggle switch 316 in the "up" position the proximal handle 306 is free to move from the "open" position to through the "alignment position" to the "over-throw position" (best shown in FIG. 13 and 14C) where the end of the inner shaft is displaced further inward relative to that of the outer shaft, as shown in FIG. 16C. The "over-throw position" allows for additional grip force in the handleset 300.

[0056] In the "alignment position", the groove features of the distal tip of the inner shaft 1000 are once again aligned with that of cannula shaft 1002 (as shown in FIG. 16D) and the toggle switch 316 (or part within the mechanism, such as the slide lock) can be engaged by a spring detent, providing tactile resistance to being repositioned and maintaining the position set by the user, as described in relation to FIG. 16A-16D. In certain examples, the handle need not be placed into the alignment position for the toggle switch to be operated.

[0057] The proximal handle 306 can be adjustably attached to an alignment component 308, as shown in FIGS. 14A-14C (wherein the proximal handle is removed). FIGS. 14A-14C show the alignment component in the "closed" (FIG. 14A), "open" (FIG. 14B) and "over-throw" (FIG. 14C) positions respectively.

[0058] When the user switches the toggle switch from the "up" position to the "down" position it actuates the alignment slide 310 and forces the proximal handle 306

to move to the state that puts the inner and outer shaft in the "overthrow position" (as best shown in FIG. 15B). In operation, while the toggle switch 316 is in the "down" position, and the proximal handle is constrained in the "alignment position."

[0059] The toggle switch 316 or internal alignment features of the handle set can also engage an elastic detent feature 314 to provide additional haptic feedback to the user and help maintain one of the two toggle states.

[0060] FIGS. 17A-17B depict the placement of a scope surgical device 2 according to an example. In these examples, the scope shaft 454A, 454B is introduced by way of a novel introducer shaft 450, as described in relation to FIGS. 11A-11B. As discussed herein in relation to FIG. 11A, it is a principle object of the system to provide an introduction system which allows the user to align the scope/camera and surgical tools inside the cavity of a patient. Critically, in exemplary embodiments of the system, the scope is introduced in such a way as to be easily positionable at the distal scope end by way of the proximal handle to increase the ease of placement and otherwise facilitate the ease of the procedure. In certain embodiments, the distal scope end further comprises a bezel, though that is in no way necessary for the function of the device.

[0061] In exemplary embodiments of the surgical system, the axis of the scope 454 and the camera 464 are independently rotatable around the axis so as to orient the bezel freely about the horizon of the camera for directed viewing. In certain embodiments, the rotation of the scope and camera can be fixed so as to maintain that orientation during rotation of the camera. As shown in FIGS. 18A-18C, rotating the entire assembly (by rotating the camera 464 - designated by reference letter A) orients the introducer shaft 450 such that the end effector 100 is free to rotate around the axis of the tool holder due to gravity or other external force (designated by reference arrow B). Rotating the assembly back to the original orientation completes the deployment of the end effector, as is shown in FIG. 19. As is shown in FIG. 18C, upon completed deployment, the end effector 100 may be capable of axis movement relative to the introducer shaft 450. This is described further in reference to FIGS. 19.

[0062] As shown in FIG. 19-20, releasing the connection 470 between the introducer shaft 450 and the camera 464 allows the end of the scope 454A to be axially deflected or displaced (shown by reference letter D), relative to the introducer shaft 450A. Re-fixing the connection in the new position 470A then maintains the displaced orientation. As shown in FIG. 20, with the scope displaced and the beveled end 170 of the scope oriented in the direction of the desired entry site 160, the insertion of the cannula shaft 200 can be monitored by the user in the theater of operation, as is depicted by the cone labeled E.

[0063] FIG. 20 also depicts an implementation further comprising an alignment indicator 202 on the cannula shaft 200 as well as a visual indicator 202A on the introduction shaft 450. The process of engaging the toolhead

with a cannula shaft and removing it from the introducer is eased when the central axis of the cannula is in the rotational plane of the tool holder. In exemplary embodiments, this can be achieved if the introducer shaft 450 is rotated so that the tool holder rotation plane is pointing towards the insertion point 160 of the cannula shaft. A visual indicator 202A on the proximal portion of the introducer shaft 450 is thus used to provide this indication.

[0064] Once the cannula 200 has been inserted the bevel 170 of the scope can be reoriented to face the end cap of the end effector by releasing the connection between the camera and the scope and re-securing it in the rotated position as shown in FIGS. 21A-22D. These figures also show the scope being used to "spot" the insertion of the cannula shaft through the abdominal wall to ensure that nothing is obstructing the insertion.

[0065] As shown in FIGS. 22A-23F, in certain embodiments, the orientation of the scope angle can be manually rotated (designated with reference letter C), by manual rotation of the proximal operation handle 151. In certain embodiments this operation handle is in the form of a ring, as shown, however other embodiments are possible. In certain embodiments, the surgical device further comprises a rotation guide 153. In yet further embodiments, the rotation guide further comprises detent stops 153A, 153B, which allow the user tactile feedback as to the position and/or locking of the scope angle. Certain embodiments of the surgical device comprise a light source attachment 154, as is well-established in the art.

[0066] The rotation of the proximal operation handle 151 is in operational and rotational communication with the scope shaft such that the distal scope bezel 170 may be oriented toward the cannula guide cap 162, as is shown for example in FIG. 23B. With the scope bezel 170 pointing towards the cannula guide cap 162 the insertion of the cannula point into the guide cap can be monitored and proper toolhead engagement 180 can be confirmed.

[0067] Once the toolhead has been successfully removed, the connection between the introduction handle and camera holder can be loosened and the scope 454 can be repositioned so that is once again coaxial with the introducer shaft 450, the motion of which is shown as reference arrow F in FIGS. 23E. The introducer shaft 450 can then be retracted or otherwise positioned along the scope. The distal end of the scope 454A is configured such that it may be accommodated through the tool holder such that the camera view 170 may be unobstructed, as is shown in FIG. 23F. Re-securing the connection between the introduction shaft and the camera holder allows the procedure to proceed in the "standard" fashion.

[0068] FIGS. 24A-32B depict various examples relating to improvements to the end effector 100. In certain examples, the surgical device comprises a single use, reloadable clip applier 120A. In certain examples, the clip applier 120A may feature advanced energy designs, such as monopolar and bipolar cautery implementations, a bipolar jaw comprising an outer rim for sealing and an

inner rim for cutting. Certain of these examples further feature the use of a single use, reloadable clip.

[0069] FIG. 24A depicts an example of a grasper 104 that can hold a set of clips 150A on its proximal portion for retrieval by a second surgical device 100A having a clip applier 120A. This grasper 104 can be one that is used for another aspect of the procedure such as retracting the liver in a gallbladder removal procedure. FIGS. 24B-24E depict the clip applier end effector 100A that has already been engaged to its control shaft going from its starting "closed" position to "open" and picking up a clip 150A from the proximal portion of the first grasper 104.

[0070] FIGS. 25A-25E depict the clip applier end effector 120A in use on a vessel 111 show the clip applier 120A approaching a clip site 119 such as a vessel 111, closing and deforming the metal clip 150A around the vessel 111 to seal it and leaving it behind. This process can then be repeated to use the rest of the clips on the first grasper 104, as described herein in reference to FIGS. 24A-E.

[0071] FIGS. 26A-27G depict an exemplary implementation of the surgical device having a reloadable clip design 155. This example uses a limited number of clips in a side-by-side configuration 156 to conserve overall end effector length 157 because size is more constrained with a modular design, as is shown in FIG. 26A.

[0072] FIGS 26B-29D depict various implementations of the clip applier 155 opening, advancing the clip 150, closing (and deforming the clip (FIG. 27D) around the clip site 111A, leaving the clip behind and advancing the next clip to the "ready position." This process can then be repeated for the number of clips 150 in the device.

[0073] FIG. 28A-28E show a partial section view of the clip advancement process where after the clip has been closed around the desired site and left behind, the next clip advances into the usage position when the handle is fully opened, as depicted in FIG. 28E.

[0074] FIG. 28A depicts an example of the clip applier end effector 120A in the closed position. The closed position can be the initial introduction closed position or the closed position achieved after placing a clip. In these examples, when a user begins to open the handle the advancement slide 120B begins to move forward (FIG. 28B), thereby advancing the clip 120C distally, in the direction of the now open jaws. The advancement slide pushes the clip forward until the clip reaches the end of the jaws 120D (as depicted in FIGS. 27A and 28C). Once the user begins to close the handle the advancement slide begins to retract (as shown in FIG. 28D). When the advancement slide is fully retracted, the next clip 120E is free to shift to the side and seat into the advancement slide (as shown in FIG. 28E).

[0075] FIGS. 29A-29D depict various views of examples of the surgical device further comprising formed or machined tabs 159 to keep the deformable clips 150 in place when actuating the link and the clip advancer is moved proximally to close the jaws 158A, 158B.

[0076] FIG. 30A-32D depict various examples of the surgical device capable of using Hemo-Lock style clips 157. FIGS. 30A-30B show examples of the Hemo-Lock style clips, which are commercially available. In certain examples and embodiments of the surgical device and system, the clip adaptor jaws 120 can be adapted to accommodate the Hemo-Lock style clips 157. Certain procedures are ideally suited for medical clips that are made from an elastic material that "locks" 157A closed rather than being "crushed" or permanently deformed by the device. One example of this style of clip is the "Hemo-Lock" clip. Implementations of the surgical depicted in FIGS. 31A-32D are adapted to accommodate this style of clip 157.

[0077] FIG. 31A depicts a Hemo-Lock Clip 157 being inserted into the end effector wherein the jaws 120 are in the open position, and the locking ring 140 is in an locked position.

[0078] In the example of FIG. 31B, the jaws 120 are closed such that the clip is substantially, but not completely closed 157B, and therefore capable of returning to the open position if released. In certain examples, this closure can be either external or internal, for example if the end effector is attached to a cannular shaft. In certain implementations, this also coincides with the alignment position previously described in relation to FIGS. 16A-16D.

[0079] FIG. 31C further depicts an example wherein the toolhead is inserted into the patient with the jaws 120 in the substantially closed state 157B described above into an introduction device (as described in relation to FIGS. 19A-23F, for example). In the examples, the locking ring 140 is rotated as is shown into the locked position. In these implementations, the jaws 120 are thus now locked in the substantially but not completely closed position 157B due to the internal actuating link interacting with the locking ring 140, as described elsewhere herein. As such, the toolhead and jaws 120 are now ready to be introduced into the operation field.

[0080] FIG. 31D depicts a cannula shaft 200 which can then be inserted to unlock the toolhead from the introducer. The toolhead is now locked to the cannula shaft and the jaws have now been unlocked and are correspondingly ready to be opened so as to correspondingly open the Hemo-Lock clip 157 for use.

[0081] FIGS. 32A-32D depicts an example in which the toggle switch on the handleset (not shown, but described in relation to FIGS. 4A-4B and 12a-15B) is first placed in the "up" position allowing the handle, and thus the jaws 120 and Hemo-Lock clip 157, to be opened for ready application to the vessel 111 (FIG. 32A). In the example of FIG. 32B, the open jaws 120 can then be placed over the target clip site 111 and the action of the handleset may be activated so as to lock the Hemo-Lock clip 157A. In certain examples, the action of the handleset being closed fully closes the jaws as to lock the Hemo-Lock clip in the closed position. In these examples, as the toggle switch on the handle is in the "up" position the

handle and thus the jaws are permitted to go past the alignment position into the overthrow position. This fully closes the clip, activating it 157A.

[0082] As shown in FIGS. 32C-D, because the clip was fully closed 157A and activated it will remain closed when the jaws 120 are opened again, thus allowing the jaws 120 and toolhead to be retracted.

[0083] Some implementations of the surgical device feature a compliant cannula rotation knob. One issue observed in user testing results from users trying to force the rotation of the outer cannula shaft when the components are not properly aligned. This can damage some of the components without users knowing they are using the device incorrectly. Additionally, even if all of the components are properly aligned, users can attempt to over rotate the cannula shaft, leading to damage as well. To prevent both of these issues, we can create compliance between the knob users interact with and the outer cannula shaft that is engaging the end effector. To prevent damage to these components, the stiffness of the link between the knob and the cannula shaft is significantly less than the stiffness of the components in the end effector assembly. The difference in stiffness means that if a user tries to apply too much force, the knob will feel differently when a user is trying to rotate it when the components are misaligned or the lock is already fully rotated. This difference in feel can be honed to make it a useful feedback tool for the user.

[0084] In further examples, the compliant cannula can be combined or replaced with a clutch that prevents a user from applying a rotational force that could damage the components in the end effector assembly. This clutch action could be accompanied with an audible and tactile click to convey that the force a user is applying is excessive.

[0085] During use, the abdomen can be inflated with carbon dioxide to allow the surgeon more room to work with and maneuver laparoscopic tools. The control shaft can be 14 gauge. The control shaft can penetrate the skin of the abdomen, for example, leaving no scar (e.g., 14 gauge needles are considered to not leave a scar).

[0086] A rotating grasper or introducer rod with a rotating connection to the introducer can be used to handle, maneuver and deliver the tool into the abdominal cavity. The surgeon can use a drawstring to tighten or loosen the grasper, as well as an actuating mechanism to rotate the grasper.

[0087] The introducer rod and the tool can be inserted through a first access site at the umbilicus. The surgeon can use an endoscope to locate the end of the control shaft 12 within the abdomen and attach the tool to the control shaft.

[0088] The control shaft can have two slits configured to allow a tool to attach to the distal end of the control shaft. The tool can have spring-like locks that can insert into the two slits of the control shaft. The tool can be attached to the control shaft in the abdominal cavity.

[0089] Once the tool is attached to the control shaft,

the surgeon can use the control shaft and the tool as a laparoscopic tool. The control shaft can have an actuating rod (e.g., the inner sub-shaft) that can actuate the tool. For example, the actuating rod can slide a rack-and-pinion mechanism to open and close a grasper tool. The grasper tool can be spring-loaded so the inner sub-shaft can close the grasper when actuated.

[0090] Once the surgeon is finished with the tool, the surgeon can activate a sleeve within a needle that can release the spring locks from the slits on the control shaft. A rotation grasper can then remove the tool through the first access site.

[0091] Any or all elements of the device and/or other devices or apparatuses described herein can be made from, for example, a single or multiple stainless steel alloys, nickel titanium alloys (e.g., Nitinol), cobalt-chrome alloys (e.g., ELGILOY® from Elgin Specialty Metals, Elgin, IL; CONICHROME® from Carpenter Metals Corp., Wyomissing, PA), nickel cobalt alloys (e.g., MP35N® from Magellan Industrial Trading Company, Inc., Westport, CT), molybdenum alloys (e.g., molybdenum TZM alloy, for example as disclosed in International Pub. No. WO 03/082363 A2, published 9 October 2003), tungsten-rhenium alloys, for example, as disclosed in International Pub. No. WO 03/082363, polymers such as polyethylene terephthalate (PET), polyester (e.g., DACRON® from E. I. Du Pont de Nemours and Company, Wilmington, DE), poly ester amide (PEA), polypropylene, aromatic polyesters, such as liquid crystal polymers (e.g., Vectran, from Kuraray Co., Ltd., Tokyo, Japan), ultra-high molecular weight polyethylene (i.e., extended chain, high-modulus or high performance polyethylene) fiber and/or yarn (e.g., SPECTRA® Fiber and SPECTRA® Guard, from Honeywell International, Inc., Morris Township, NJ, or DYNEEMA® from Royal DSM N.V., Heerlen, the Netherlands), polytetrafluoroethylene (PTFE), expanded PTFE (ePTFE), polyether ketone (PEK), polyether ether ketone (PEEK), poly ether ketone ketone (PEKK) (also poly aryl ether ketone ketone), nylon, polyether-block copolyamide polymers (e.g., PEBAX® from ATOFINA, Paris, France), aliphatic polyether polyurethanes (e.g., TECOFLEX® from Thermedics Polymer Products, Wilmington, MA), polyvinyl chloride (PVC), polyurethane, thermoplastic, fluorinated ethylene propylene (FEP), absorbable or resorbable polymers such as polyglycolic acid (PGA), poly-L-glycolic acid (PLGA), polylactic acid (PLA), poly-L-lactic acid (PLLA), polycaprolactone (PCL), polyethyl acrylate (PEA), polydioxanone (PDS), and pseudo-polyamino tyrosine-based acids, extruded collagen, silicone, zinc, echogenic, radioactive, radiopaque materials, a biomaterial (e.g., cadaver tissue, collagen, allograft, autograft, xenograft, bone cement, morselized bone, osteogenic powder, beads of bone) any of the other materials listed herein or combinations thereof. Examples of radiopaque materials are barium sulfate, zinc oxide, titanium, stainless steel, nickel-titanium alloys, tantalum and gold.

[0092] While the retraction systems, in accordance

with the present disclosure, have been described as being used in connection with surgical procedures performed within the abdominal cavity, it is envisioned that the retraction systems disclosed may be used in other surgical procedures. It is understood that various modifications may be made to the embodiments of the presently disclosed surgical device and system. Therefore, the above description should not be construed as limiting, but merely illustrative of the variations described herein.

Claims

1. A medical introduction system, the system comprising:

(a) an elongate trocar tube (452) defining a trocar lumen;
 (b) an introduction component (450) constructed and arranged to be positioned through the trocar lumen, the introduction component (450) comprising:

- (i) an elongate introduction tube;
- (ii) a distal channel (450A) defined at a distal portion of the introduction tube;
- (iii) a proximal channel (450B) defined at a proximal portion of the introduction tube, wherein the proximal channel (450B) is disposed at substantially 180 degrees around the longitudinal axis of the introduction tube in relation to the distal channel (450A); and
- (iv) an end effector (100) operably coupled to a distal end of the introduction tube

(c) a laparoscope (454) constructed and arranged to be positioned through the trocar lumen with the introduction component, the laparoscope comprising:

- (i) an elongate laparoscope rod comprising distal and proximal ends (454A, 454B);
- (ii) a camera positioned at a proximal end (454B) of the elongate rod and further comprising a lens at the distal end of the laparoscope rod,

wherein the laparoscope rod is constructed and arranged to deflect between a coaxial position and an axially deflected position in relation to the introduction tube such that the laparoscope rod extends out of the distal and proximal channels (450A, 450B) in the axially deflected position, and

wherein the camera is constructed and arranged to rotate freely around a longitudinal axis of the laparoscope rod, whereby the lens can be oriented to capture a desired view;

(d) an adjustable locking mechanism operationally integrated with the introduction component (450) and laparoscope (454), wherein the adjustable locking mechanism is constructed and arranged to lock the laparoscope rod in the coaxial position or the axially deflected position; and

(e) a handle tool configured to be positioned through a separate entry site (160), the handle tool comprising:

- (i) a control shaft (200) configured to be coupleable to the end effector (100); and
- (ii) a handleset (300) configured to be in operational communication with the end effector (100) by way of the control shaft (200).

2. The medical introduction system of claim 1, further comprising a rotation guide (153) configured to regulate the rotation of the camera relative to the laparoscope rod.

3. The medical introduction system of claim 1, wherein the introduction component end effector (100) is configured to be able to be engaged by the handle tool.

4. The medical introduction system of claim 3, further comprising a visual indicator (141), wherein the end effector (100) further comprises a cannula guide cap (162).

5. The medical introduction system of claim 1, wherein the handle tool further comprises an end effector (100).

6. The medical introduction system of claim 5, wherein the handle tool end effector (100) is a clip applier (120A), wherein the clip applier (120A) further comprises a plurality of clips.

7. The medical introduction system of claim 5, wherein the end effector (100) is a grasper (104).

8. The medical introduction system of claim 5, wherein the grasper (104) further comprises a plurality of clips (150A) affixed at the proximal portion of the end effector (100).

9. The medical introduction system of claim 5, further comprising a rotation mechanism, wherein the laparoscope rod and camera are independently rotatable relative to one another by way of a proximal operation handle (151).

10. The medical introduction system of claim 1, wherein the introduction component (450) further comprises a camera attachment mechanism.

11. The medical introduction system of claim 1, wherein the handleset (300) comprises:

- (a) a proximal handle (306) configured to move between a closed position and an open position; 5
- (b) a distal handle (302);
- (c) a locking slide (310) operably coupled to the proximal handle (306);
- (d) a toggle switch (316) operably coupled to the locking slide (310); and 10
- (e) a rotation knob (312).

Patentansprüche

1. Medizinisches Einführungssystem, wobei das System Folgendes umfasst:

- (a) ein längliches Trokar-Rohr (452), das ein Trokar-Lumen definiert; 20
- (b) eine Einführungskomponente (450), die so konstruiert und angeordnet ist, dass sie durch das Trokar-Lumen positioniert werden kann, wobei die Einführungskomponente (450) Folgendes umfasst: 25

- (i) ein längliches Einführungsrohr; 30
- (ii) einen distalen Kanal (450A), der an einem distalen Abschnitt des Einführungsrohrs definiert ist;
- (iii) einen proximalen Kanal (450B), der an einem proximalen Abschnitt des Einführungsrohrs definiert ist, wobei der proximale Kanal (450B) im Wesentlichen bei 180 Grad um die Längsachse des Einführungsrohrs in Bezug auf den distalen Kanal (450A) angeordnet ist; und 35
- (iv) einen Endeffektor (100), der mit einem distalen Ende des Einführungsrohrs operabel gekoppelt ist 40

- (c) ein Laparoskop (454), das so konstruiert und angeordnet ist, um durch das Trokar-Lumen mit der Einführungskomponente positioniert zu werden, wobei das Laparoskop Folgendes umfasst: 45

- (i) einen länglichen Laparoskopstab, der distale und proximale Enden (454A, 454B) umfasst; 50
- (ii) eine Kamera, die an einem proximalen Ende (454B) des länglichen Stabes positioniert ist und ferner eine Linse am distalen Ende des Laparoskopstabes umfasst, 55

wobei der Laparoskopstab konstruiert und angeordnet ist, um zwischen einer coaxialen Position und einer axial abgelenkten Position in Be-

zug auf das Einführungsrohr so abzulenken, dass sich der Laparoskopstab aus den distalen und proximalen Kanälen (450A, 450B) in der axial abgelenkten Position heraus erstreckt, und wobei die Kamera so konstruiert und angeordnet ist, dass sie sich frei um eine Längsachse des Laparoskopstabes dreht, wodurch das Objektiv ausgerichtet werden kann, um eine gewünschte Ansicht zu erfassen; (d) einen einstellbaren Verriegelungsmechanismus, der mit der Einführungskomponente (450) und dem Laparoskop (454) operabel integriert ist, wobei der einstellbare Verriegelungsmechanismus konstruiert und angeordnet ist, um den Laparoskopstab in der coaxialen Position oder der axial abgelenkten Position zu verriegeln; und (e) ein Griffwerkzeug, das konfiguriert ist, um durch eine separate Eintrittsstelle (160) positioniert zu werden, wobei das Griffwerkzeug Folgendes umfasst:

- (i) eine Steuerwelle (200), die konfiguriert ist, um mit dem Endeffektor (100) koppelbar zu sein; und
- (ii) ein Griffsatz (300), der konfiguriert ist, um über die Steuerwelle (200) mit dem Endeffektor (100) in Betriebsverbindung zu stehen.

2. Medizinisches Einführungssystem nach Anspruch 1, ferner umfassend eine Drehführung (153), die konfiguriert ist, um die Drehung der Kamera in Bezug auf den Laparoskopstab zu regeln.
3. Medizinisches Einführungssystem nach Anspruch 1, wobei der Einführungskomponenten-Endeffektor (100) konfiguriert ist, um zum Eingreifen mit dem Griffwerkzeug in der Lage zu sein.
4. Medizinisches Einführungssystem nach Anspruch 3, ferner umfassend einen Sichtindikator (141), wobei der Endeffektor (100) ferner eine Kanülenführungsskappe (162) umfasst.
5. Medizinisches Einführungssystem nach Anspruch 1, wobei das Griffwerkzeug ferner einen Endeffektor (100) umfasst.
6. Medizinisches Einführungssystem nach Anspruch 5, wobei der Griffwerkzeug-Endeffektor (100) ein Klammerapplikator (120A) ist, wobei der Klammerapplikator (120A) ferner eine Vielzahl von Klammern umfasst.
7. Medizinisches Einführungssystem nach Anspruch 5, wobei der Endeffektor (100) ein Greifer (104) ist.

8. Medizinisches Einführungssystem nach Anspruch 5, wobei der Greifer (104) ferner eine Vielzahl von Klammern (150A) umfasst, die am proximalen Abschnitt des Endeffektors (100) befestigt sind.

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9. Medizinisches Einführungssystem nach Anspruch 5, ferner umfassend einen Drehmechanismus, wobei der Laparoskopstab und die Kamera unabhängig voneinander über einen proximalen Bediengriff (151) relativ zueinander drehbar sind.

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10. Medizinisches Einführungssystem nach Anspruch 1, wobei die Einführungskomponente (450) ferner einen Kamerabefestigungsmechanismus umfasst.

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11. Medizinisches Einführungssystem nach Anspruch 1, wobei der Griffsatz (300) Folgendes umfasst:

(a) einen proximalen Griff (306), der konfiguriert ist, um sich zwischen einer geschlossenen Position und einer offenen Position zu bewegen;

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(b) einen distalen Griff (302)

(c) einen Verriegelungsschlitten (310), der mit dem proximalen Griff (306) operabel gekoppelt ist;

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(d) einen Kippschalter (316), der mit dem Verriegelungsschlitten (310) operabel gekoppelt ist; und

(e) einen Drehknopf (312).

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Revendications

1. Système d'introduction médical, le système comprenant :

35

(a) un tube de trocart allongé (452) définissant une lumière de trocart ;

(b) un composant d'introduction (450) construit et agencé pour être positionné à travers la lumière de trocart, le composant d'introduction (450) comprenant :

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(i) un tube d'introduction allongé ;

(ii) un canal distal (450A) défini au niveau d'une partie distale du tube d'introduction ;

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(iii) un canal proximal (450B) défini au niveau d'une partie proximale du tube d'introduction, dans lequel le canal proximal (450B) est disposé sensiblement à 180 degrés autour de l'axe longitudinal du tube d'introduction par rapport au canal distal (450A) ; et

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(iv) un effecteur terminal (100) couplé de manière opérationnelle à une extrémité distale du tube d'introduction

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(c) un laparoscope (454) construit et agencé

pour être positionné à travers la lumière de trocart avec le composant d'introduction, le laparoscope comprenant :

(i) une tige de laparoscope allongée comprenant des extrémités distale et proximale (454A, 454B) ;

(ii) une caméra positionnée à une extrémité proximale (454B) de la tige allongée et comprenant en outre un objectif à l'extrémité distale de la tige de laparoscope,

dans lequel la tige de laparoscope est construite et agencée pour dévier entre une position coaxiale et une position déviée axialement par rapport au tube d'introduction de telle sorte que la tige de laparoscope s'étende hors des canaux distal et proximal (450A, 450B) dans la position déviée axialement, et

dans lequel la caméra est construite et agencée pour tourner librement autour d'un axe longitudinal de la tige de laparoscope, de sorte que l'objectif peut ainsi être orienté pour capturer une vue souhaitée ;

(d) un mécanisme de verrouillage ajustable intégré de manière opérationnelle au composant d'introduction (450) et au laparoscope (454), dans lequel le mécanisme de verrouillage réglable est construit et agencé pour verrouiller la tige de laparoscope dans la position coaxiale ou la position déviée axialement ; et

(e) un outil de manipulation configuré pour être positionné à travers un site d'entrée séparé (160), l'outil de manipulation comprenant :

(i) un arbre de commande (200) configuré pour pouvoir être couplé à l'effecteur terminal (100) ; et

(ii) un ensemble de poignées (300) configuré pour être en communication opérationnelle avec l'effecteur terminal (100) par l'intermédiaire de l'arbre de commande (200) .

2. Système d'introduction médical selon la revendication 1, comprenant en outre un guide de rotation (153) configuré pour réguler la rotation de la caméra par rapport à la tige de laparoscope.

3. Système d'introduction médical selon la revendication 1, dans lequel l'effecteur terminal de composant d'introduction (100) est configuré pour pouvoir être mis en prise par l'outil de manipulation.

4. Système d'introduction médical selon la revendication 3, comprenant en outre un indicateur visuel (141), dans lequel l'effecteur terminal (100) comprend en outre un capuchon de guidage de canule (162).

5. Système d'introduction médical selon la revendication 1, dans lequel l'outil de manipulation comprend en outre un effecteur terminal (100).
6. Système d'introduction médical selon la revendication 5, dans lequel l'effecteur terminal d'outil de manipulation (100) est un applicateur d'agrafes (120A), dans lequel l'applicateur d'agrafes (120A) comprend en outre une pluralité d'agrafes. 5
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7. Système d'introduction médical selon la revendication 5, dans lequel l'effecteur terminal (100) est une pince de préhension (104).
8. Système d'introduction médical selon la revendication 5, dans lequel la pince de préhension (104) comprend en outre une pluralité d'agrafes (150A) fixées à la partie proximale de l'effecteur terminal (100). 15
9. Système d'introduction médical selon la revendication 5, comprenant en outre un mécanisme de rotation, dans lequel la tige de laparoscope et la caméra peuvent tourner indépendamment l'une par rapport à l'autre au moyen d'une poignée d'actionnement proximale (151). 20
25
10. Système d'introduction médical selon la revendication 1, dans lequel le composant d'introduction (450) comprend en outre un mécanisme de fixation de caméra. 30
11. Système d'introduction médical selon la revendication 1, dans lequel l'ensemble de poignées (300) comprend : 35
 - (a) une poignée proximale (306) configurée pour se déplacer entre une position fermée et une position ouverte ;
 - (b) une poignée distale (302) ;
 - (c) un coulisseau de verrouillage (310) couplé de manière opérationnelle à la poignée proximale (306) ; 40
 - (d) un commutateur à bascule (316) couplé de manière opérationnelle au coulisseau de verrouillage (310) ; et 45
 - (e) une molette rotative (312).

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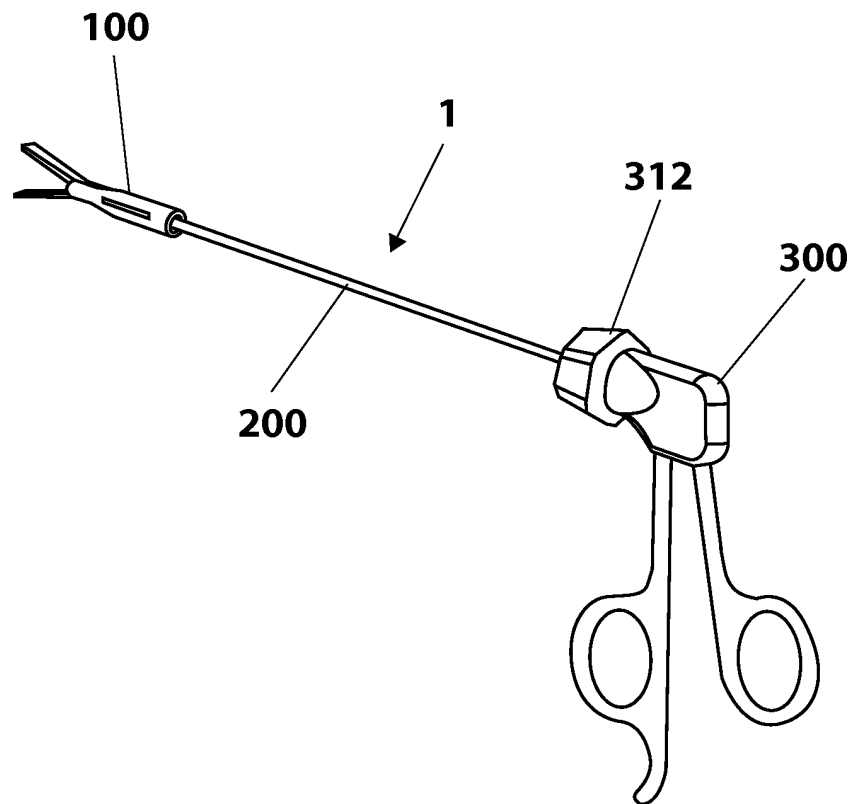


Figure 1

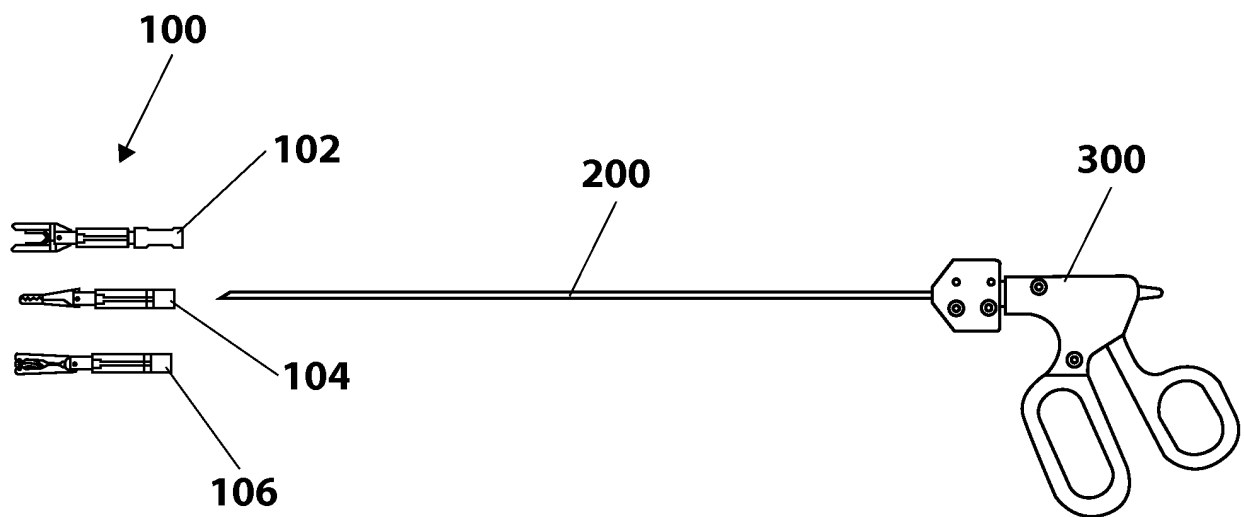


Figure 2

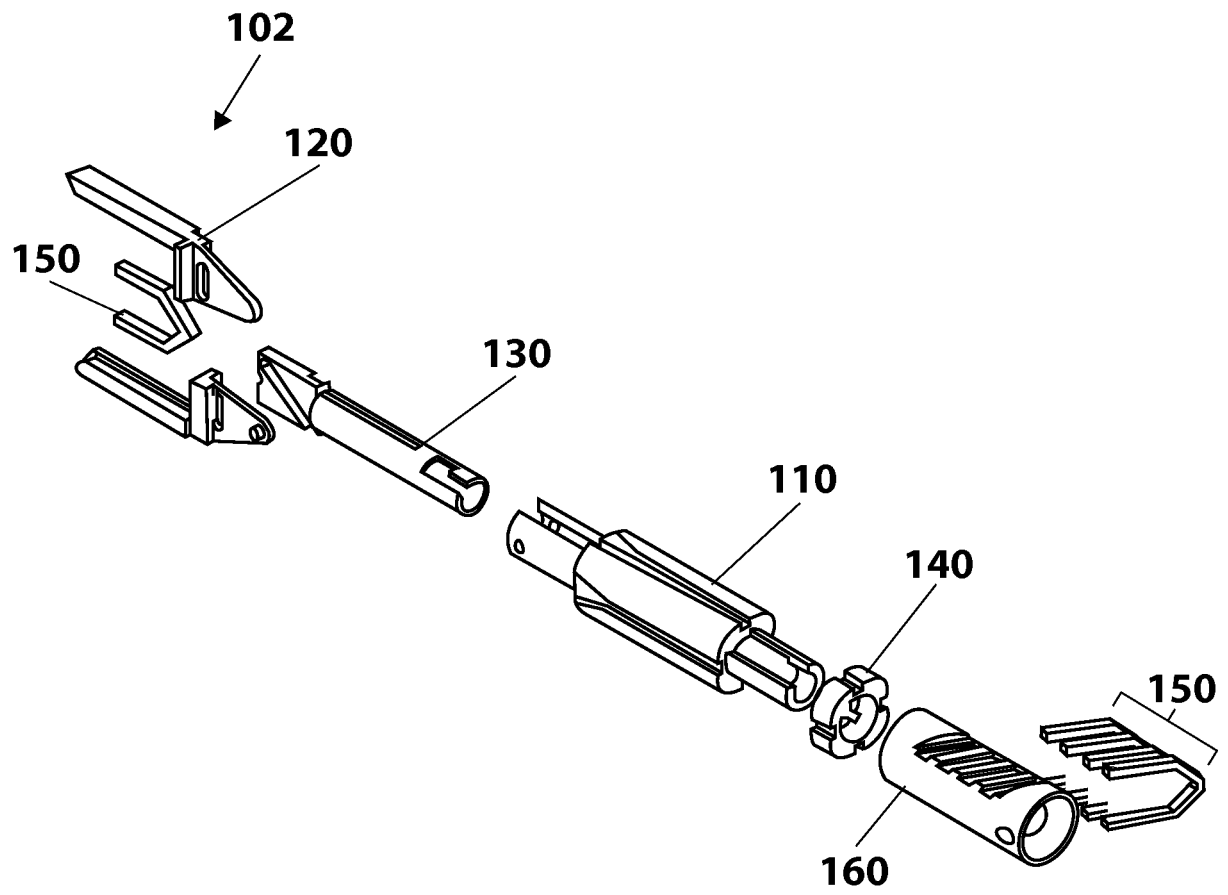


Figure 3A

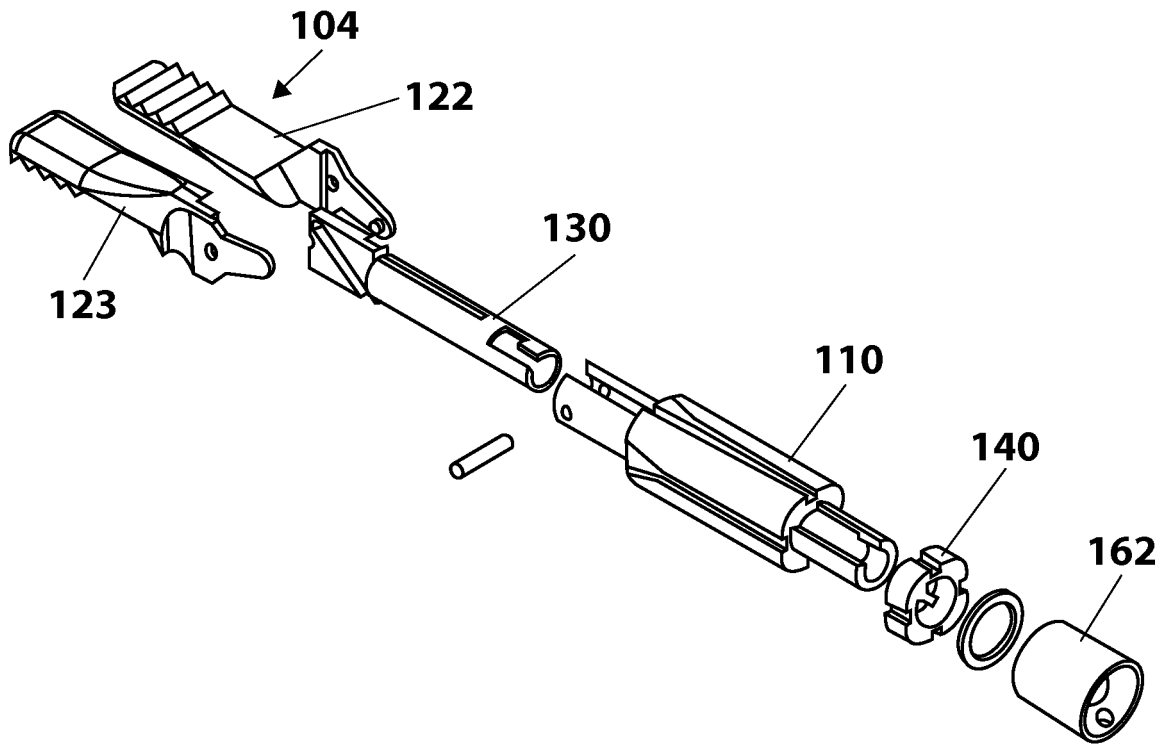


Figure 3B

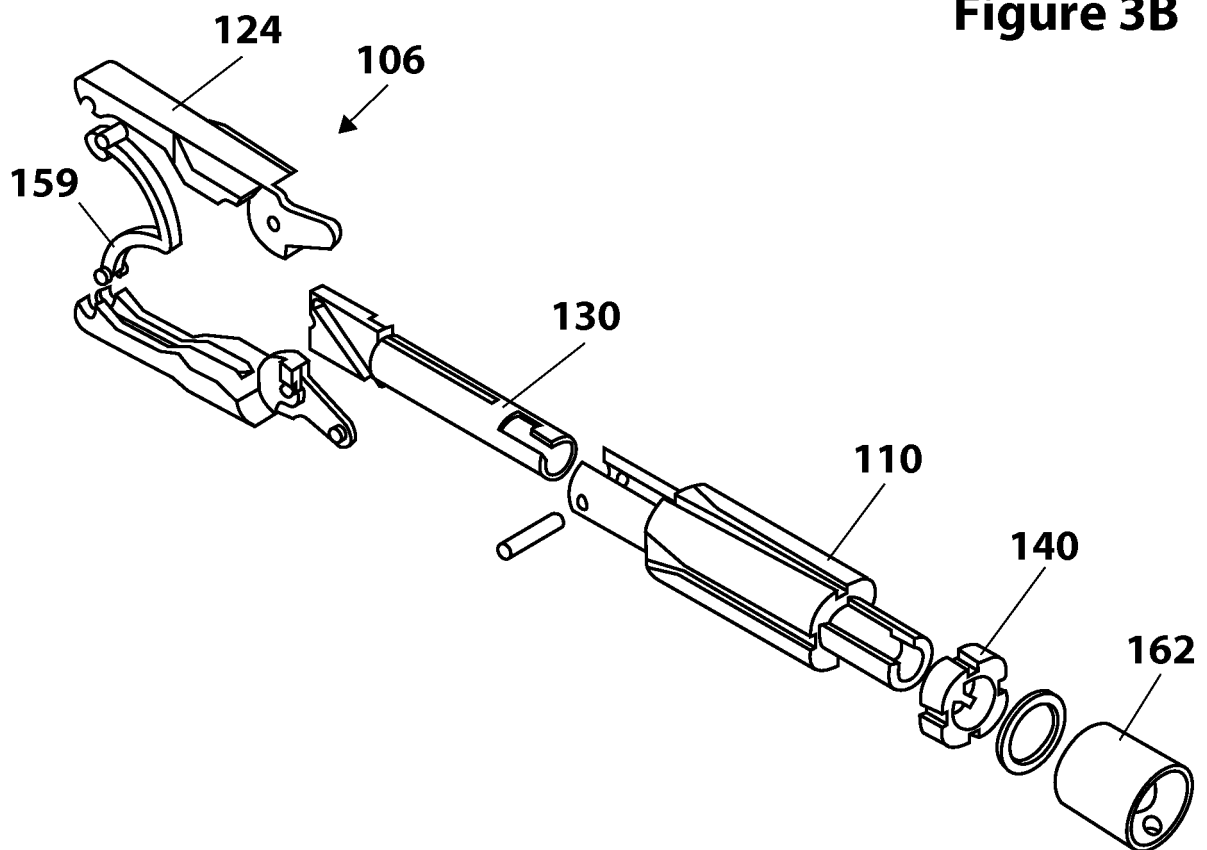


Figure 3C

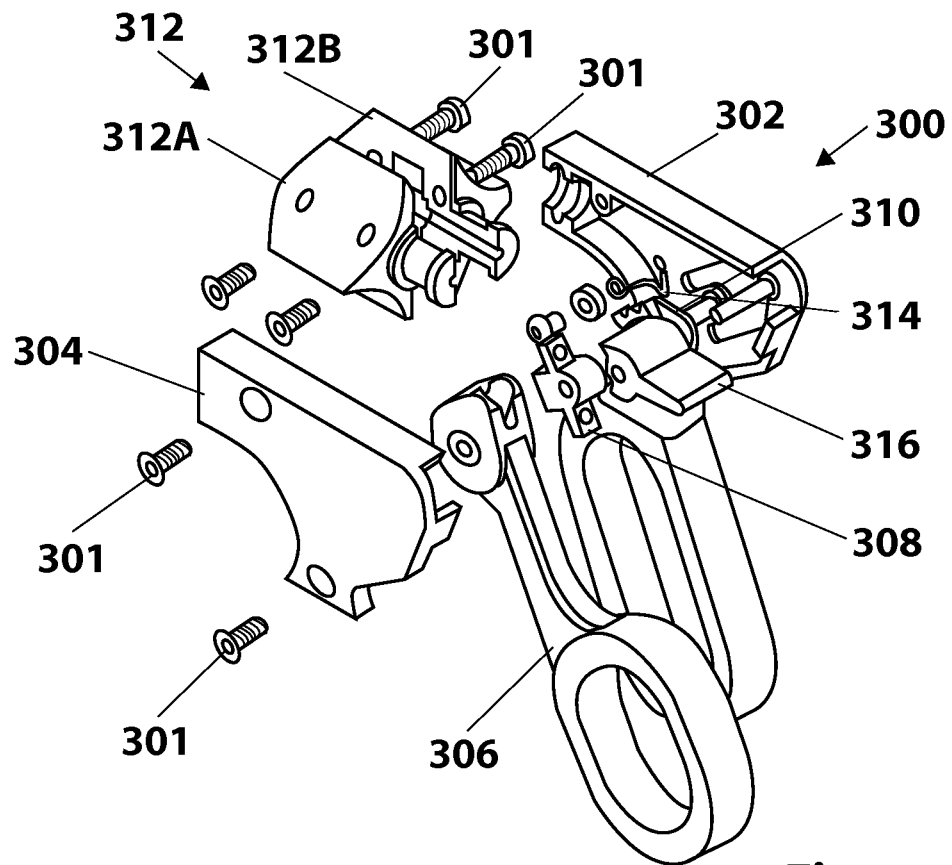


Figure 4A

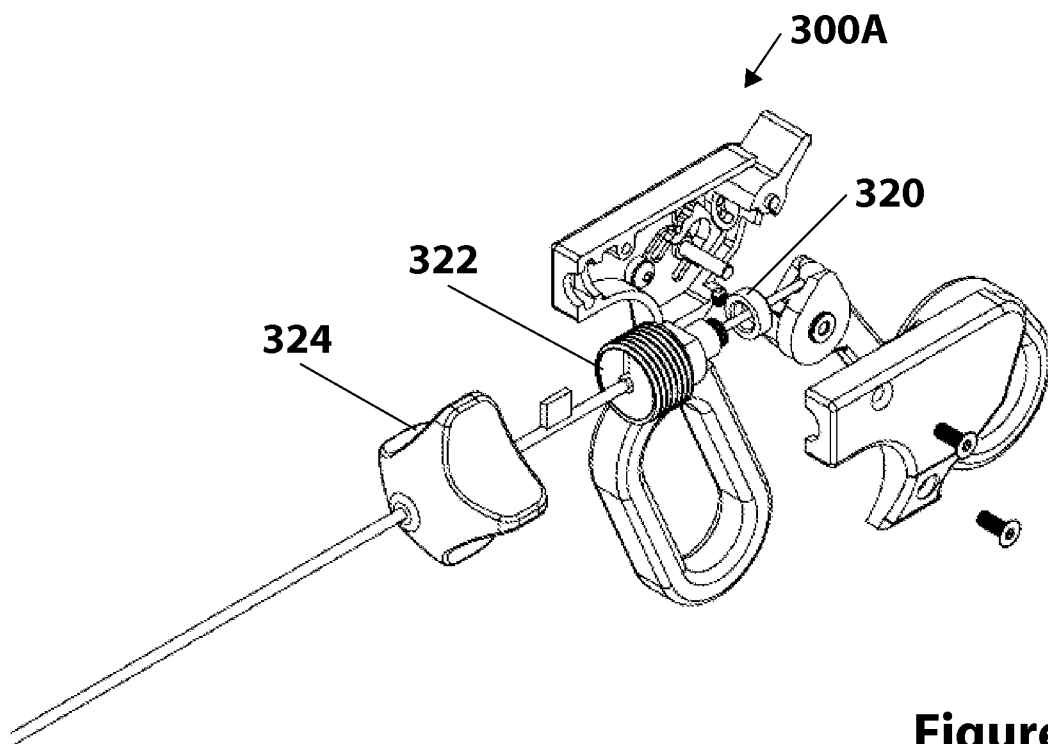


Figure 4B

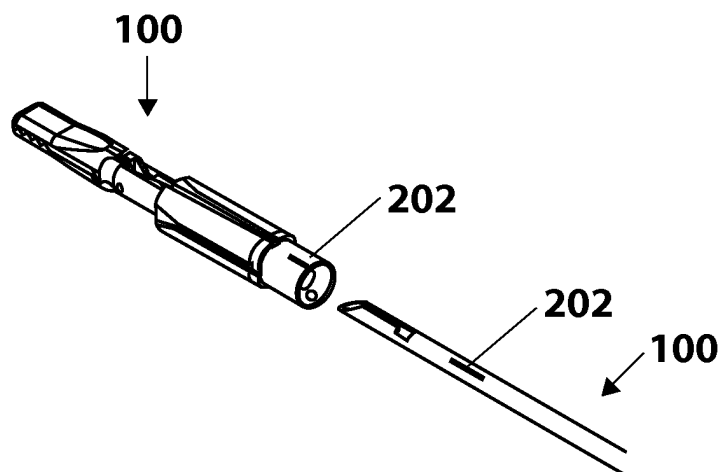


Figure 5A

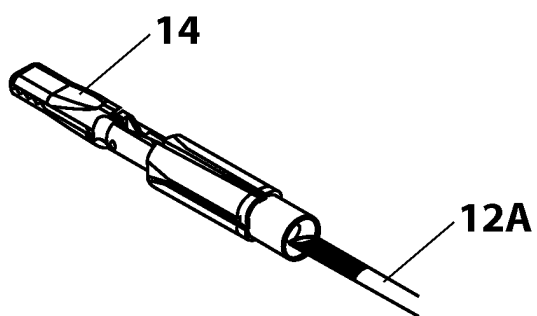


Figure 5B

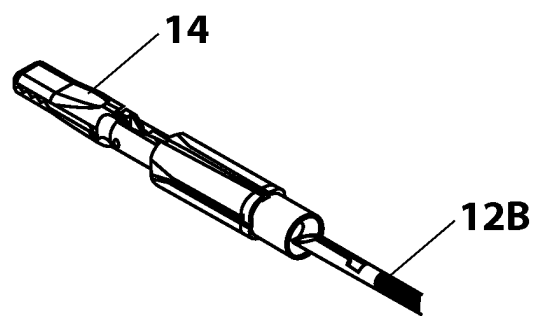


Figure 5C

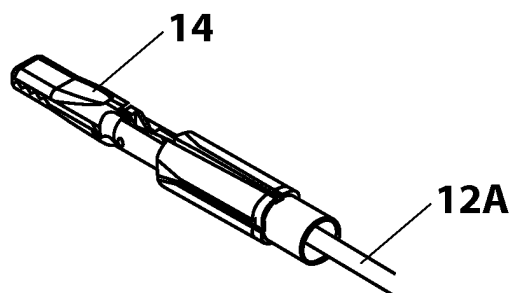


Figure 5D

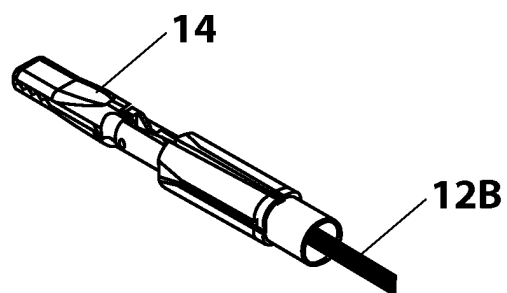


Figure 5E

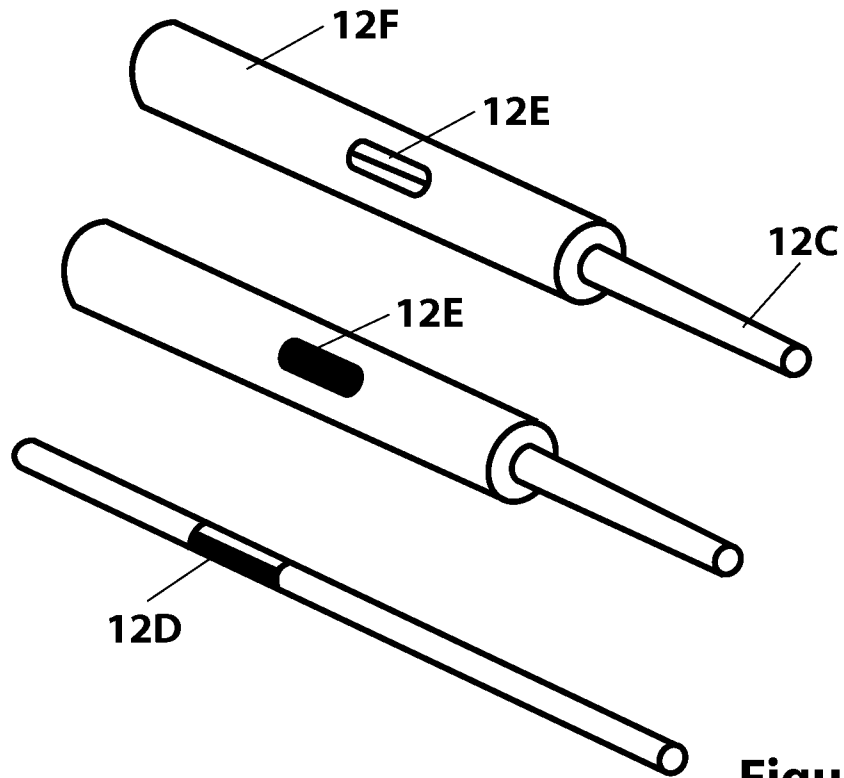


Figure 6

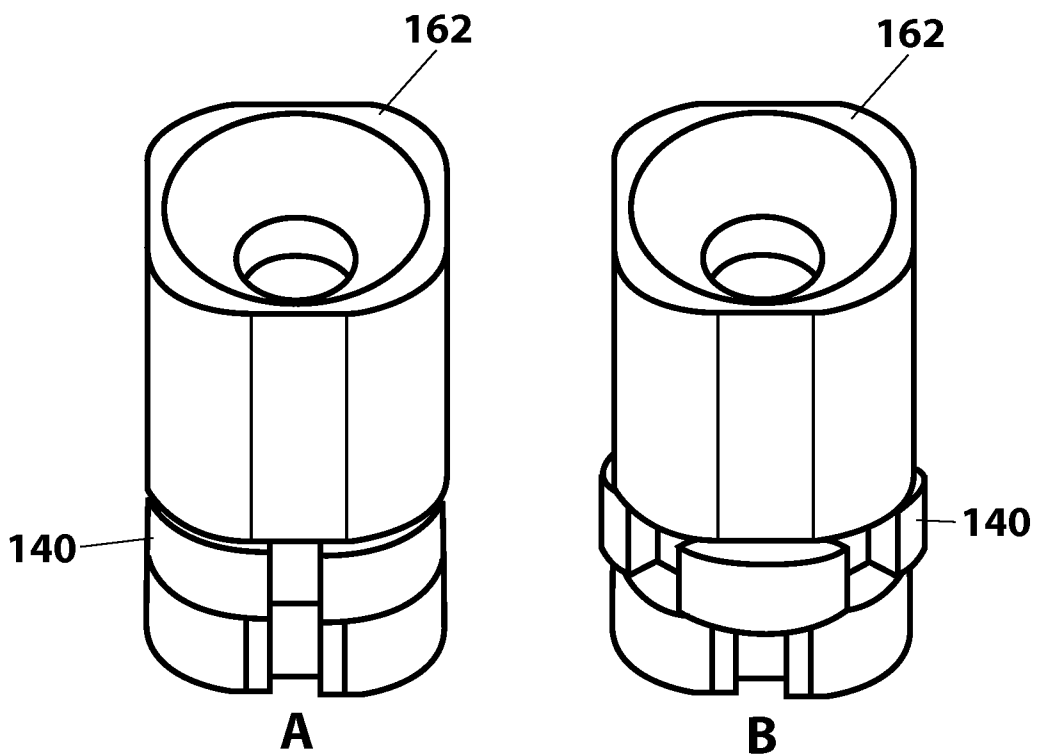


Figure 7A

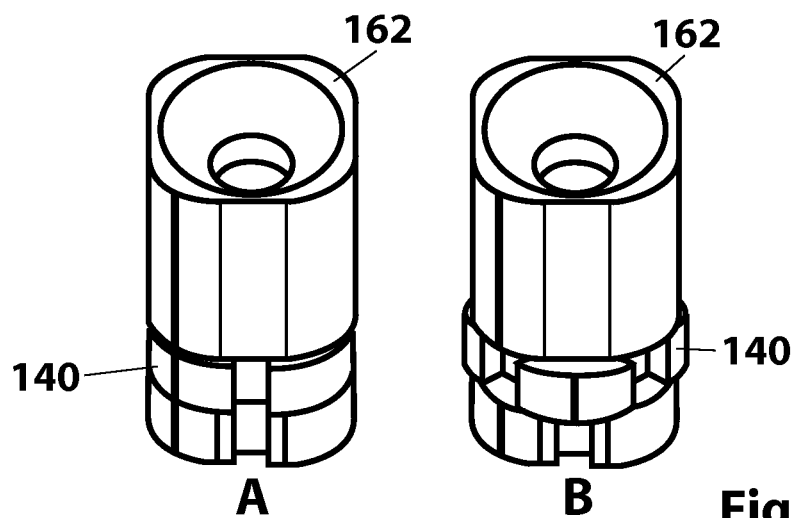


Figure 7B

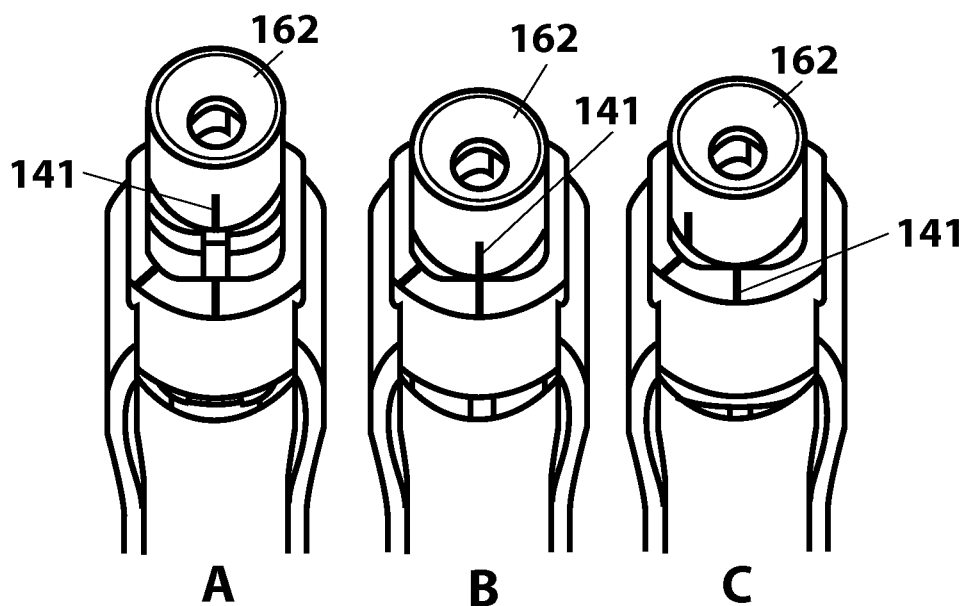


Figure 7C

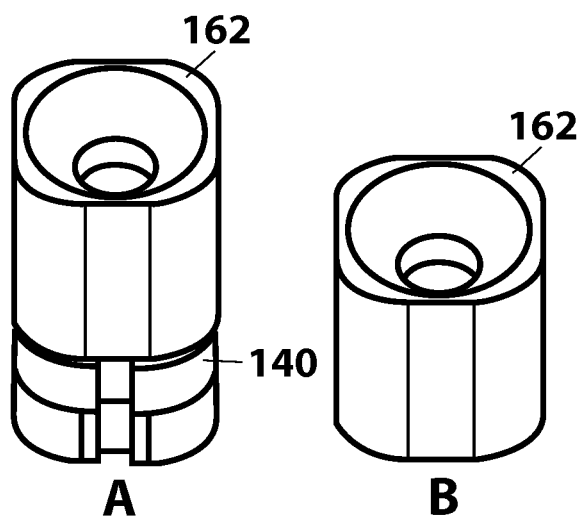


Figure 7D

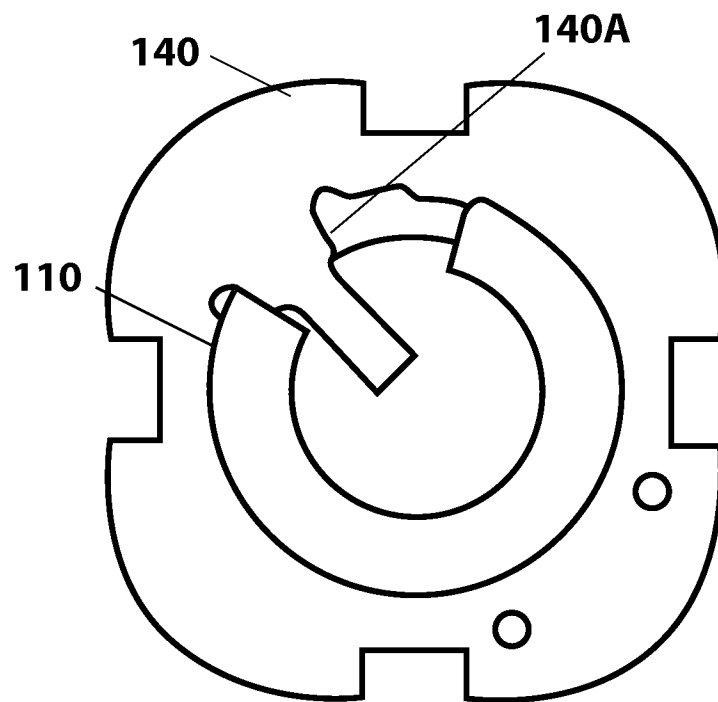


Figure 8A

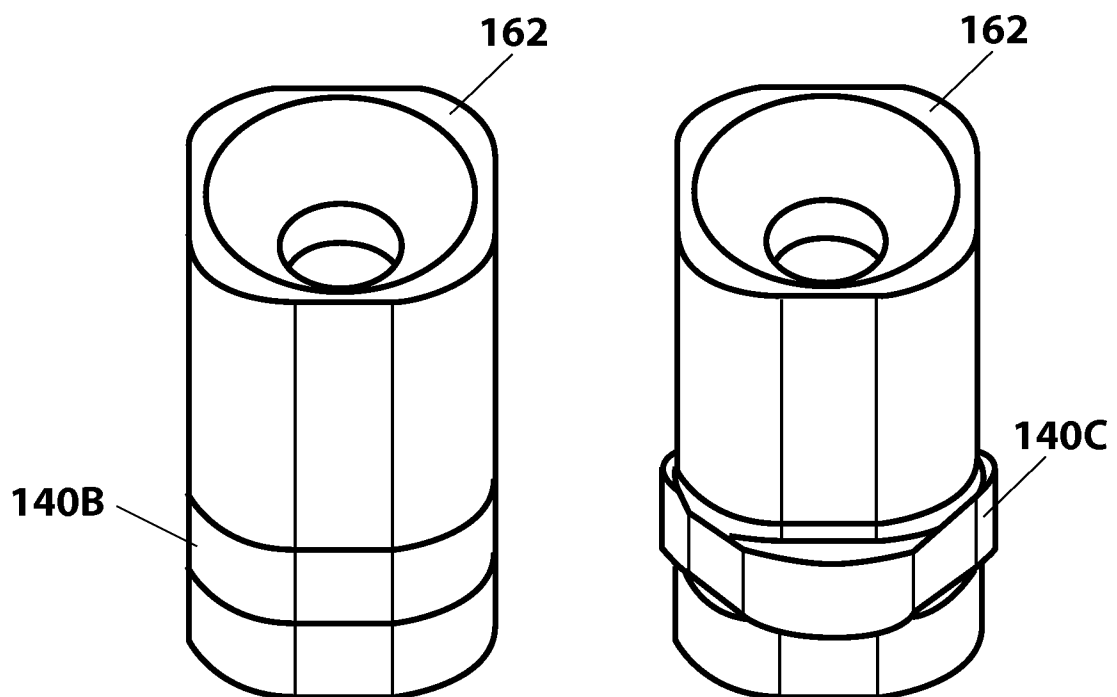


Figure 8B

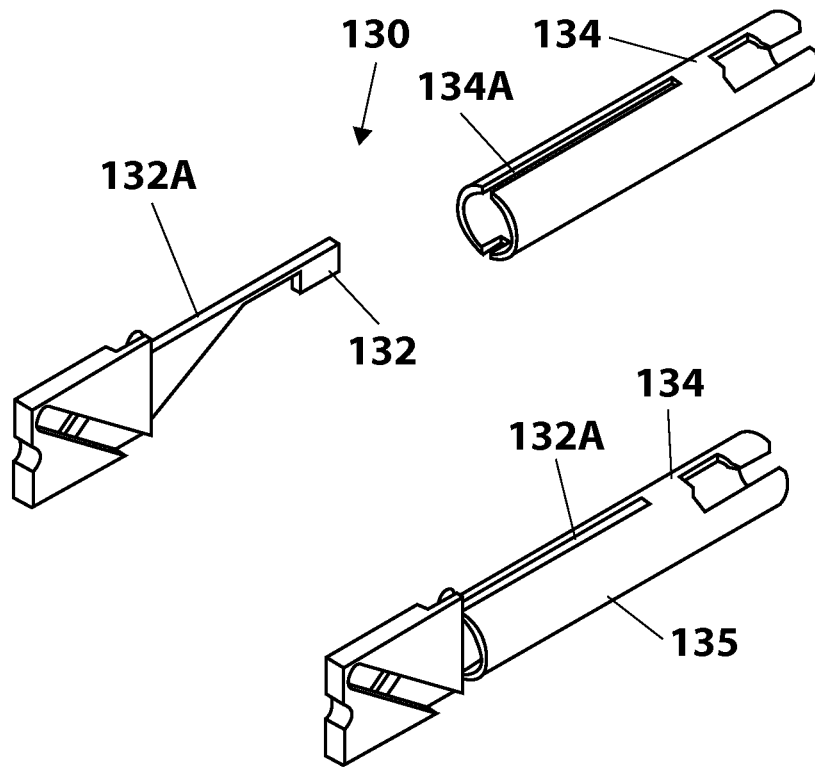


Figure 9A

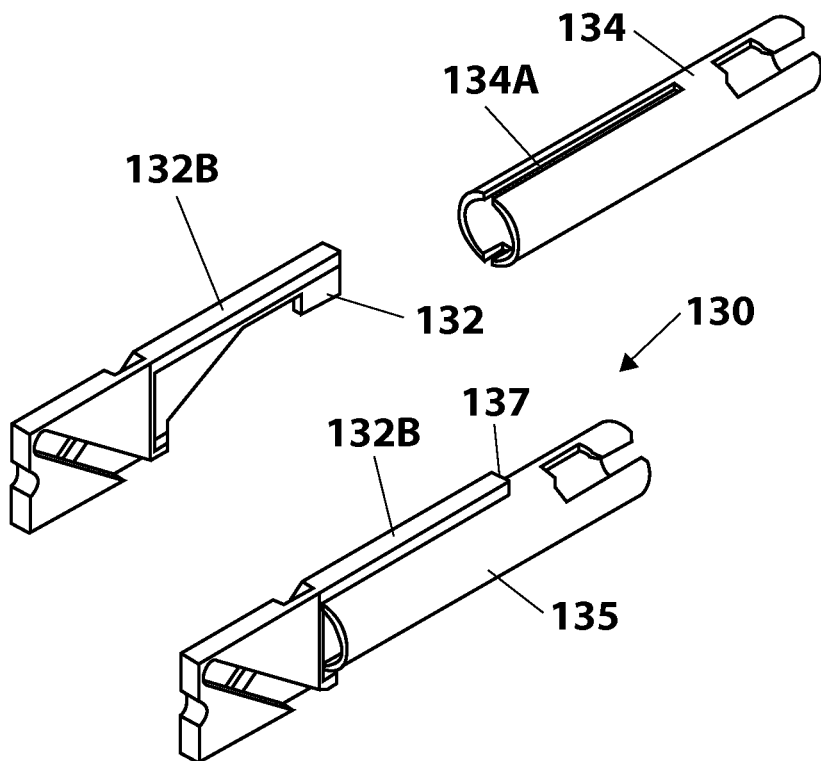


Figure 9B

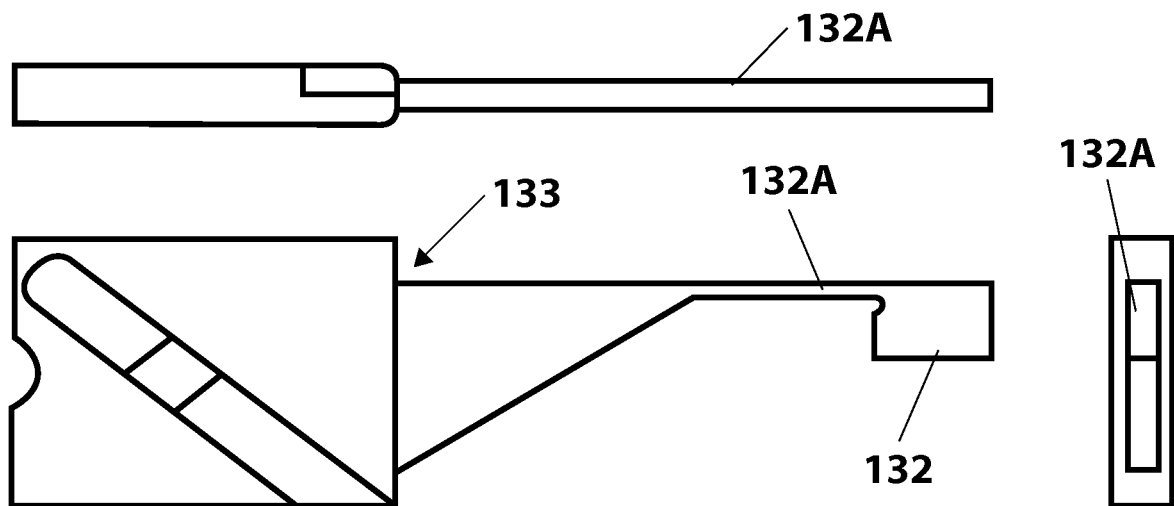


Figure 9C

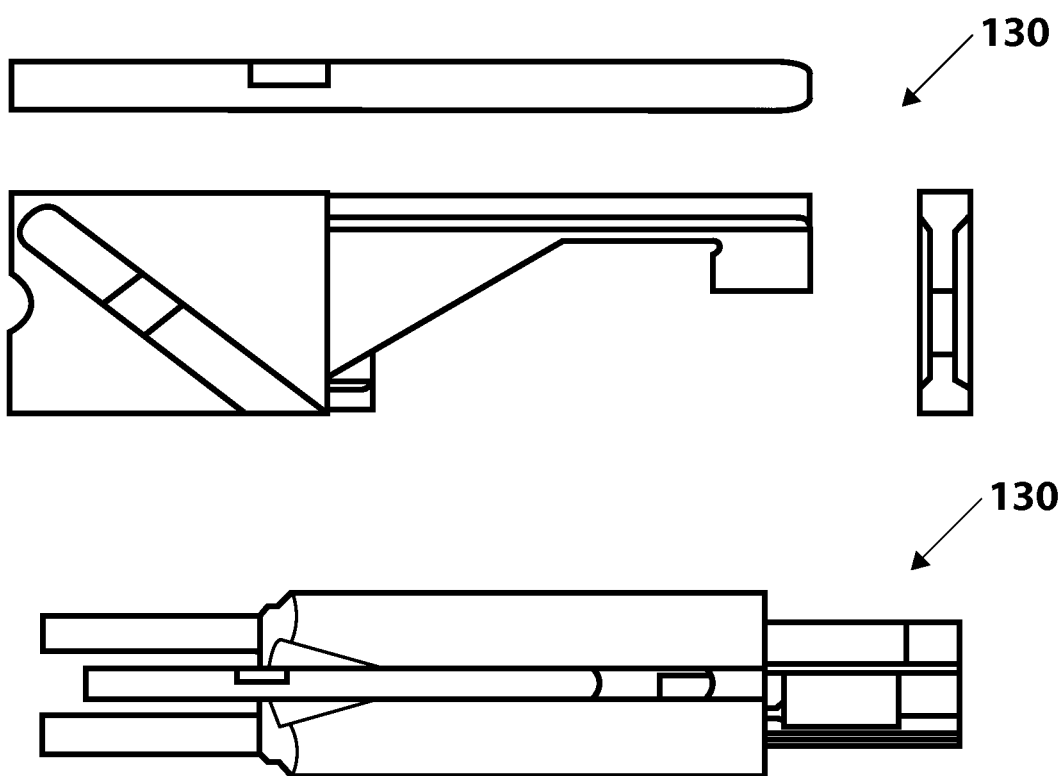
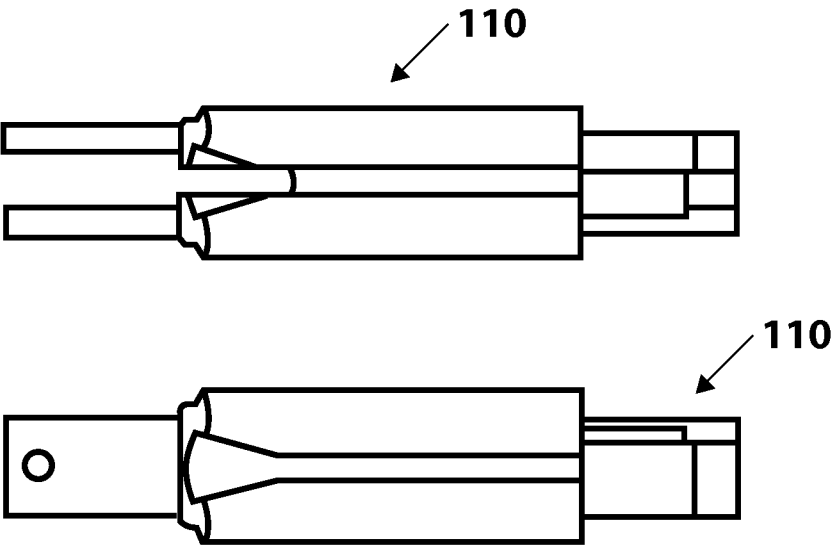


Figure 9D



PRIOR ART

Figure 10A

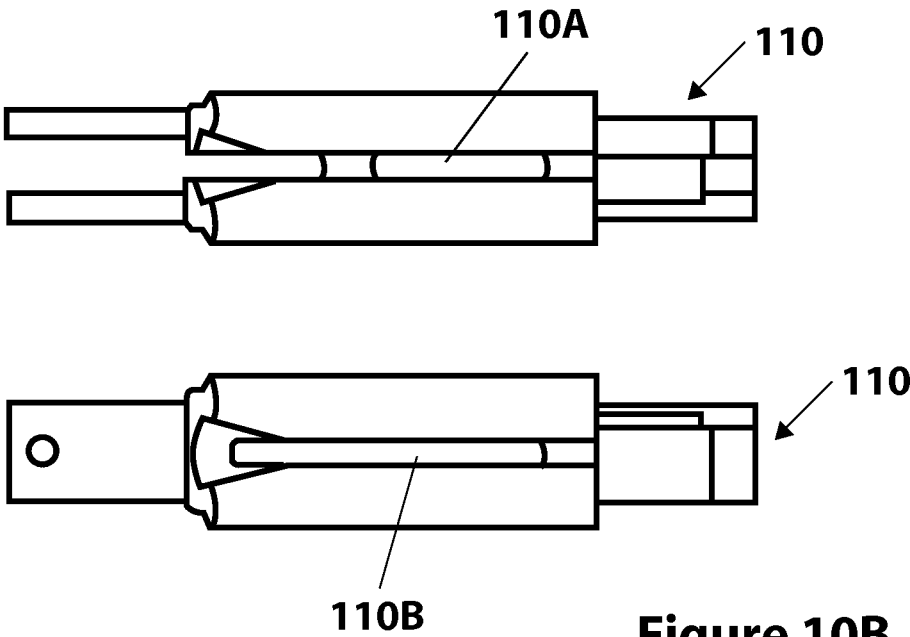


Figure 10B

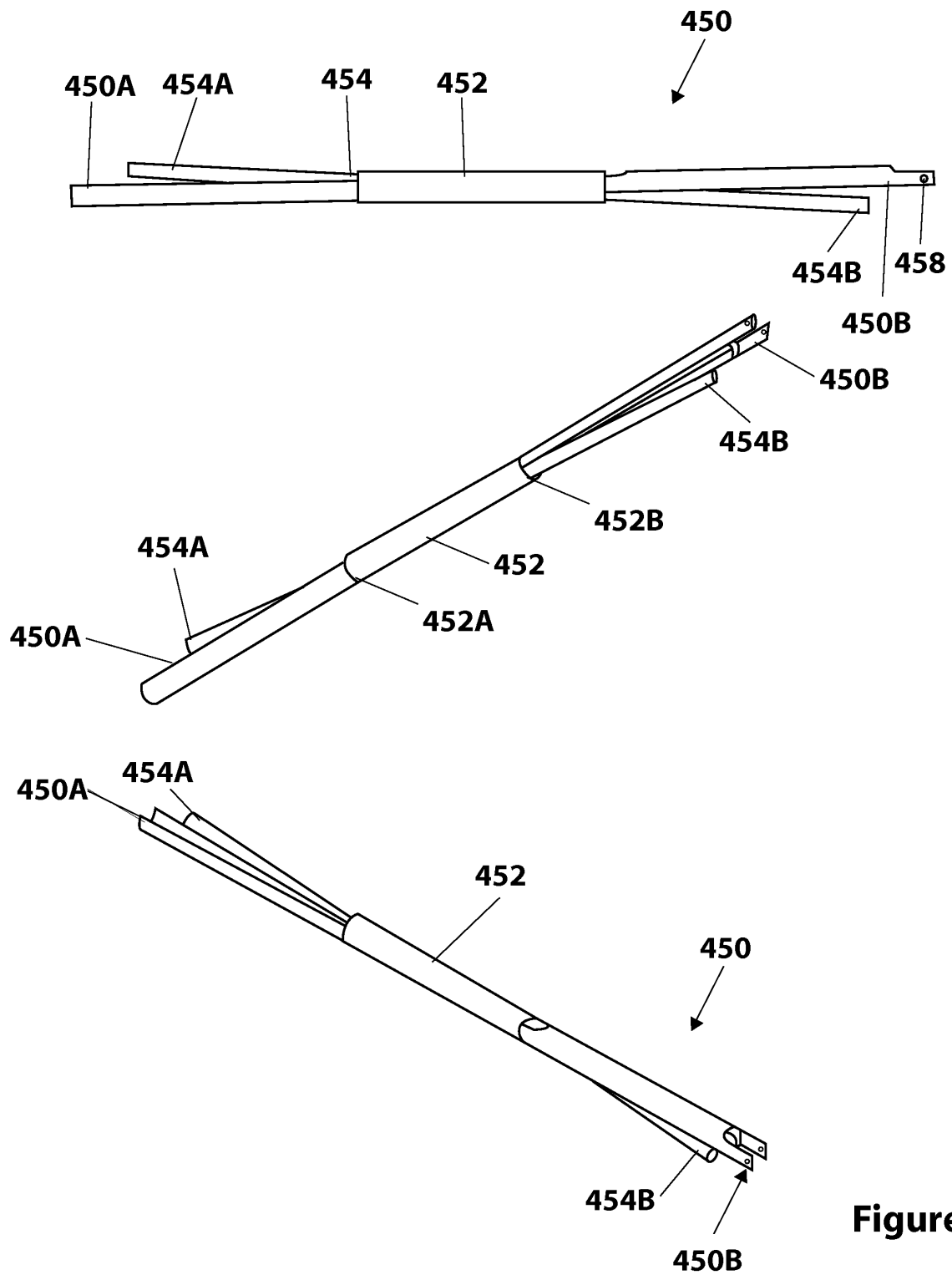


Figure 11A

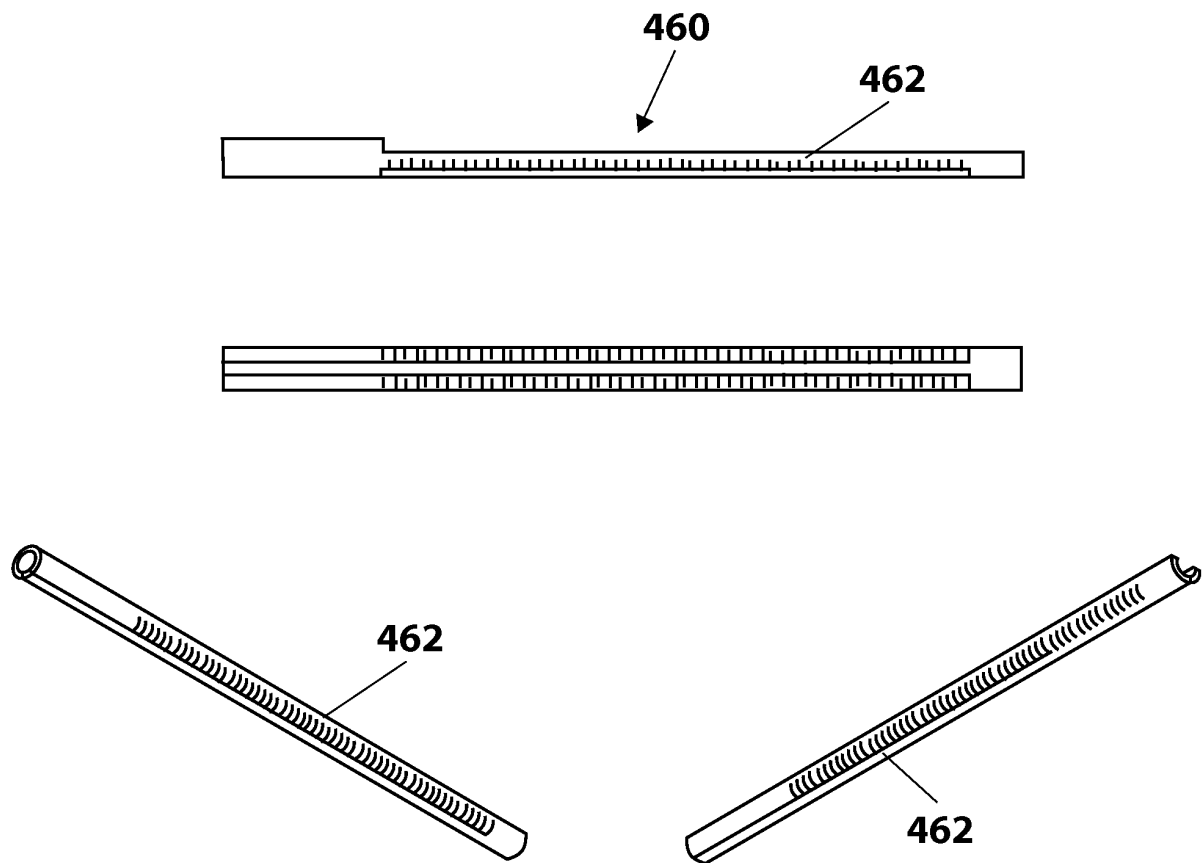


Figure 11B

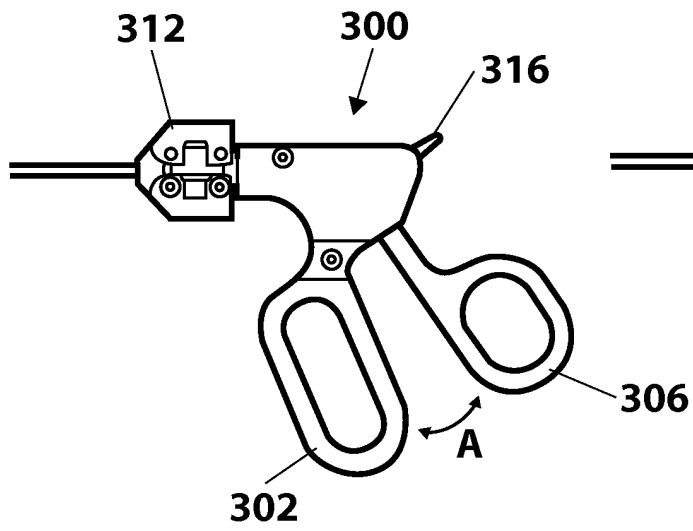


Figure 12A

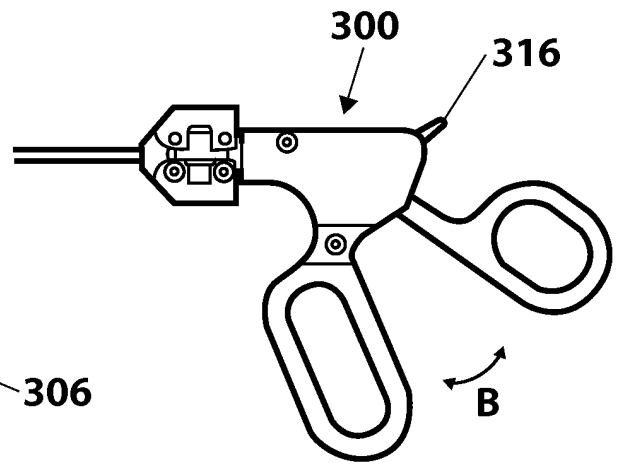


Figure 12B

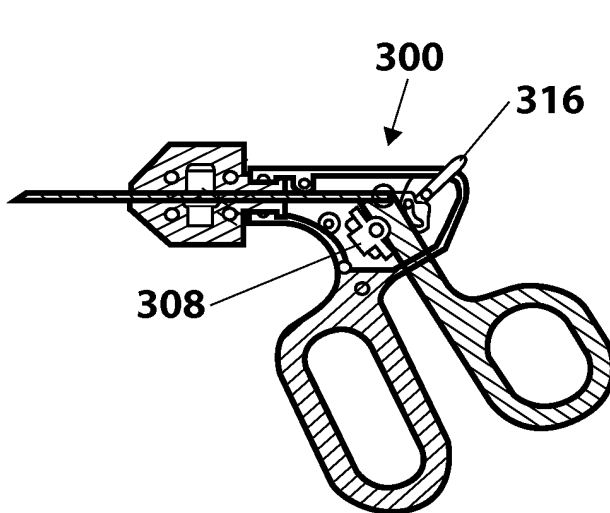


Figure 12C

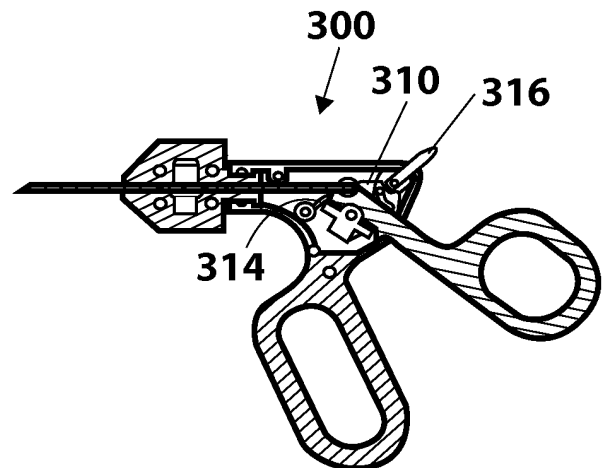


Figure 12D

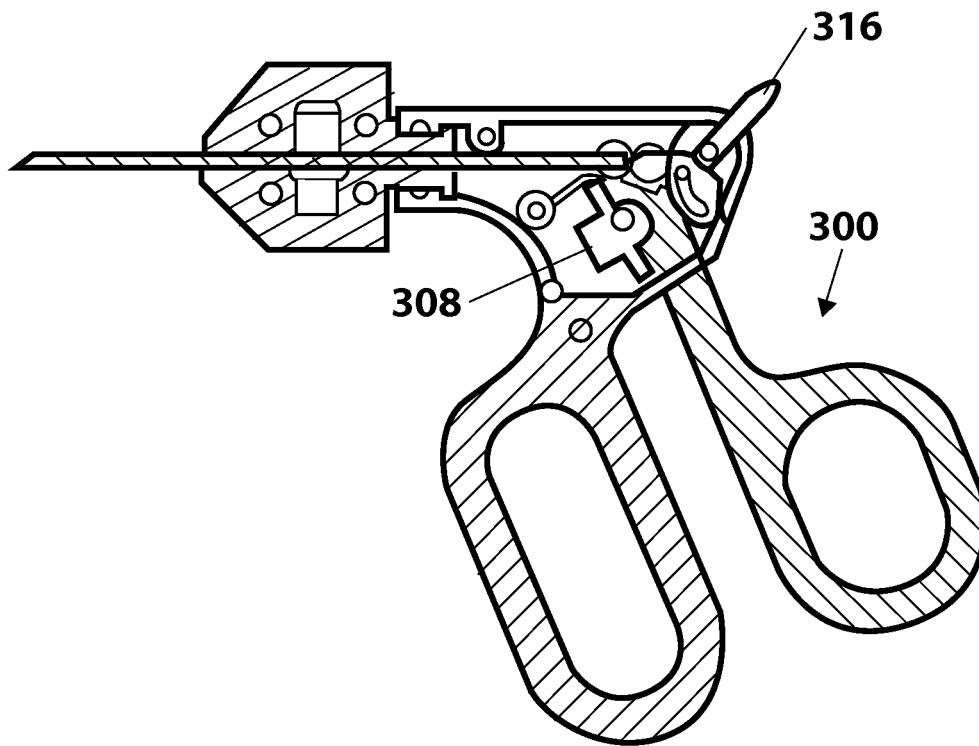


Figure 13

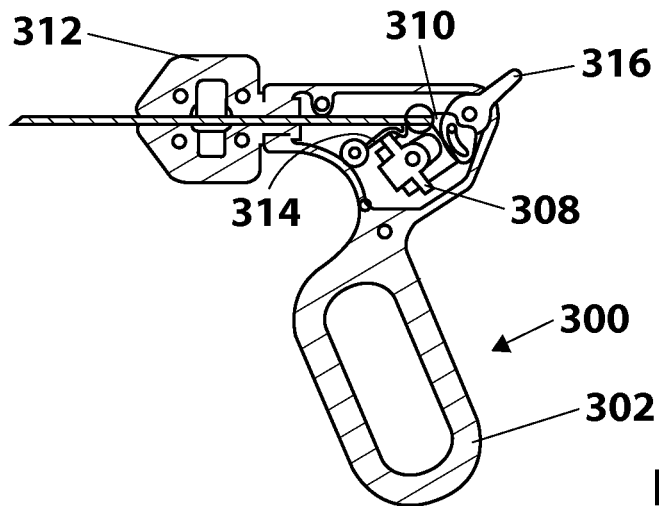


Figure 14A

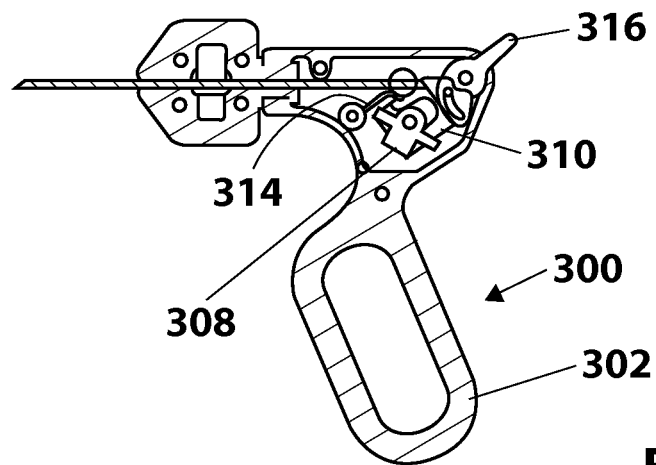


Figure 14B

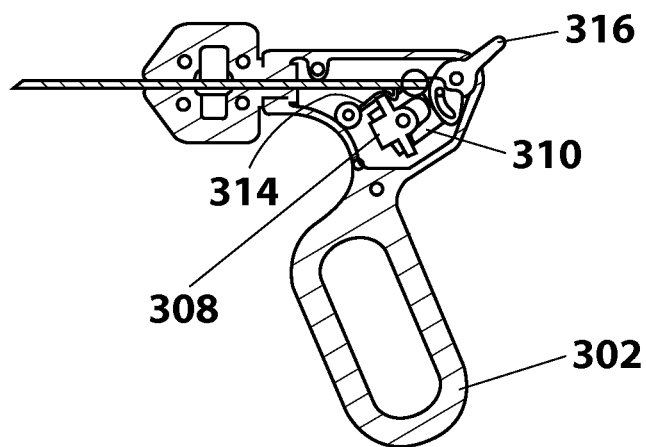


Figure 14C

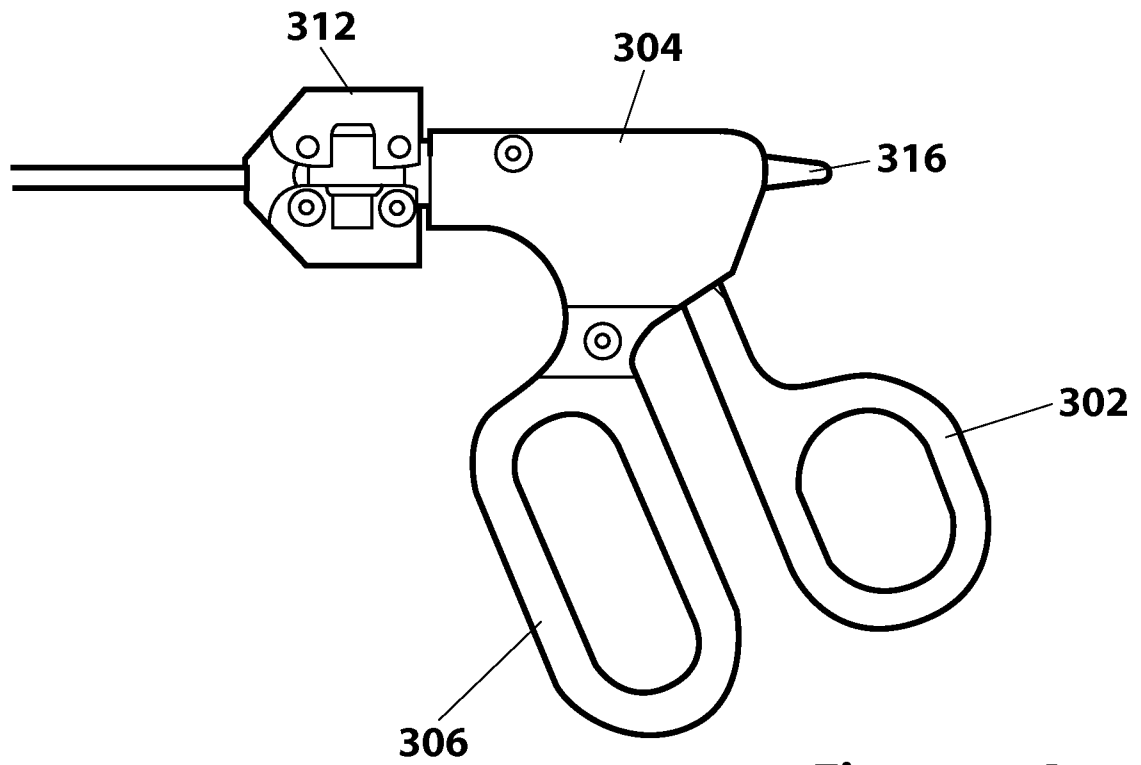


Figure 15A

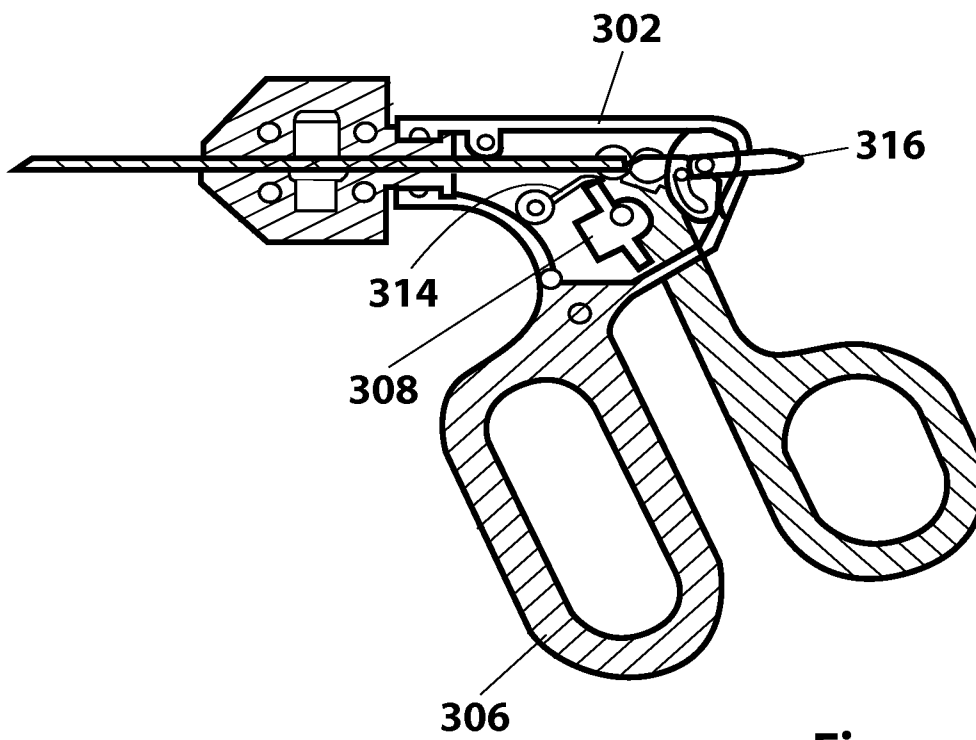


Figure 15B

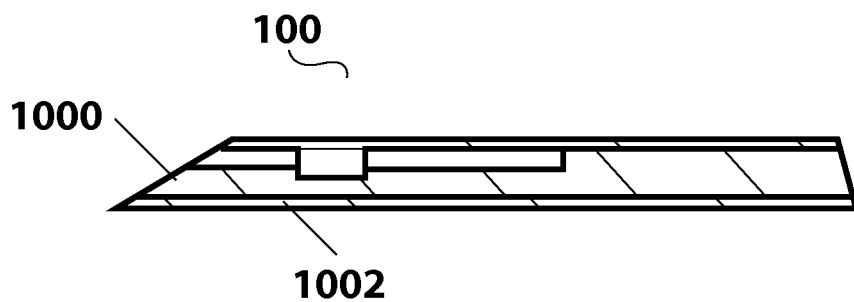


Figure 16A

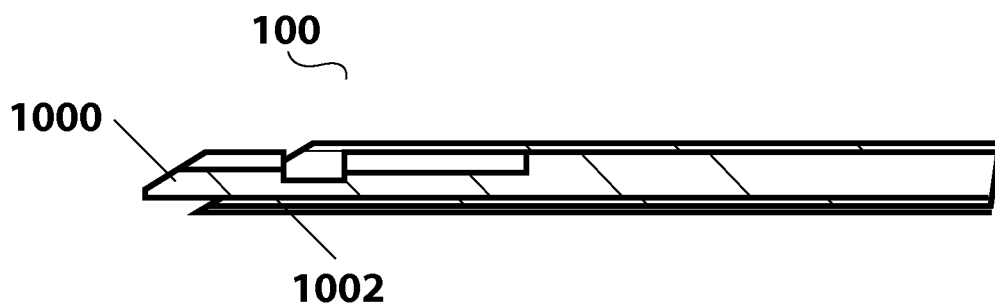


Figure 16B

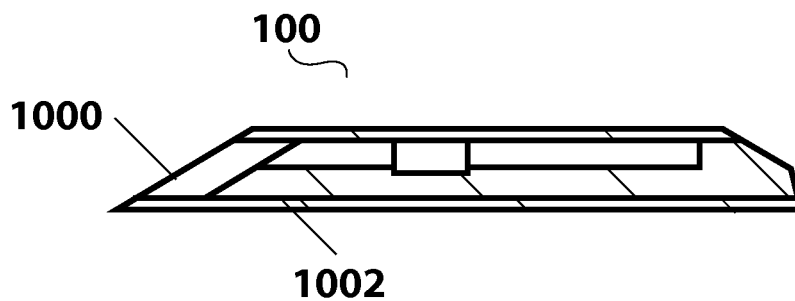


Figure 16C

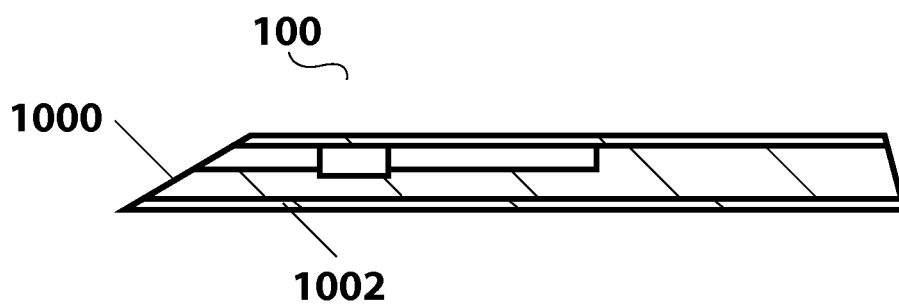


Figure 16D

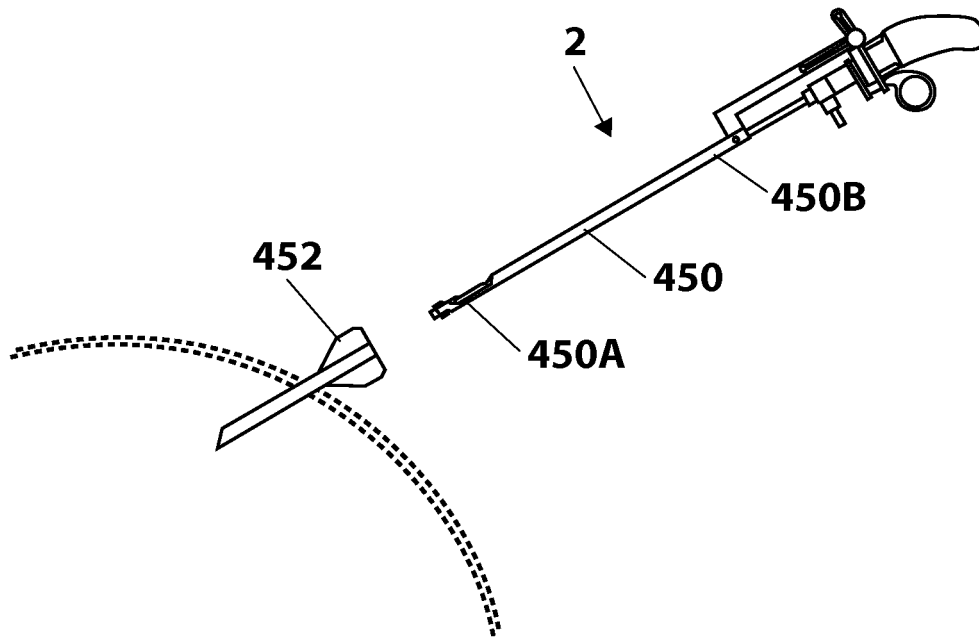


Figure 17A

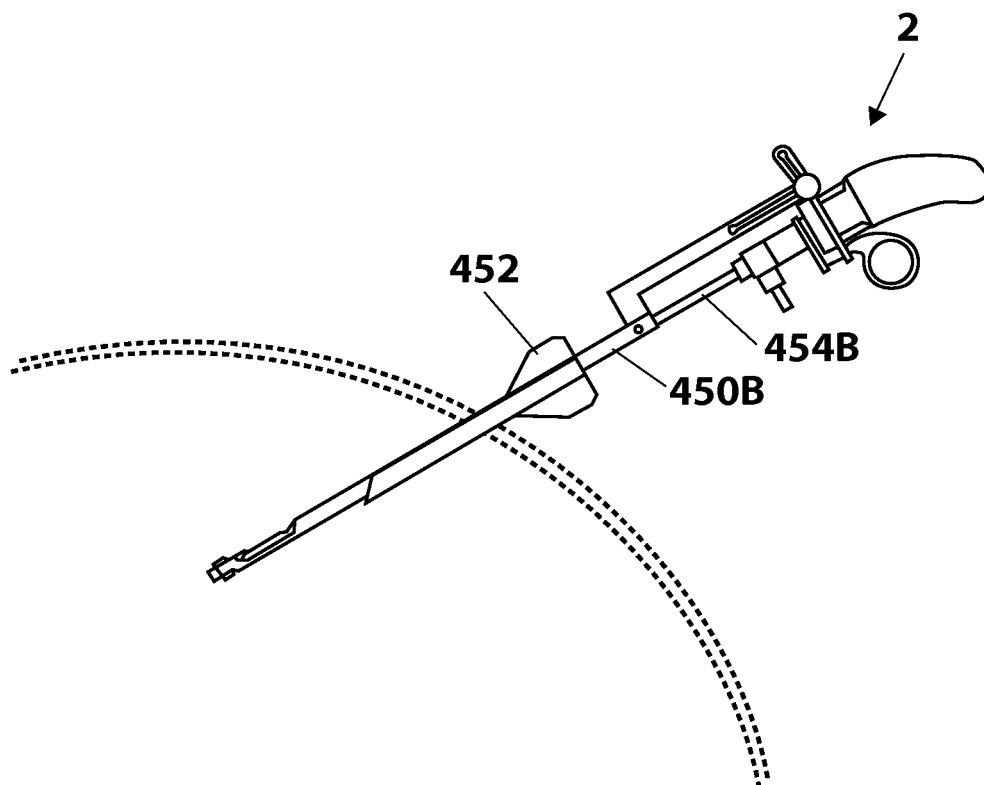


Figure 17B

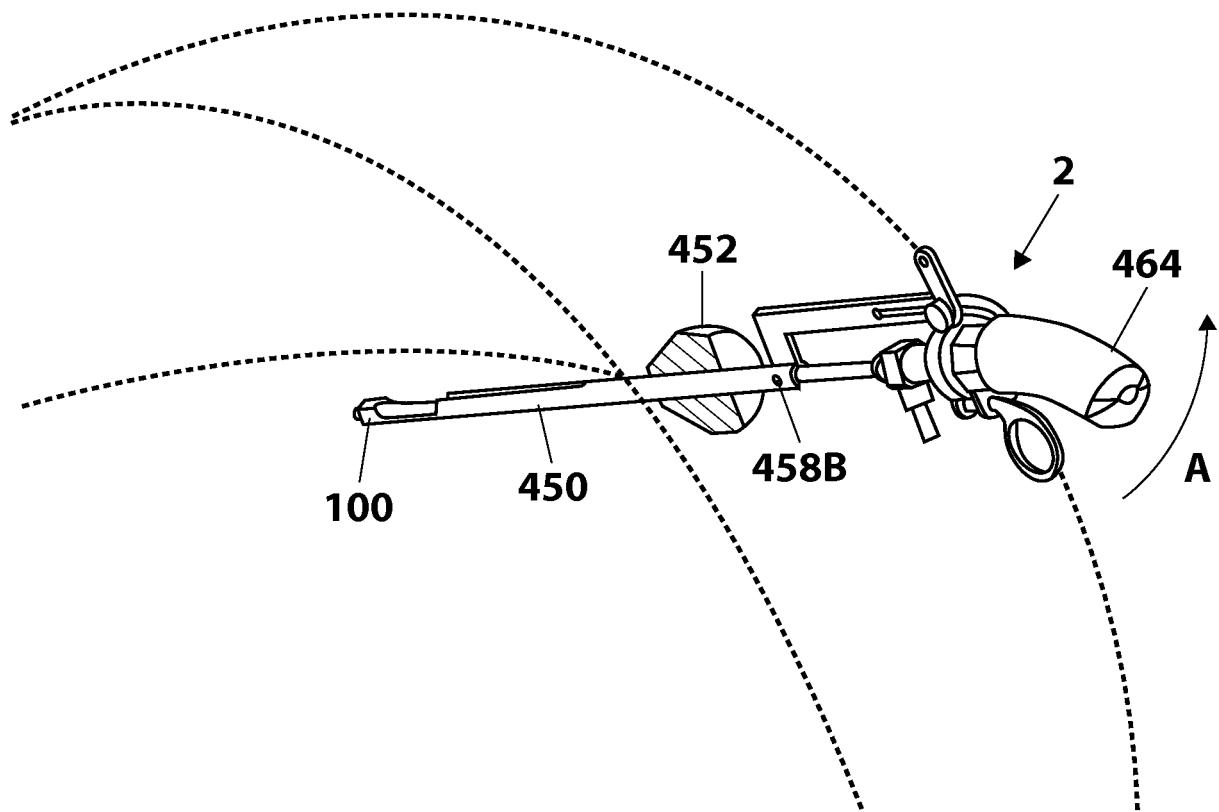


Figure 18A

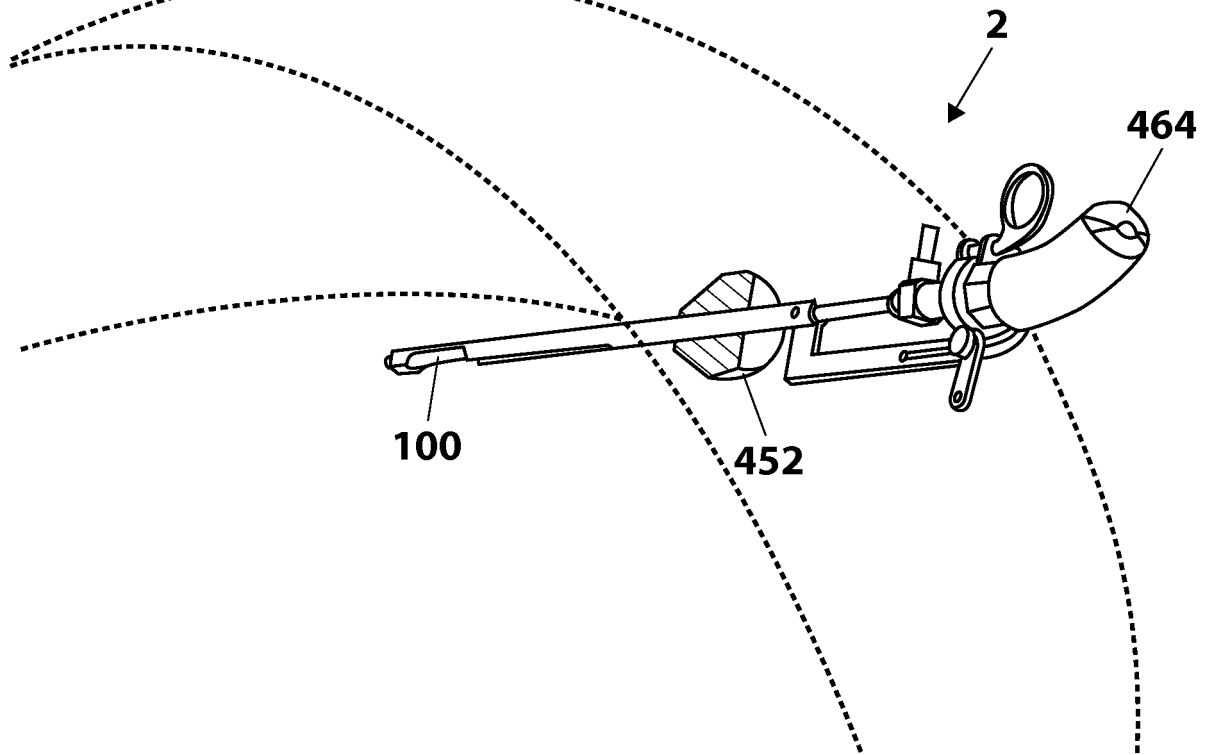


Figure 18B

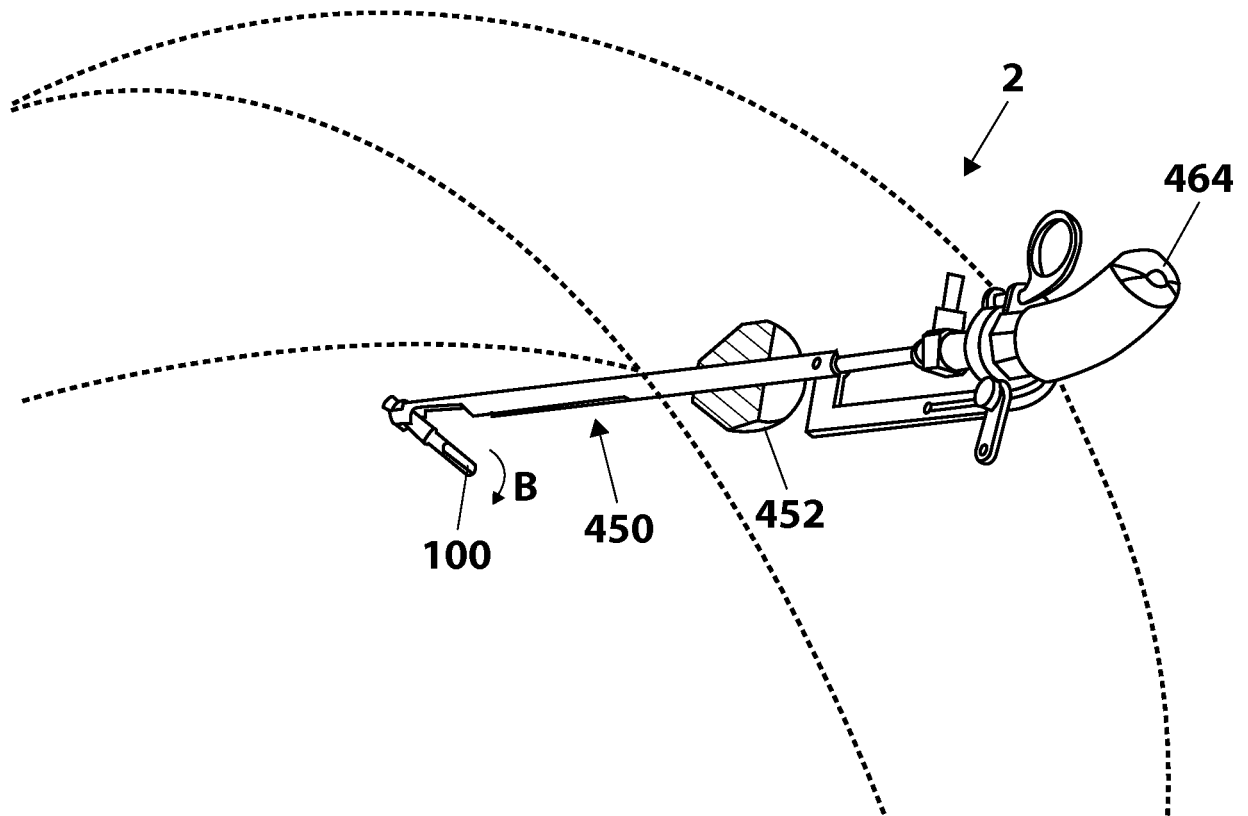


Figure 18C

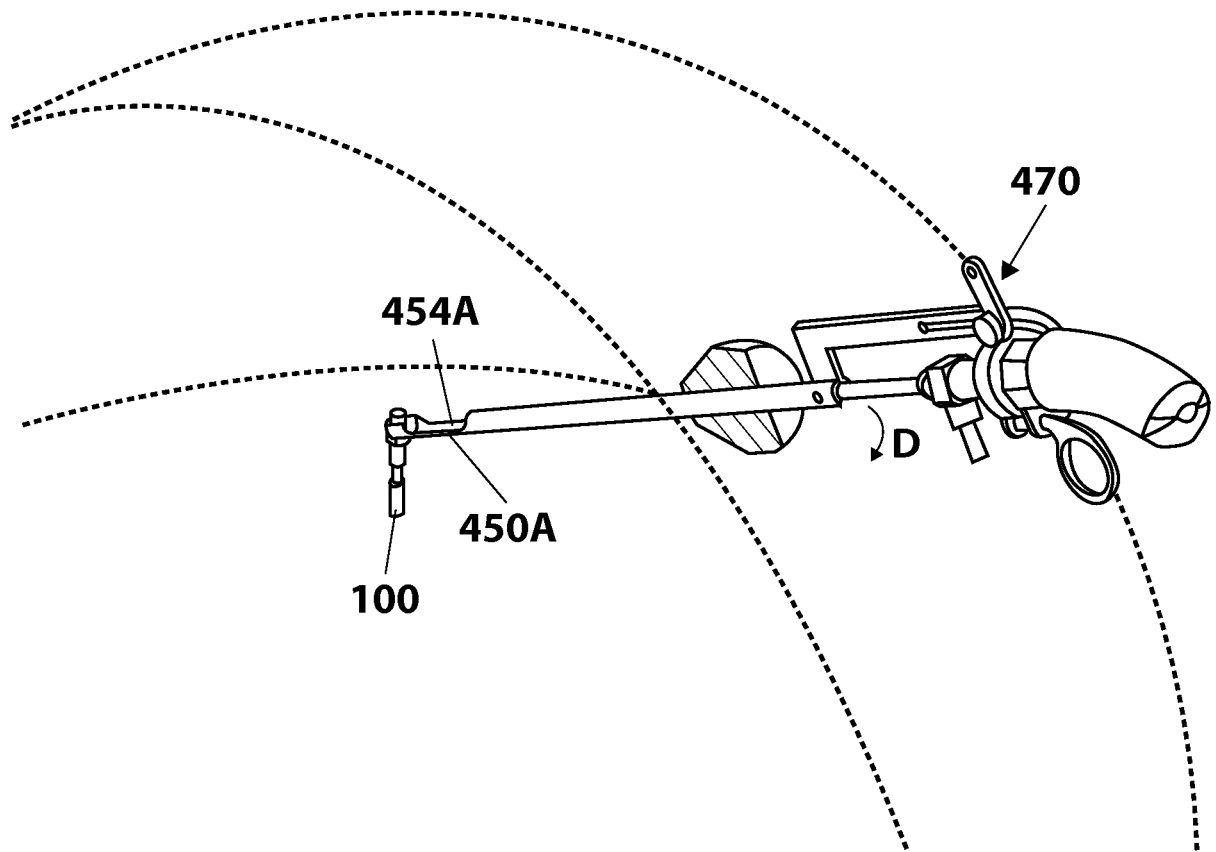


Figure 19

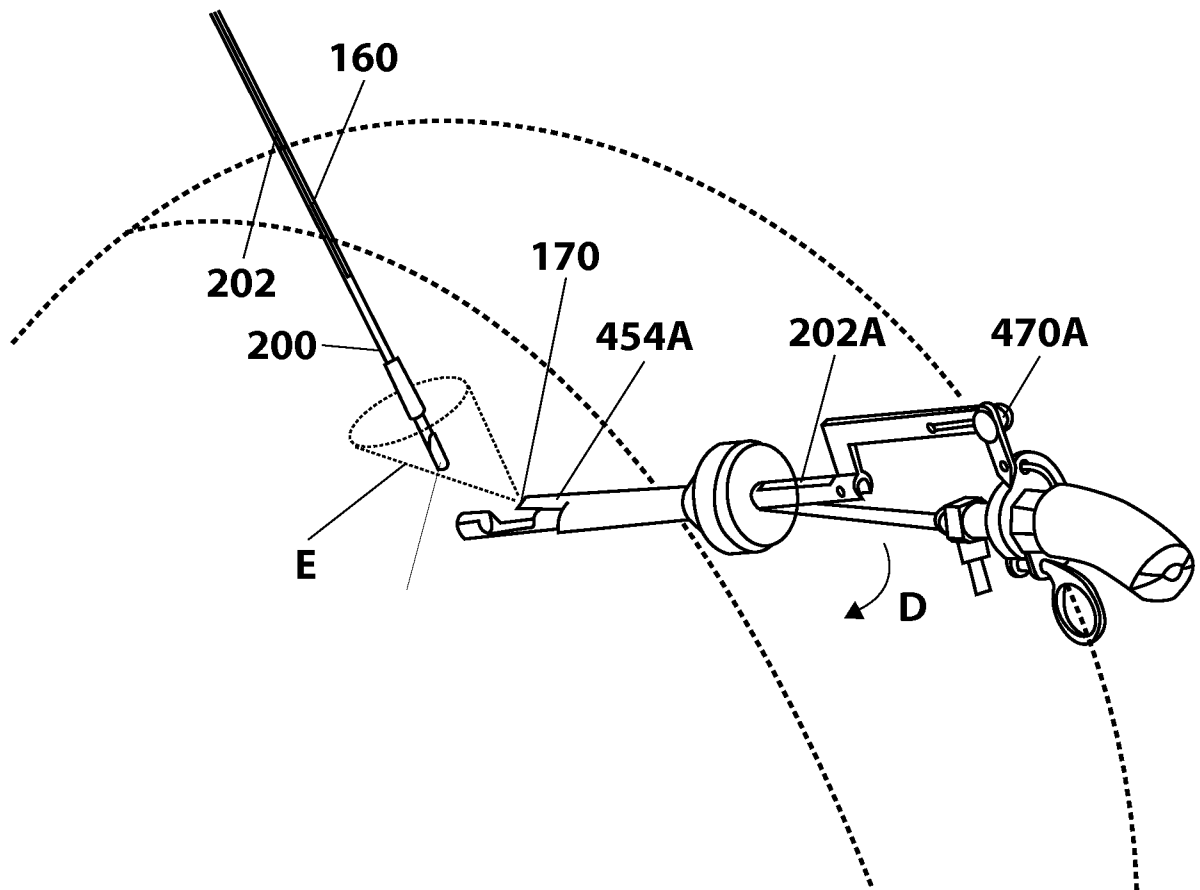


Figure 20

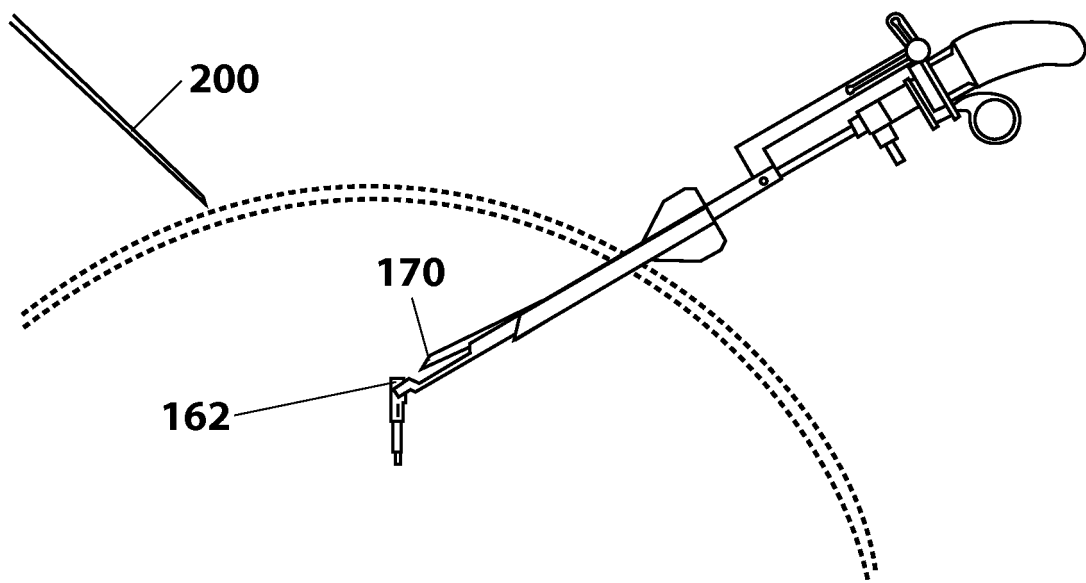


Figure 21A

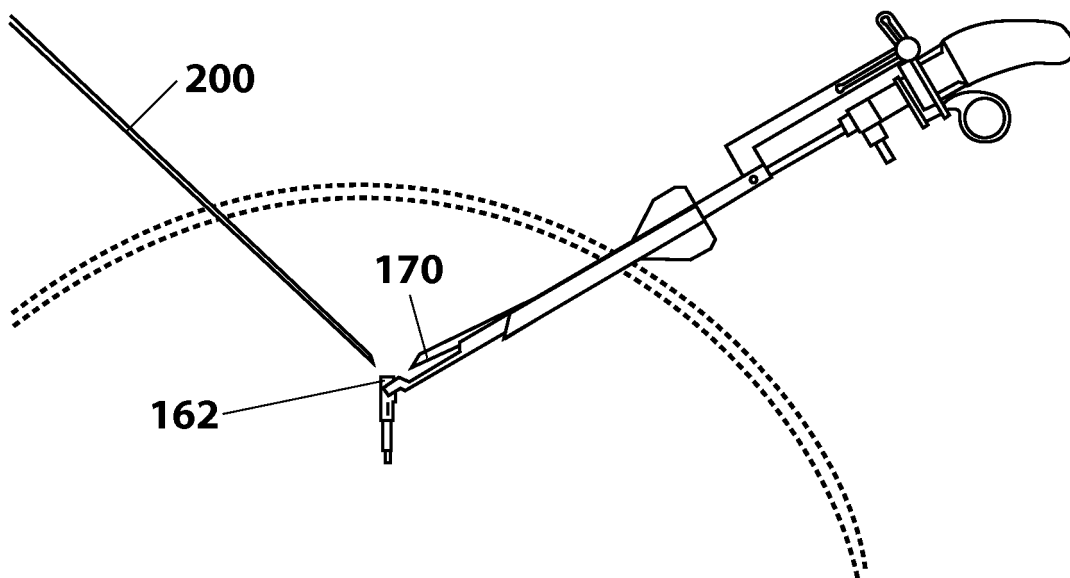


Figure 21B

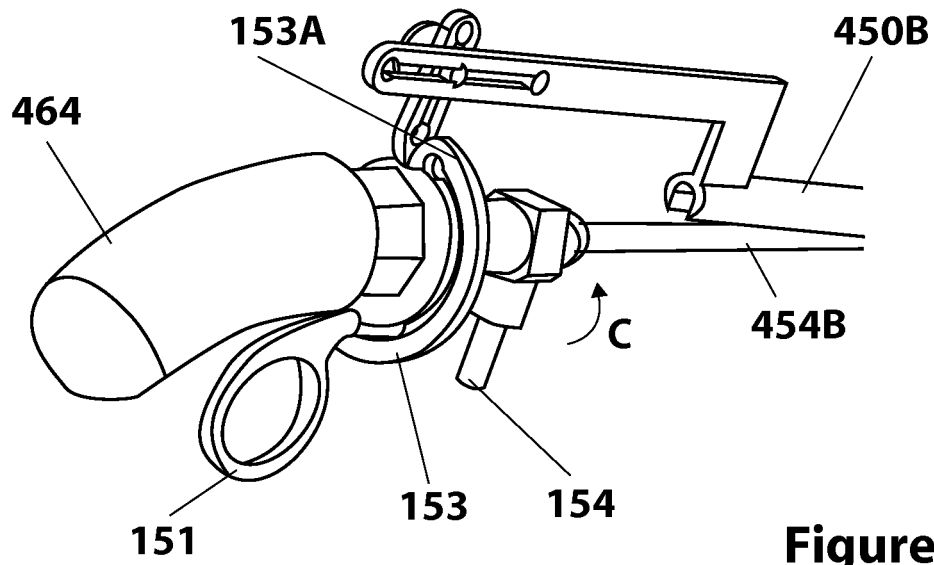


Figure 22A

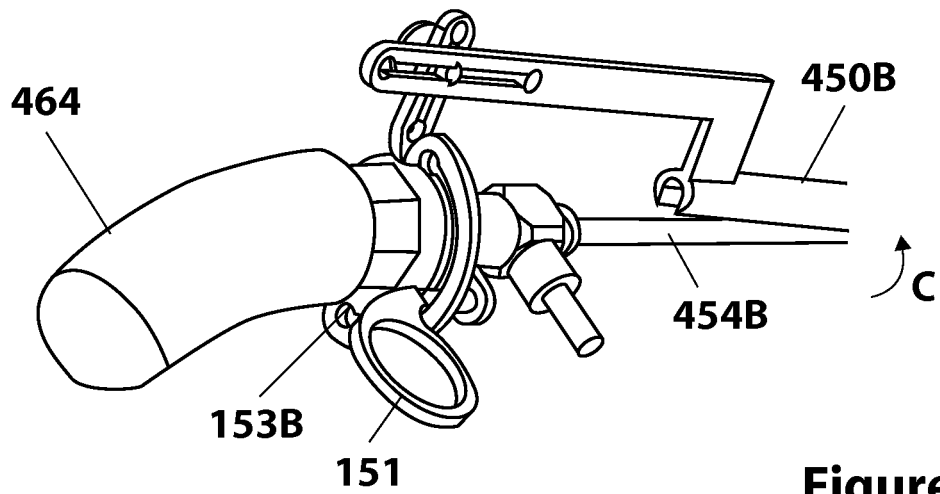


Figure 22B

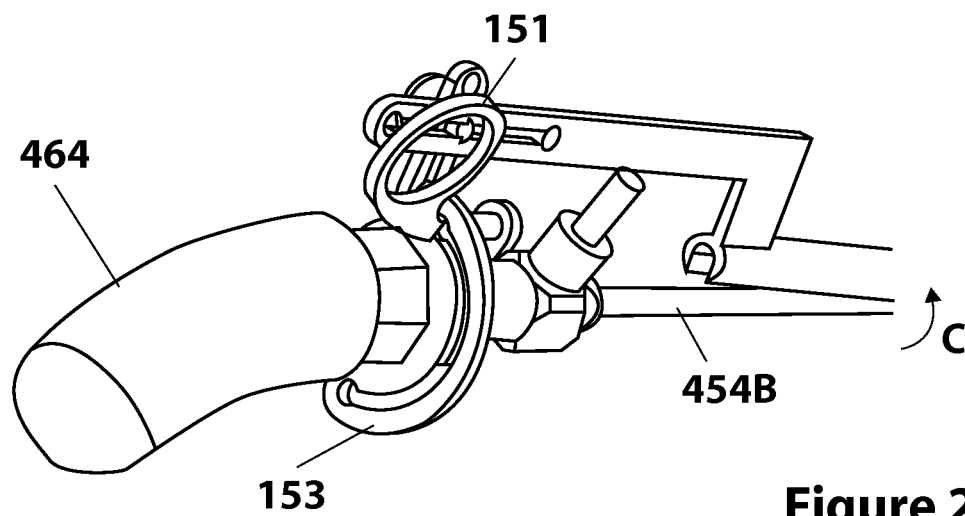


Figure 22C

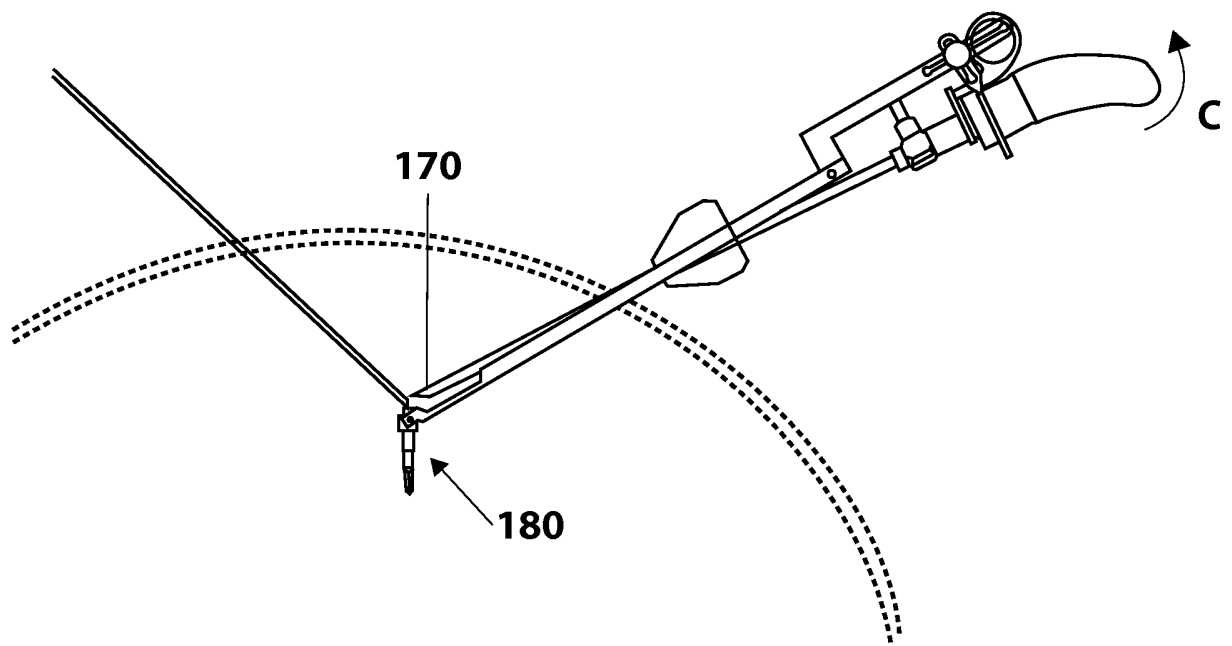


Figure 23A

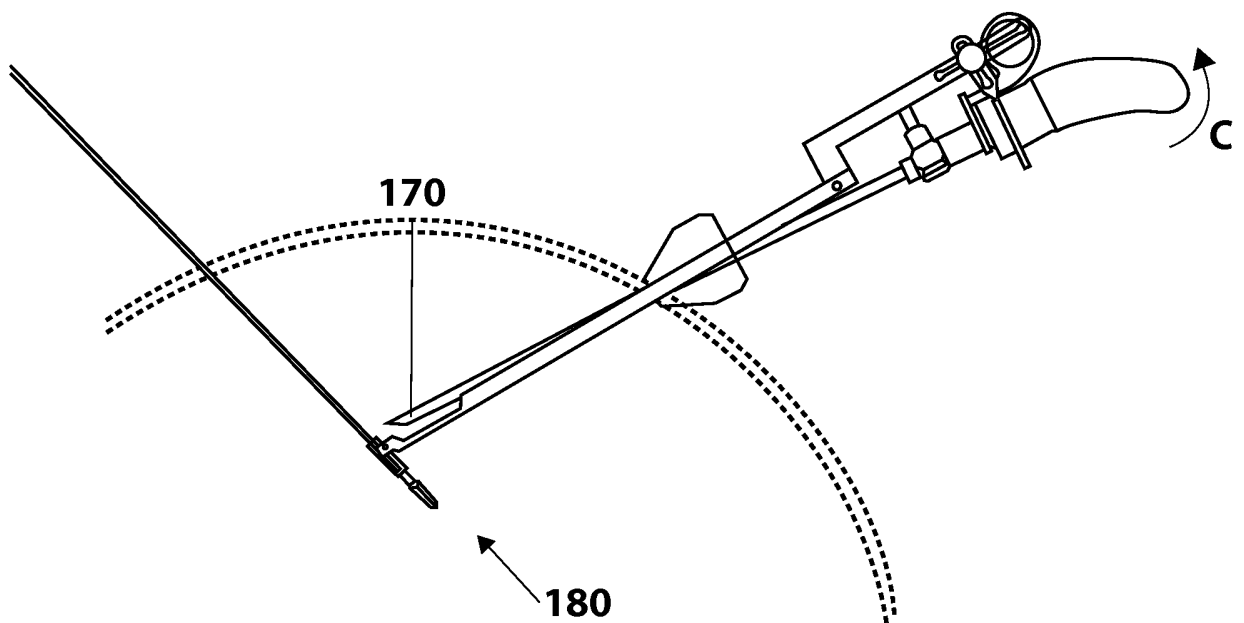


Figure 23B

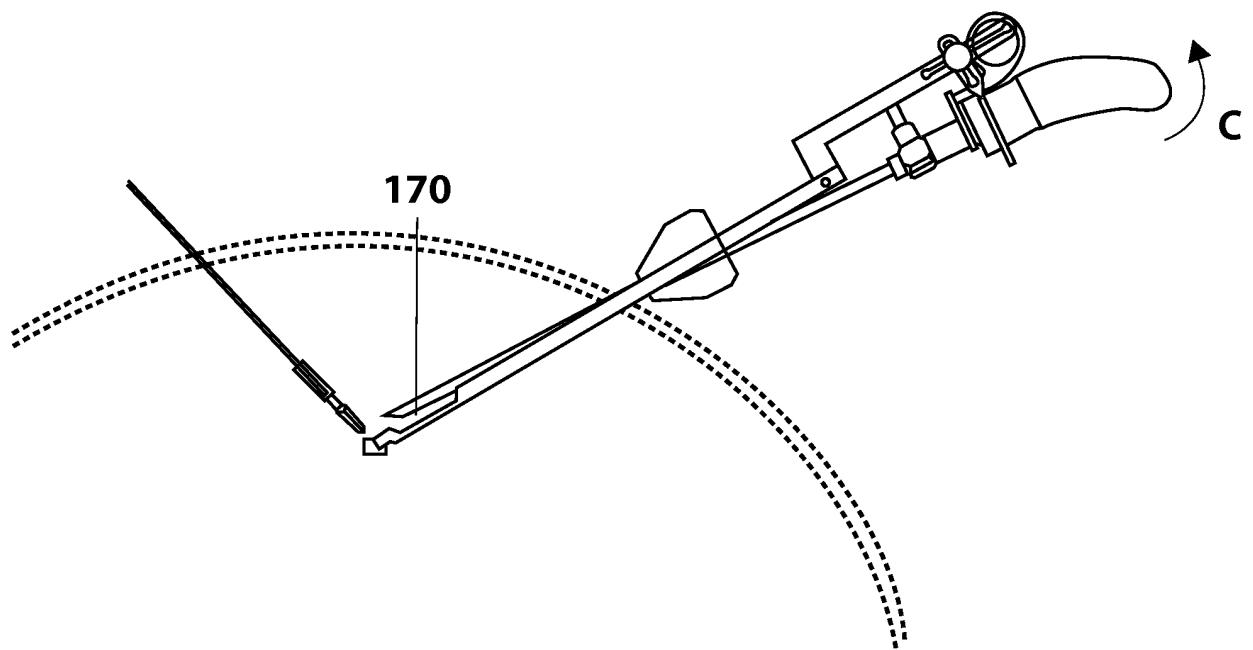


Figure 23C

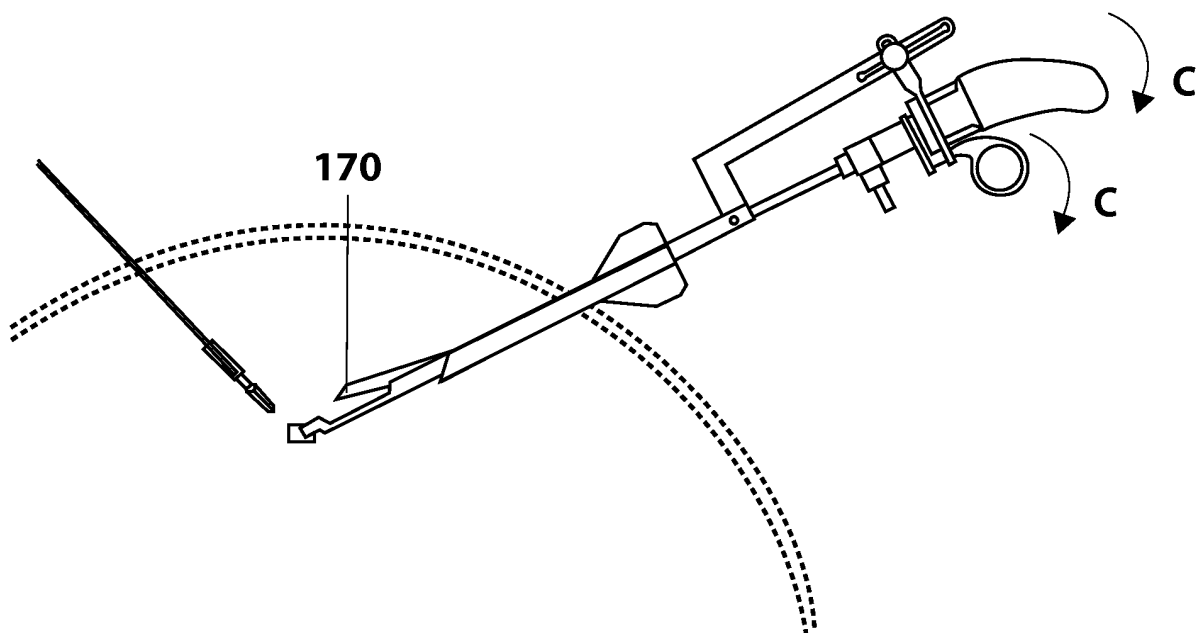


Figure 23D

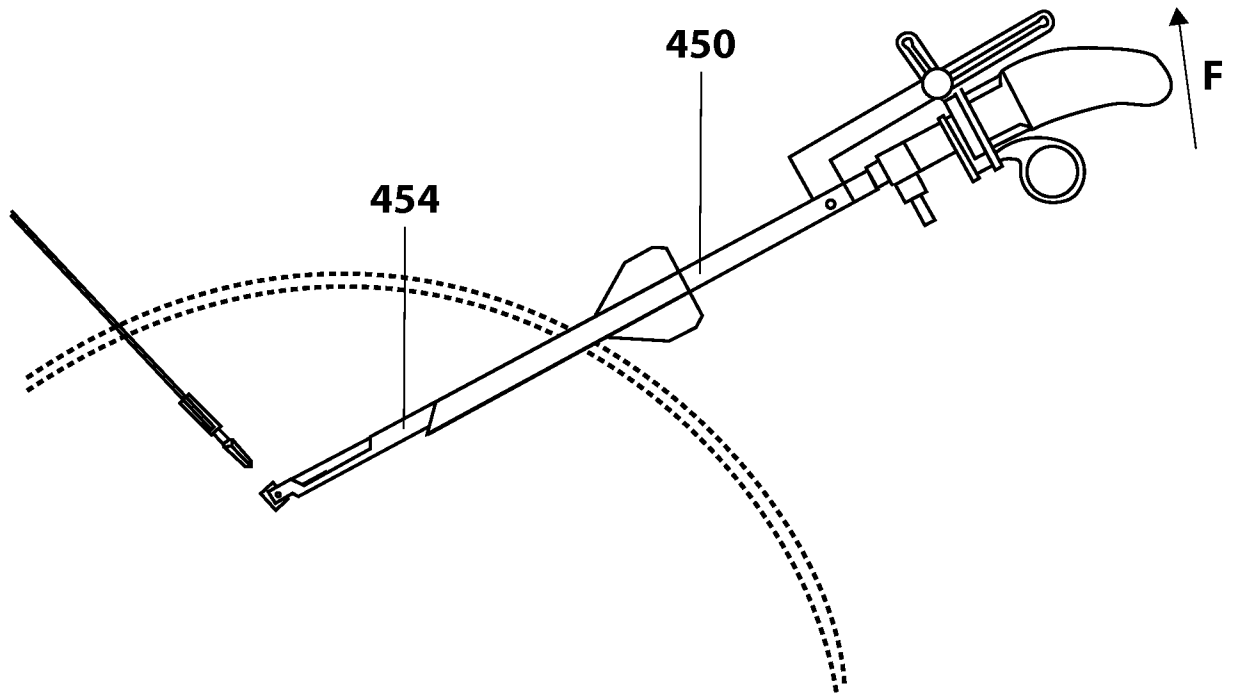


Figure 23E

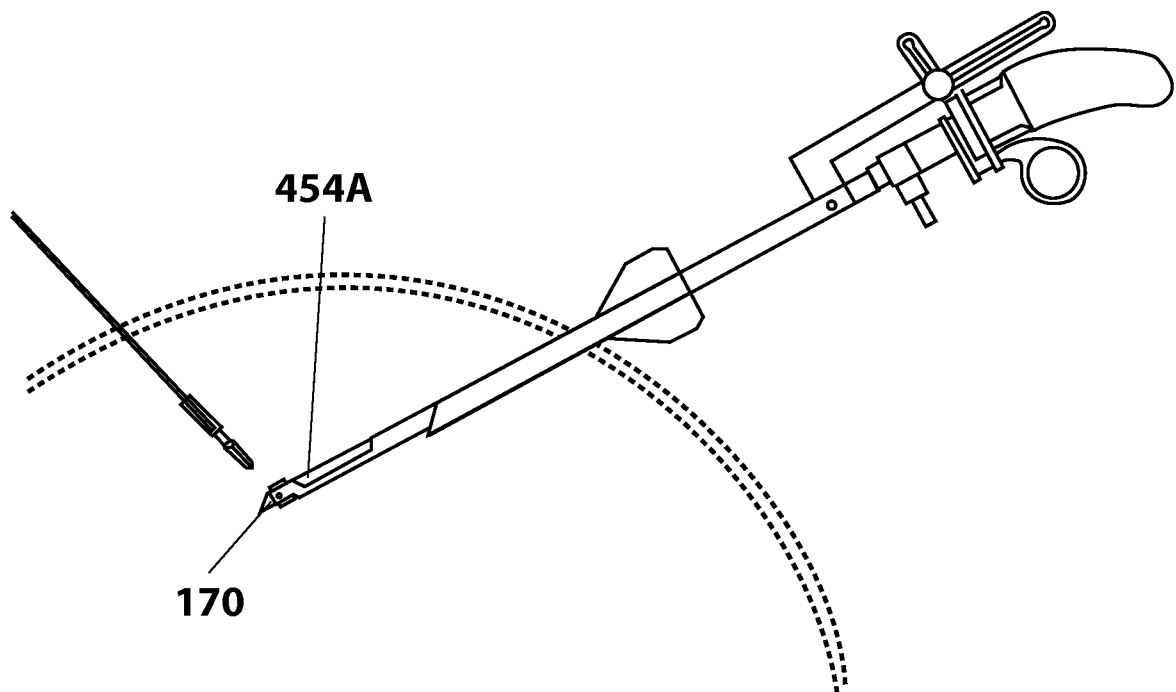


Figure 23F

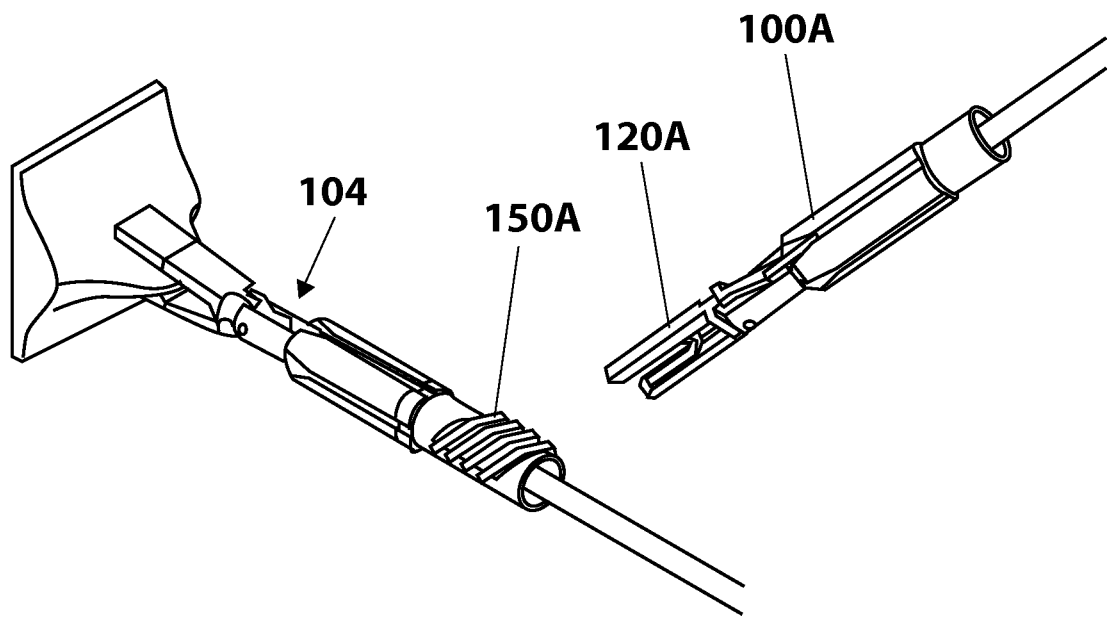


Figure 24A

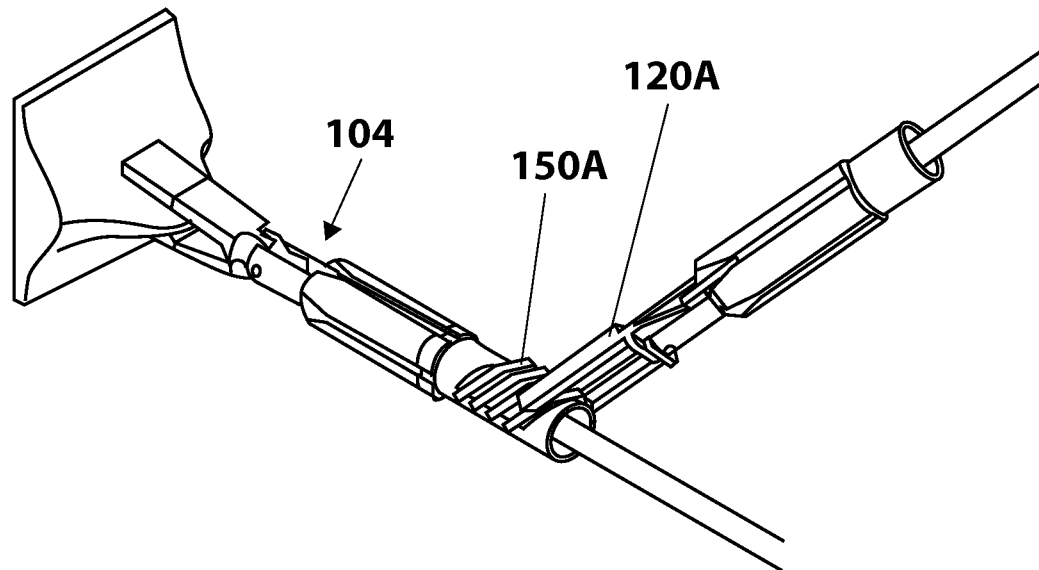


Figure 24B

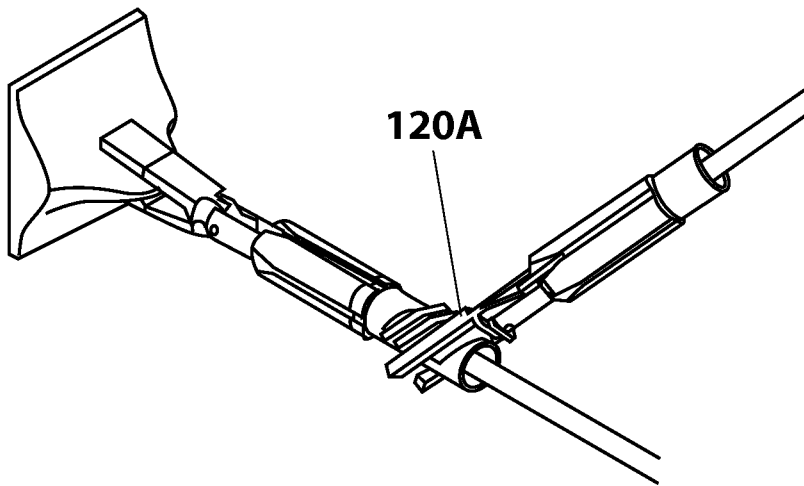


Figure 24C

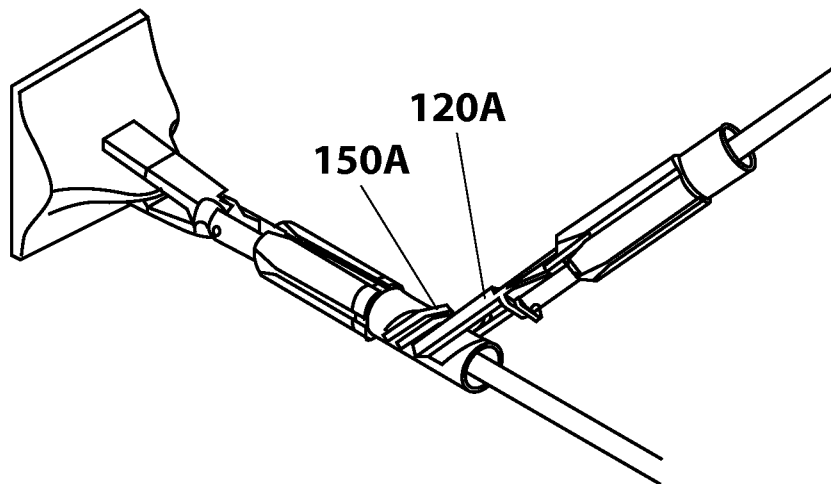


Figure 24D

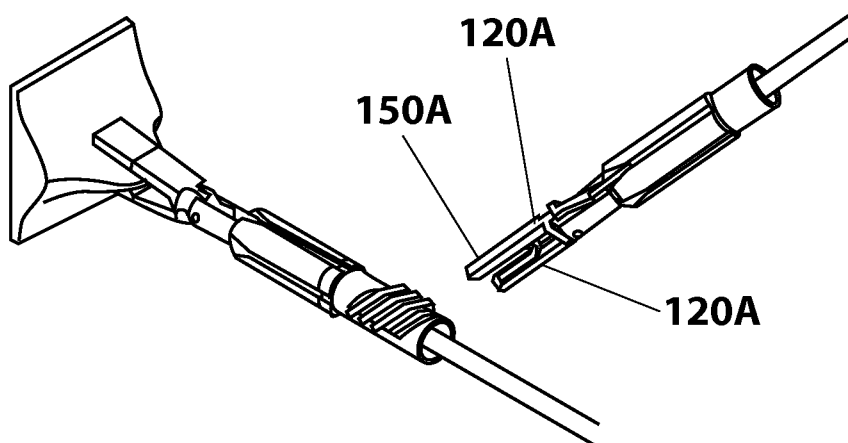


Figure 24E

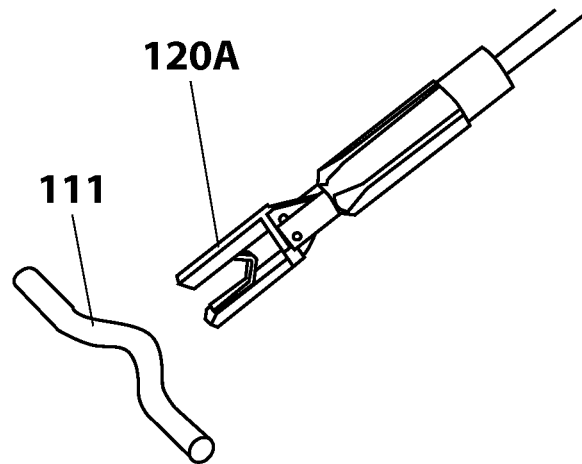


Figure 25A

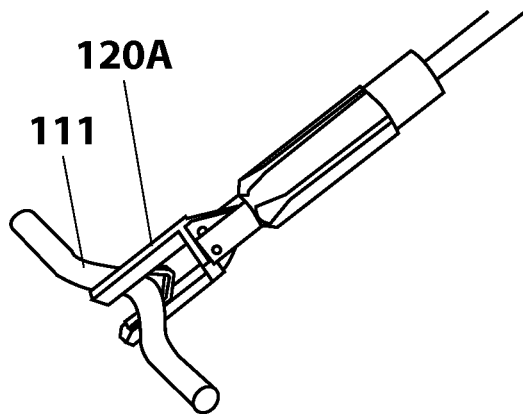


Figure 25B

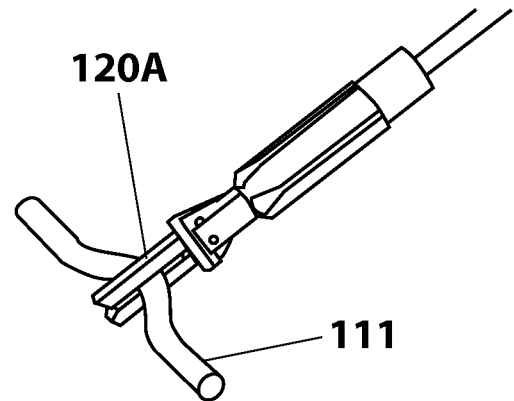


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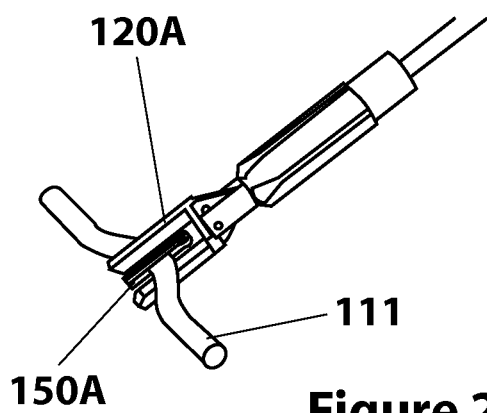


Figure 25D

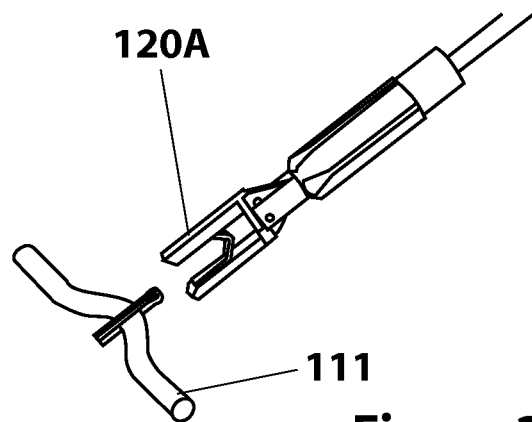


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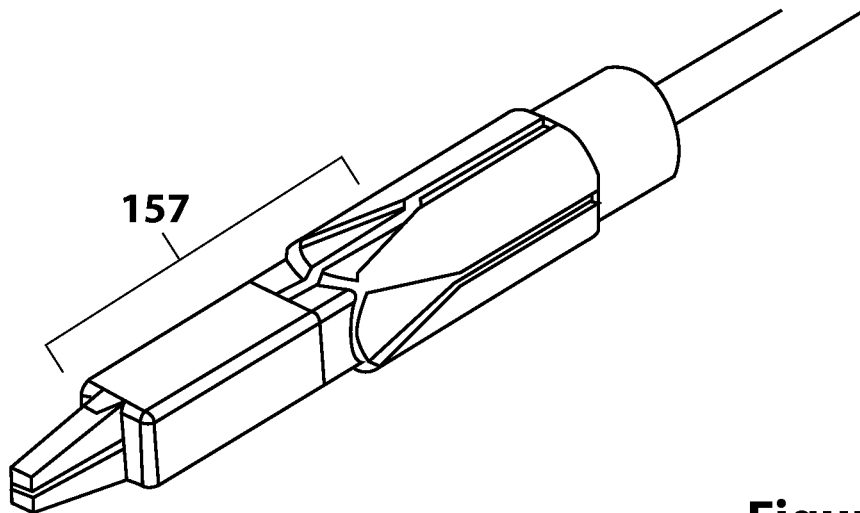


Figure 26A

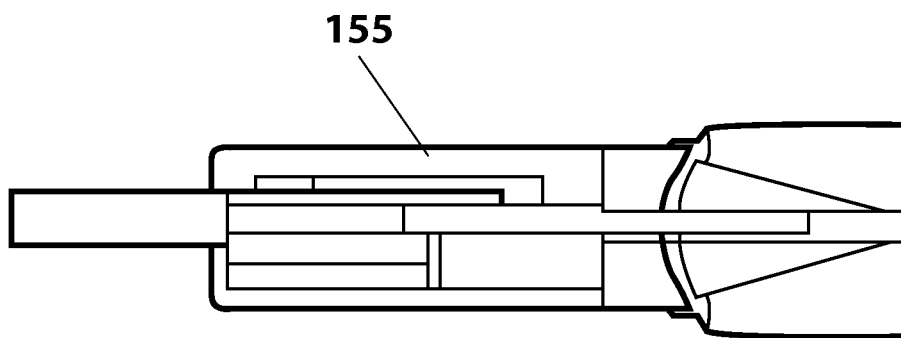


Figure 26B

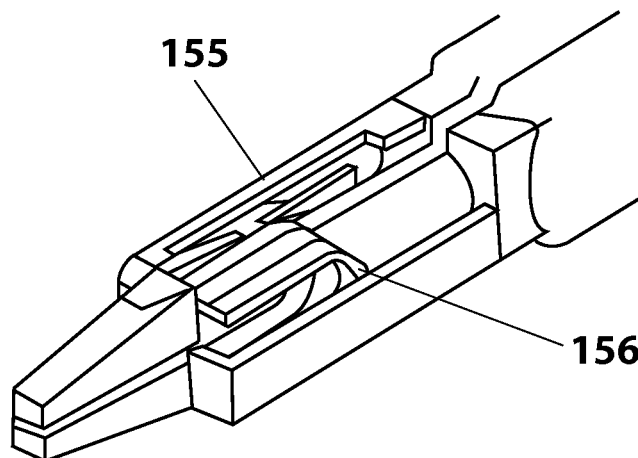


Figure 26C

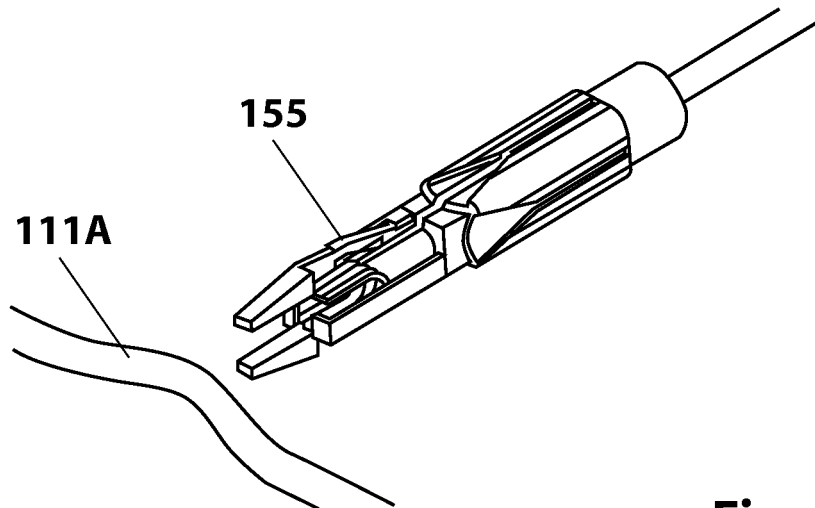


Figure 27A

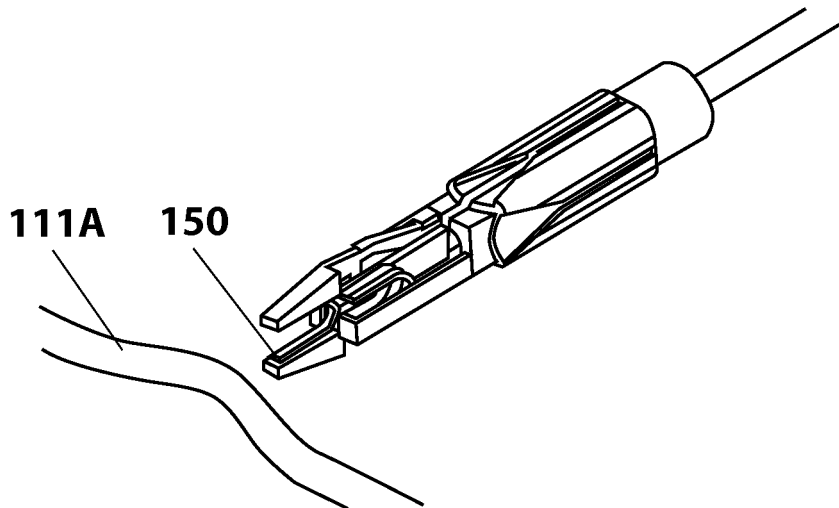


Figure 27B

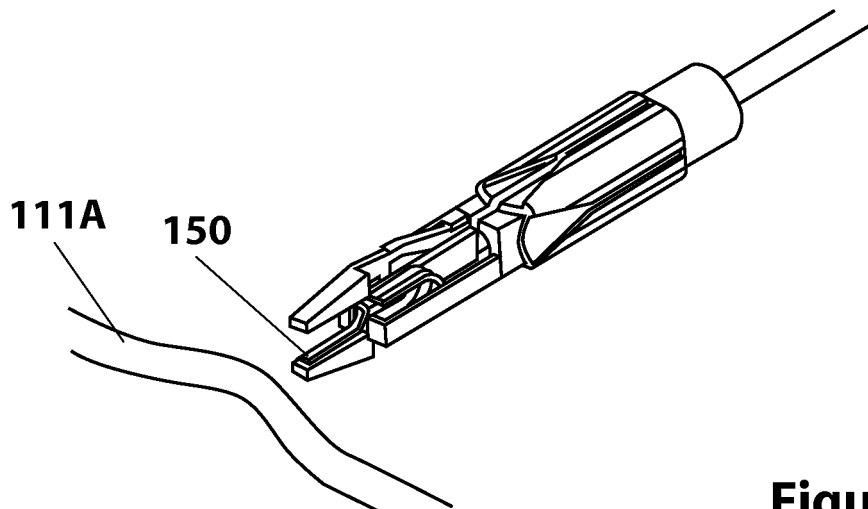


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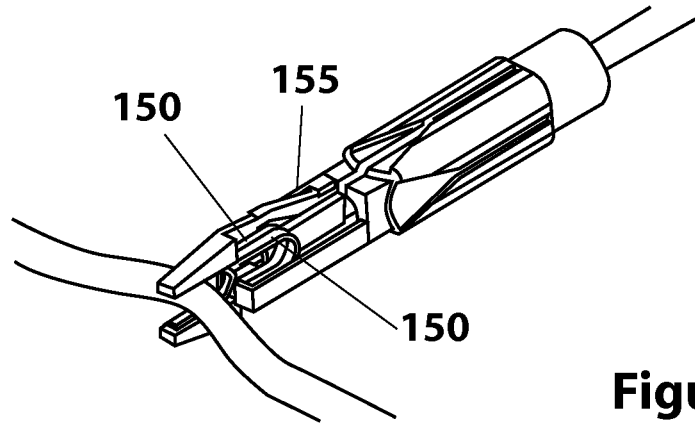


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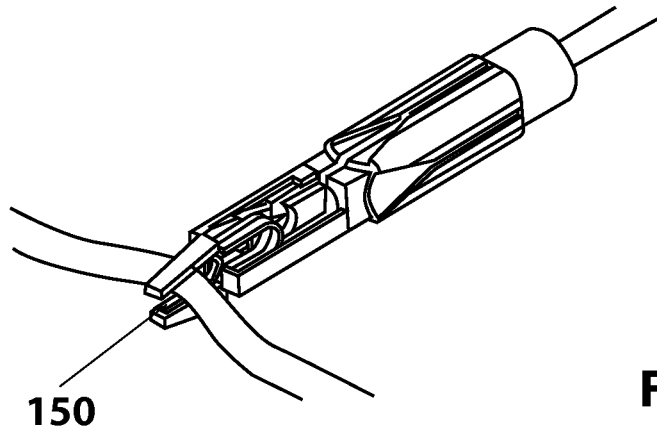


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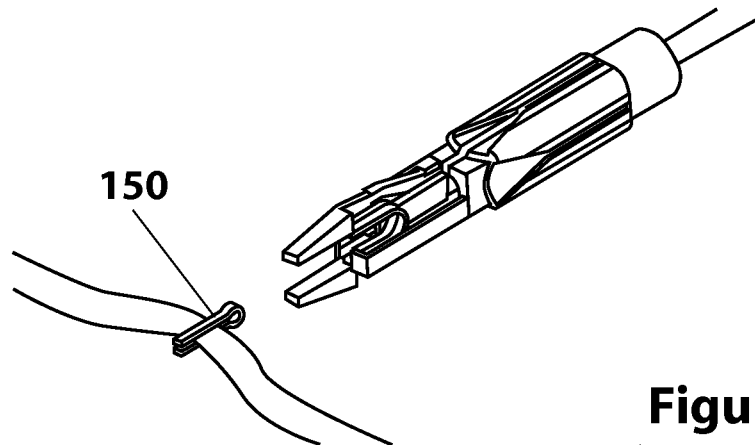


Figure 27F

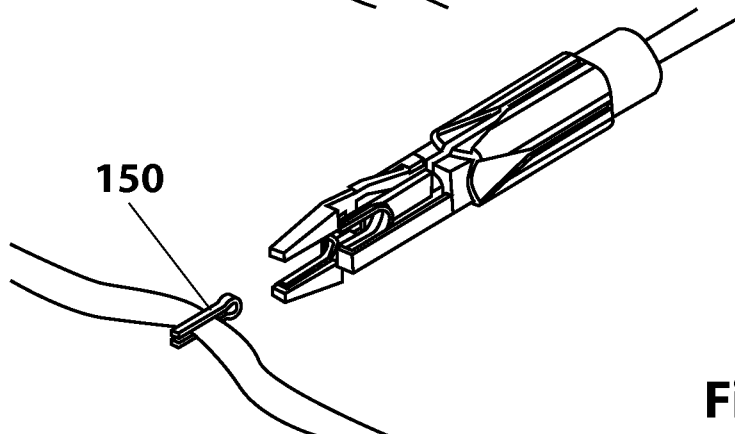


Figure 27G

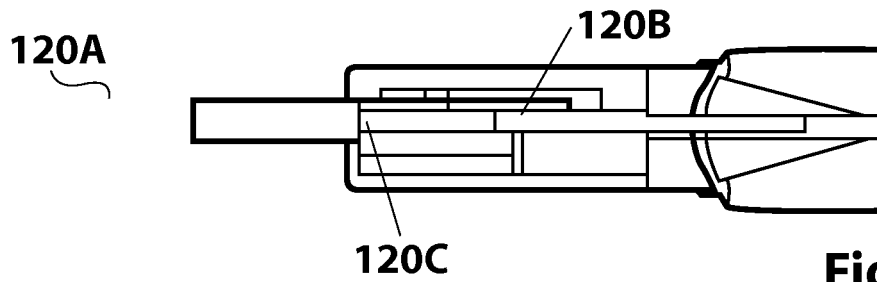


Figure 28A

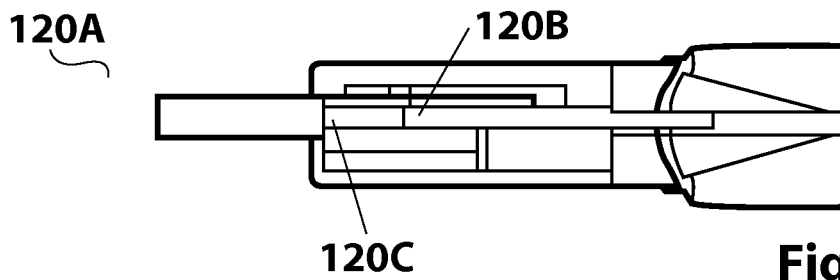


Figure 28B

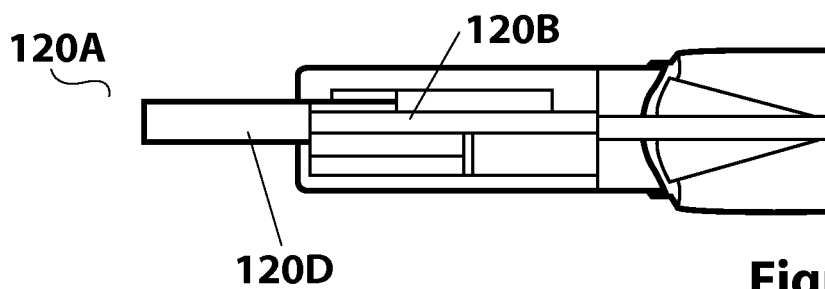


Figure 28C

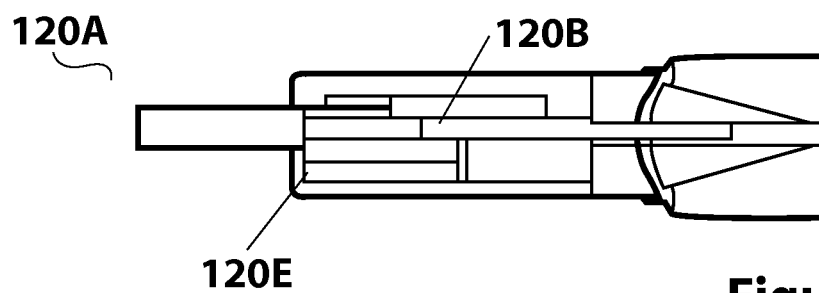


Figure 28D

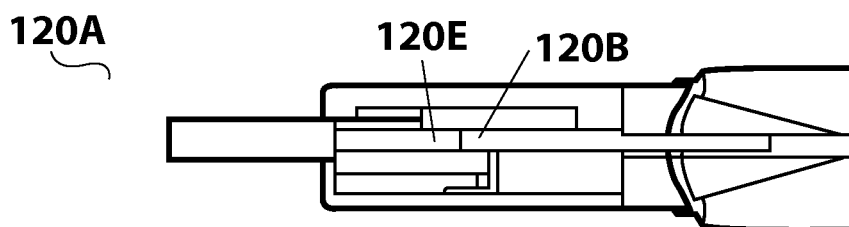


Figure 28E

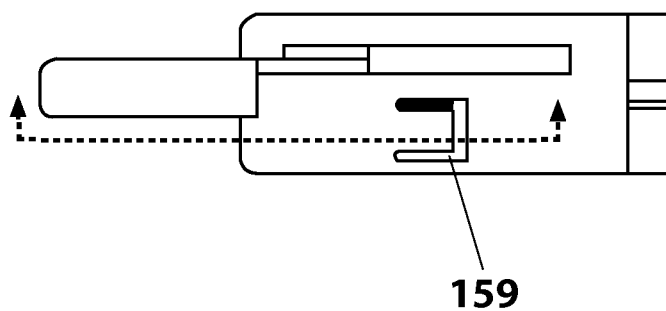


Figure 29A

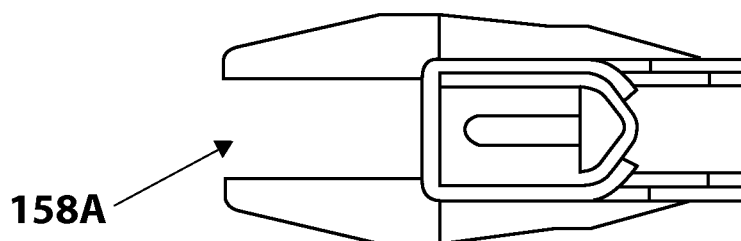


Figure 29B

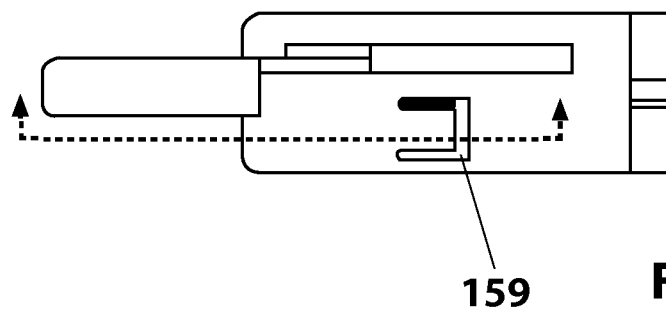


Figure 29C

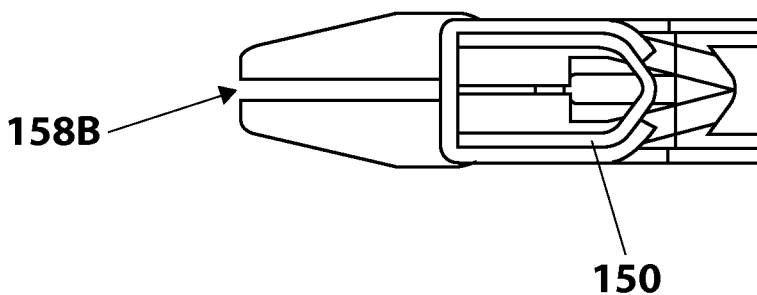


Figure 29D

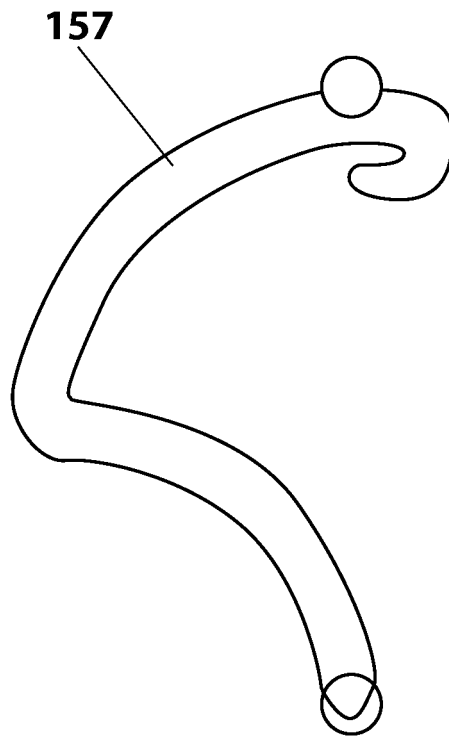


Figure 30A

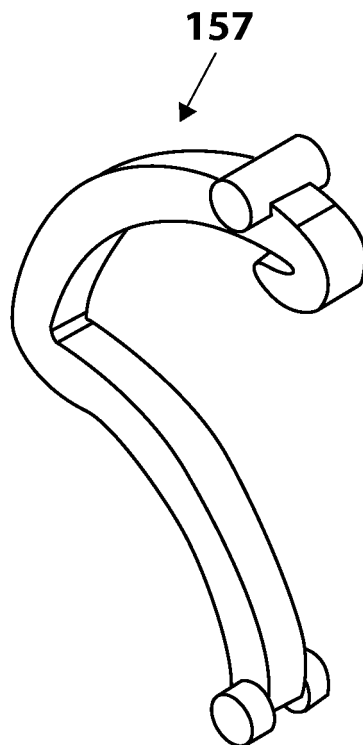


Figure 30B

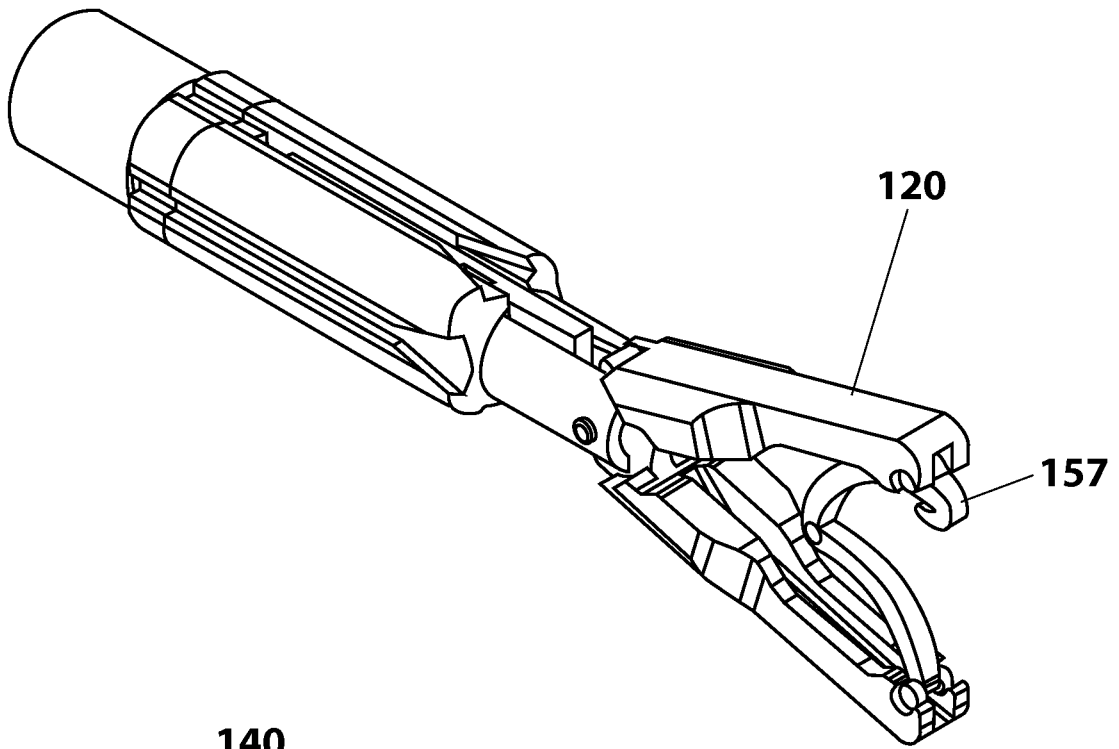


Figure 31A

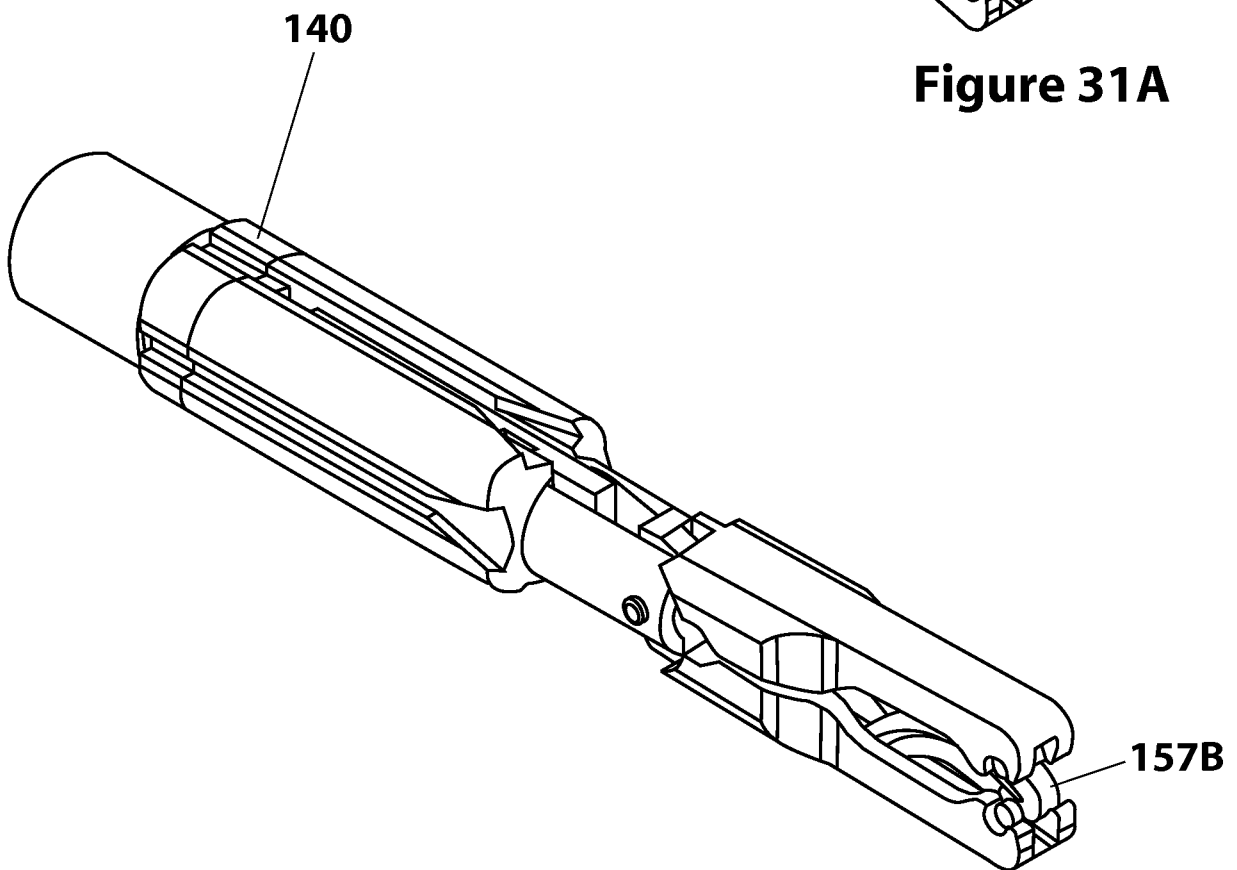


Figure 31B

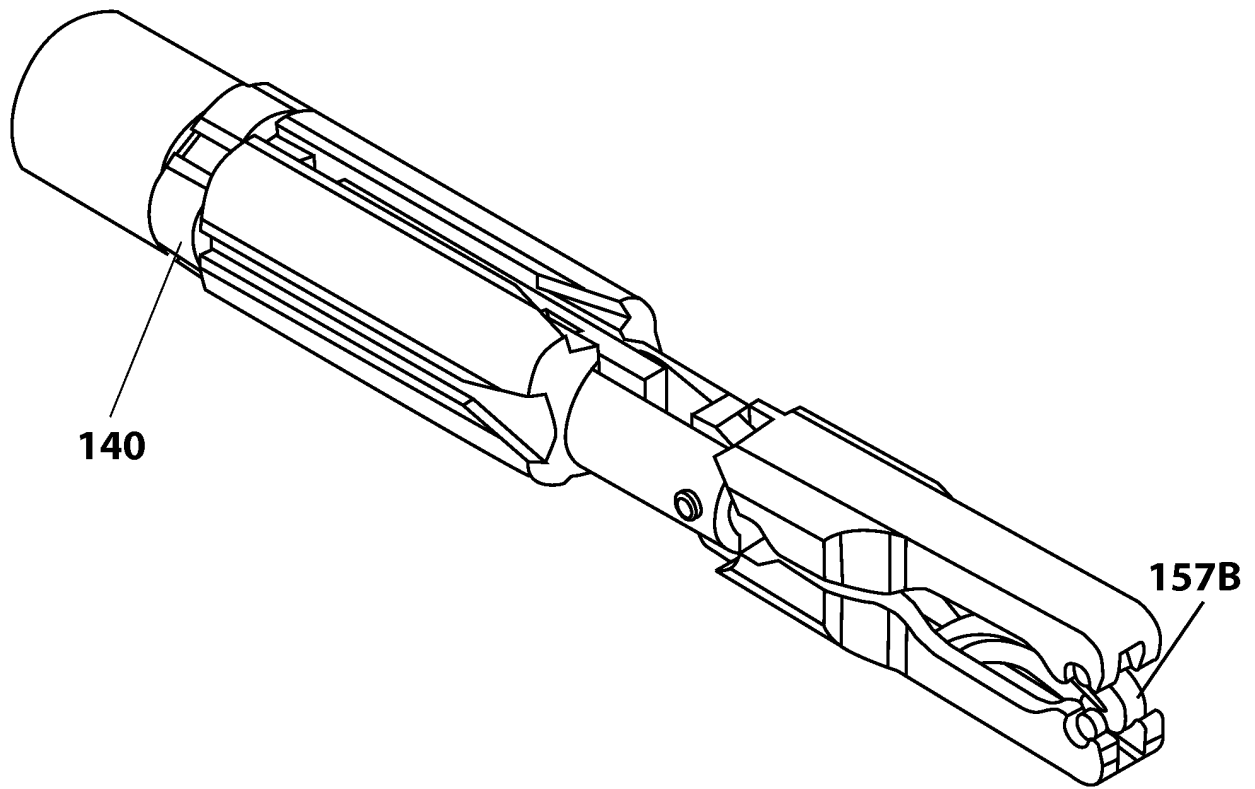


Figure 31C

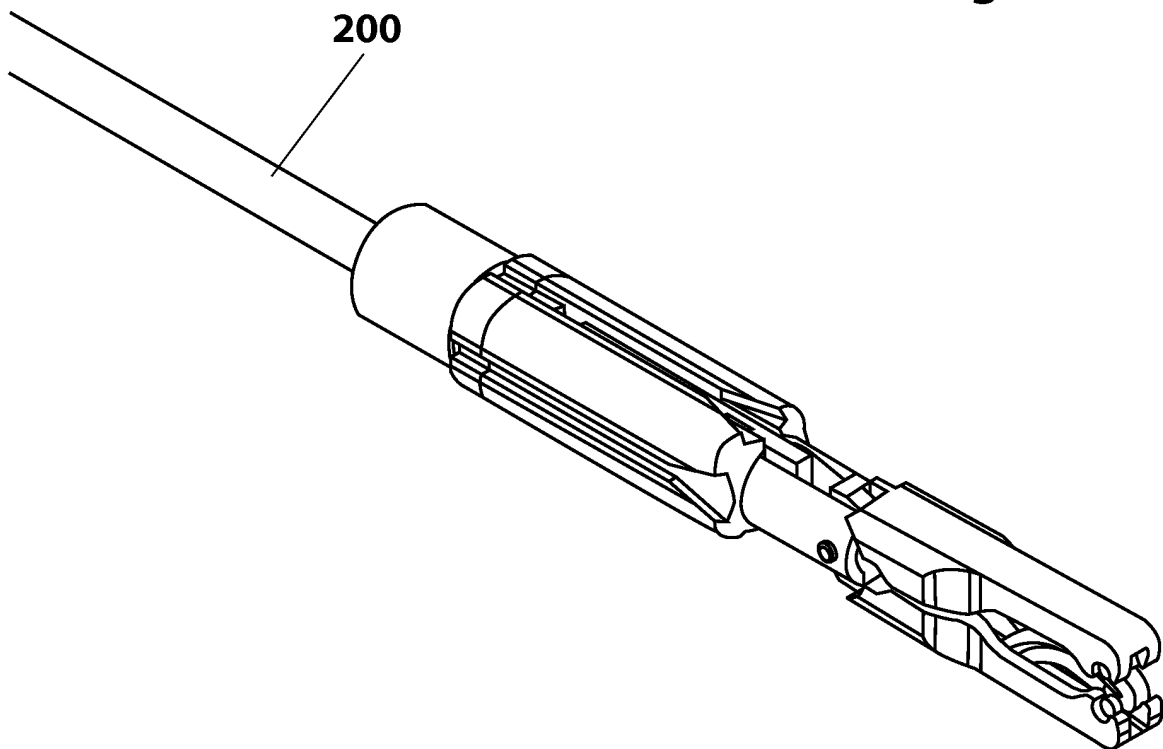


Figure 31D

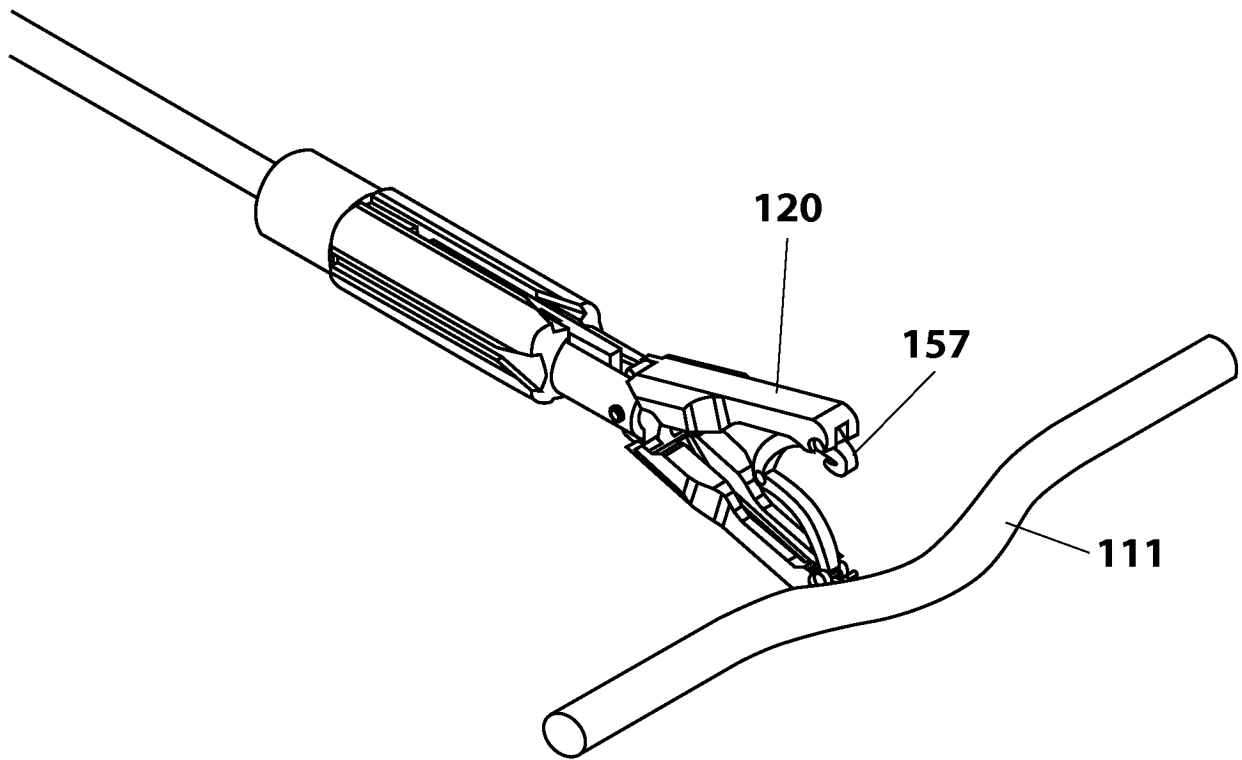


Figure 32A

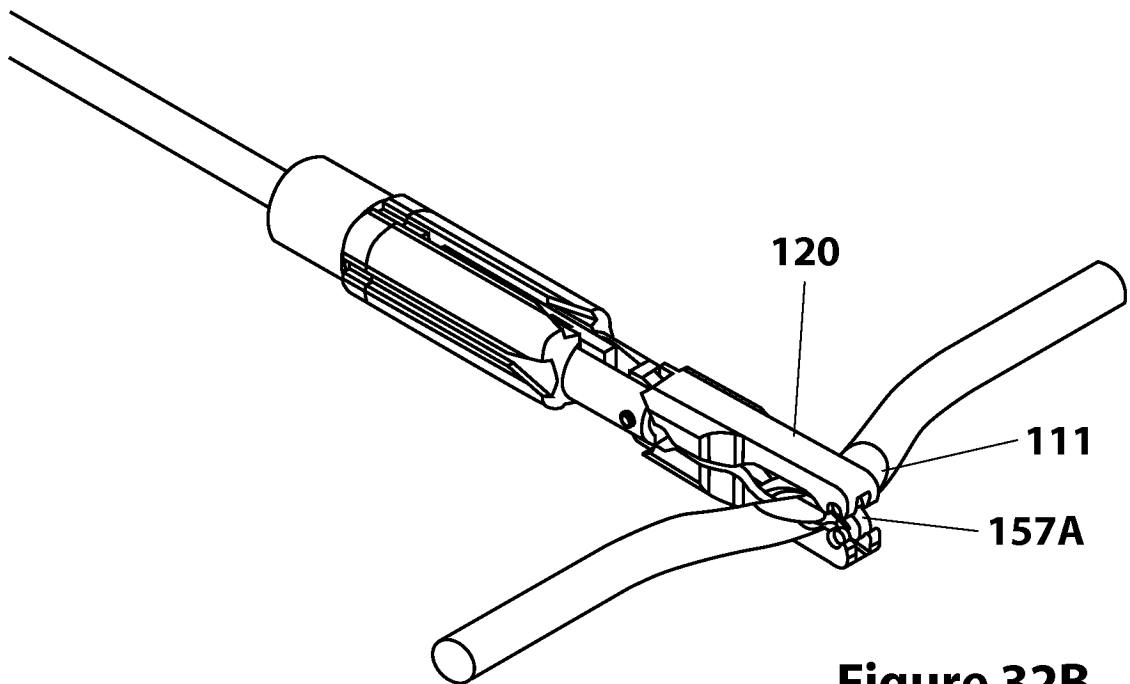


Figure 32B

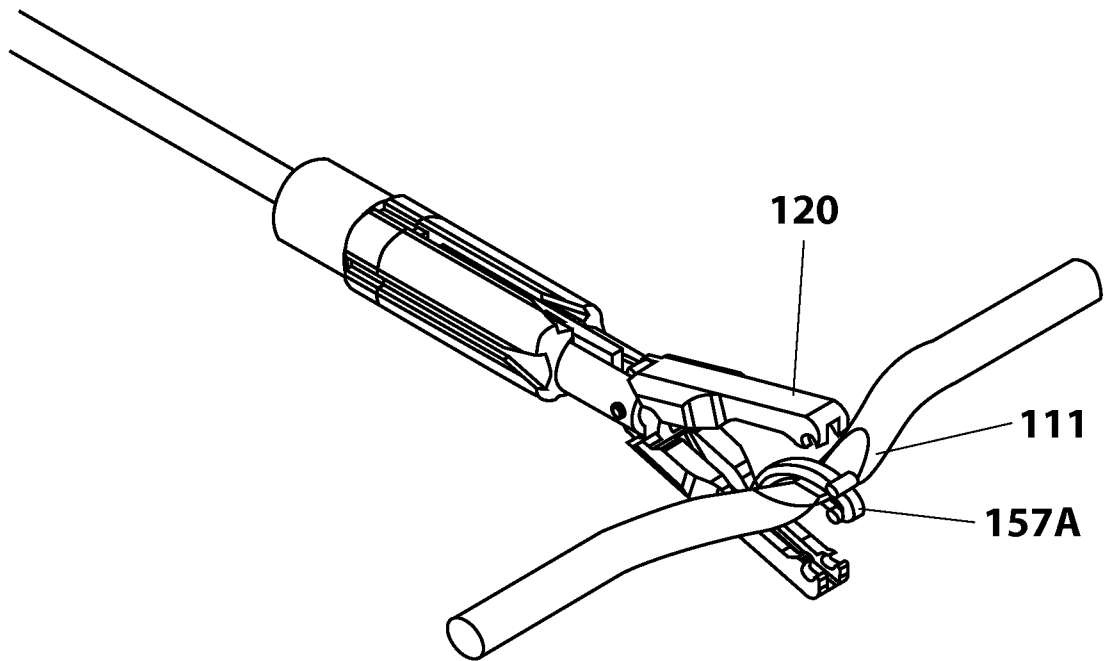


Figure 32C

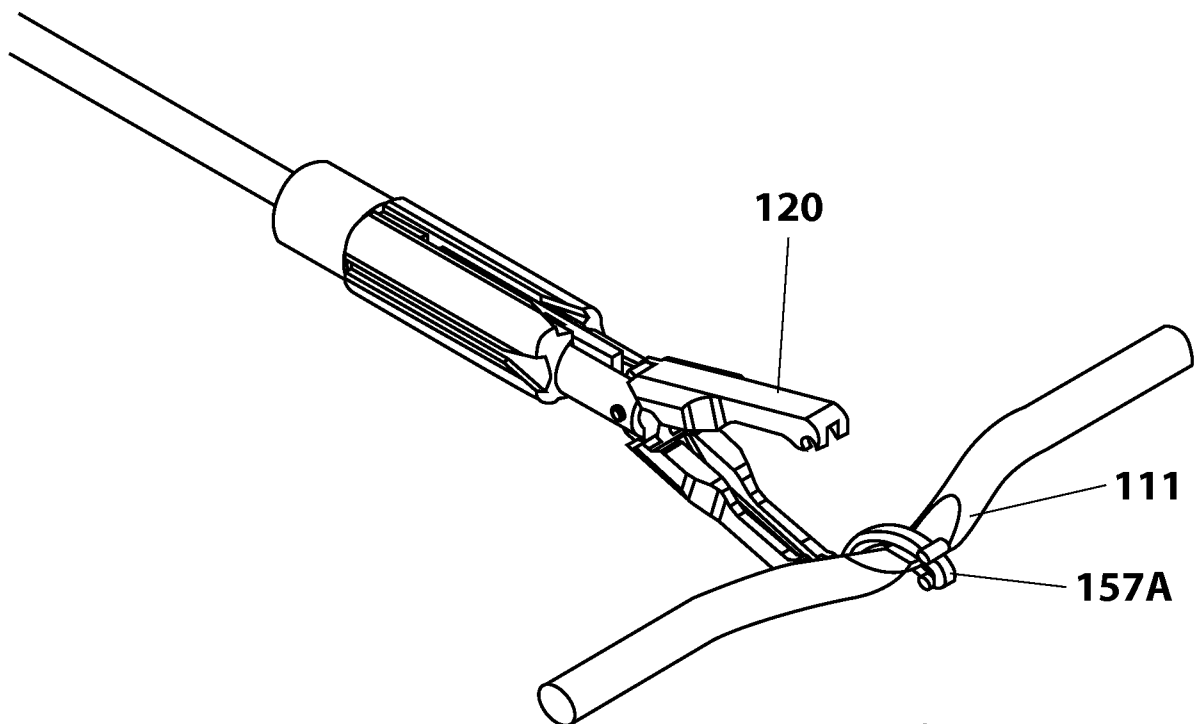


Figure 32D

REFERENCES CITED IN THE DESCRIPTION

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- US 2003130559 A1 [0008]
- WO 2010114634 A1 [0016]
- WO 2012112622 A2 [0016]
- WO 03082363 A2 [0091]
- WO 03082363 A [0091]

专利名称(译)	手术装置，系统和相关方法		
公开(公告)号	EP2967647A2	公开(公告)日	2016-01-20
申请号	EP2014764118	申请日	2014-03-17
[标]申请(专利权)人(译)	米瑞特手术		
申请(专利权)人(译)	米雷特外科INC.		
当前申请(专利权)人(译)	米雷特外科INC.		
[标]发明人	PELL CHRISTOPHER ROOP JOHN DUGGAN BRYAN		
发明人	PELL, CHRISTOPHER ROOP, JOHN DUGGAN, BRYAN		
IPC分类号	A61B17/34 A61B1/00		
CPC分类号	A61B1/00087 A61B1/00098 A61B17/1285 A61B17/29 A61B17/3417 A61B90/361 A61B2017/00473 A61B2017/3445 A61B2017/3447 A61B1/00066 A61B1/00096 A61B1/042 A61B1/313 A61B1/3132 A61B17/3423 A61B2017/347		
优先权	61/792957 2013-03-15 US		
其他公开文献	EP2967647B1 EP2967647A4		
外部链接	Espacenet		

摘要(译)

公开了用于腹部手术的装置，系统和方法。系统可以具有耦合到导引器的范围。该系统可以具有一个或多个末端执行器，其可以连接到导引器并通过穿过患者脐的小穿孔插入腹部。末端执行器可以具有手术工具，例如抓紧器。该系统可以具有可操纵的控制臂，该控制臂可以通过穿过患者体壁的小穿孔插入腹部。末端执行器可以连接到控制臂上，同时或同时从导引器或托盘上拆下。然后，控制臂可以操纵末端执行器以执行手术。