US 20180028210A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2018/0028210 A1**

Nobis, IV et al. (43) **Pub. Date: Feb. 1, 2018**

(54) **LAPAROSCOPIC INSTRUMENT WITH ATTACHABLE END EFFECTOR**

(71) Applicant: **Ethicon LLC**, Guaynabo, PR (US)

(72) Inventors: **Rudolph H. Nobis, IV**, Mason, OH (US); **James T. Spivey**, Whitehouse Station, NJ (US); **Christopher J. Hess**, Blue Ash, OH (US); **Kevin M. Huey**, Brea, CA (US)

(21) Appl. No.: **15/727,980**

(22) Filed: **Oct. 9, 2017**

Related U.S. Application Data

(63) Continuation of application No. 12/889,458, filed on Sep. 24, 2010.

Publication Classification

(51) **Int. Cl.**

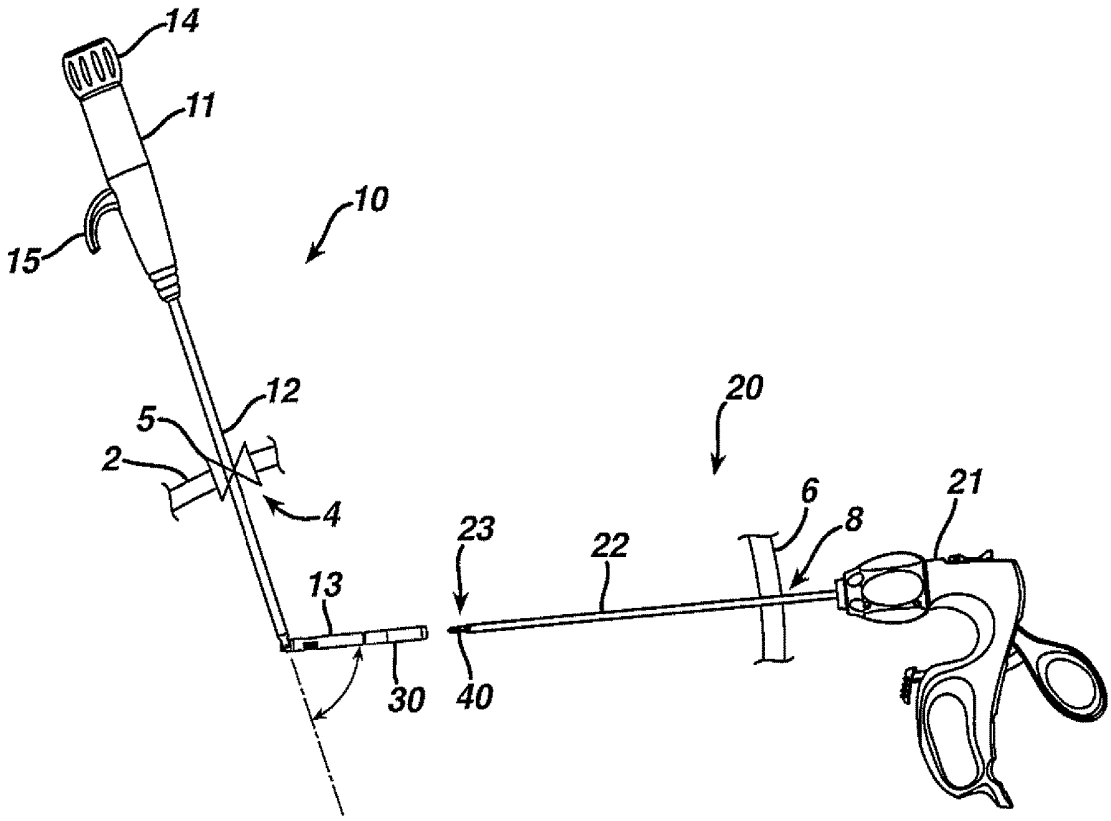
A61B 17/29	(2006.01)
A61B 17/00	(2006.01)
A61B 17/34	(2006.01)

(52) **U.S. Cl.**

CPC ***A61B 17/29*** (2013.01); *A61B 2017/3454* (2013.01); *A61B 2017/2946* (2013.01); *A61B 2017/00362* (2013.01); *A61B 2017/2931* (2013.01); *A61B 2017/00477* (2013.01); *A61B 2017/294* (2013.01)

(57) **ABSTRACT**

A laparoscopic surgical device comprises an elongate shaft defining a longitudinal axis, the shaft comprising a distal end and a proximal end. A plurality of arms project distally from the distal end of the elongate shaft, the arms each comprising a lateral notch. The arms are axially slideable relative the elongate shaft and are medially deflectable. An elongate pin is positioned medially relative the arms. The elongate pin is axially slideable relative the arms between a locked position preventing medial deflection of the arms and an unlocked position allowing medial deflection of the arms. A surgical end effector is selectively attachable in vivo and detachable in vivo to the mating feature of the arms, the surgical end effector comprising a torque transfer means and tissue contact apparatus that open and close in response to the axial movement of the two arms when attached to the surgical end effector.



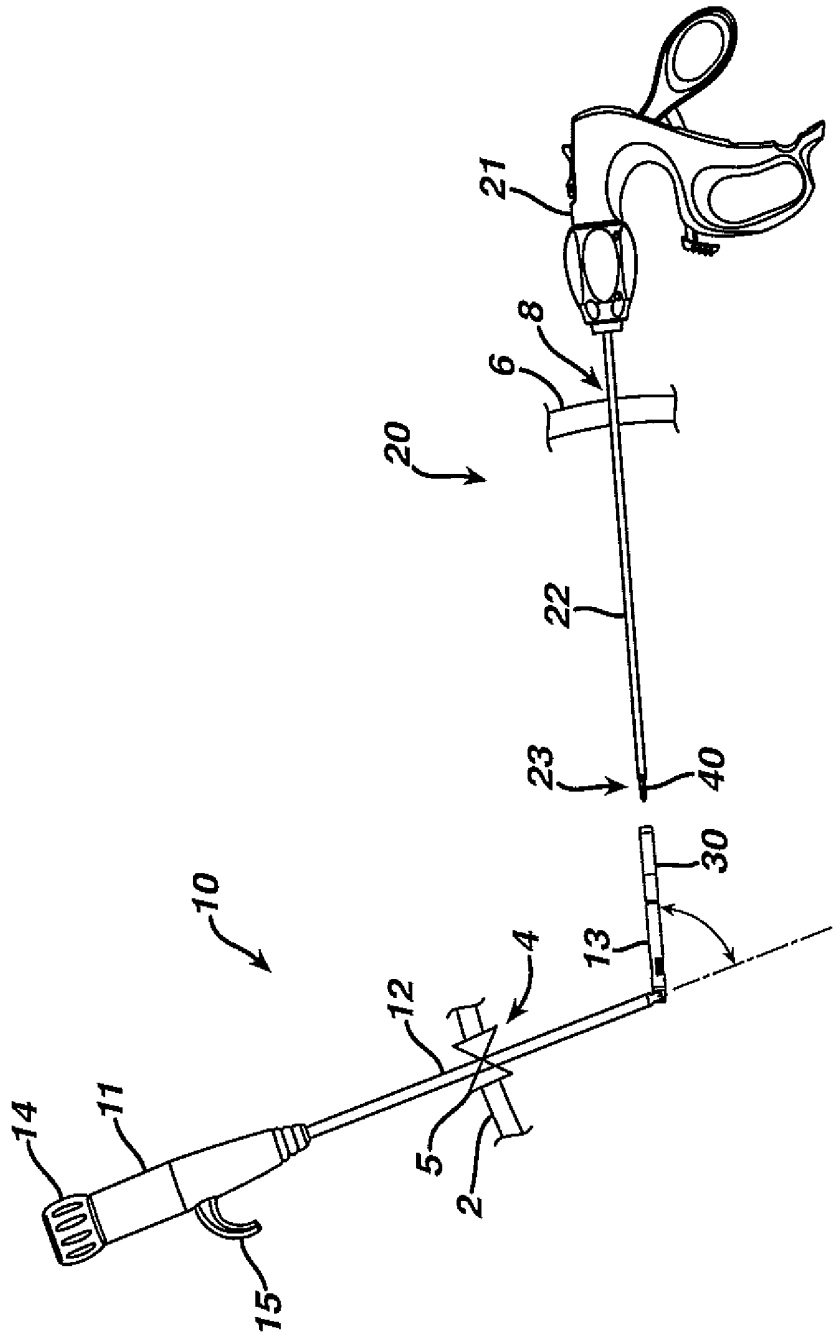


FIG. 1

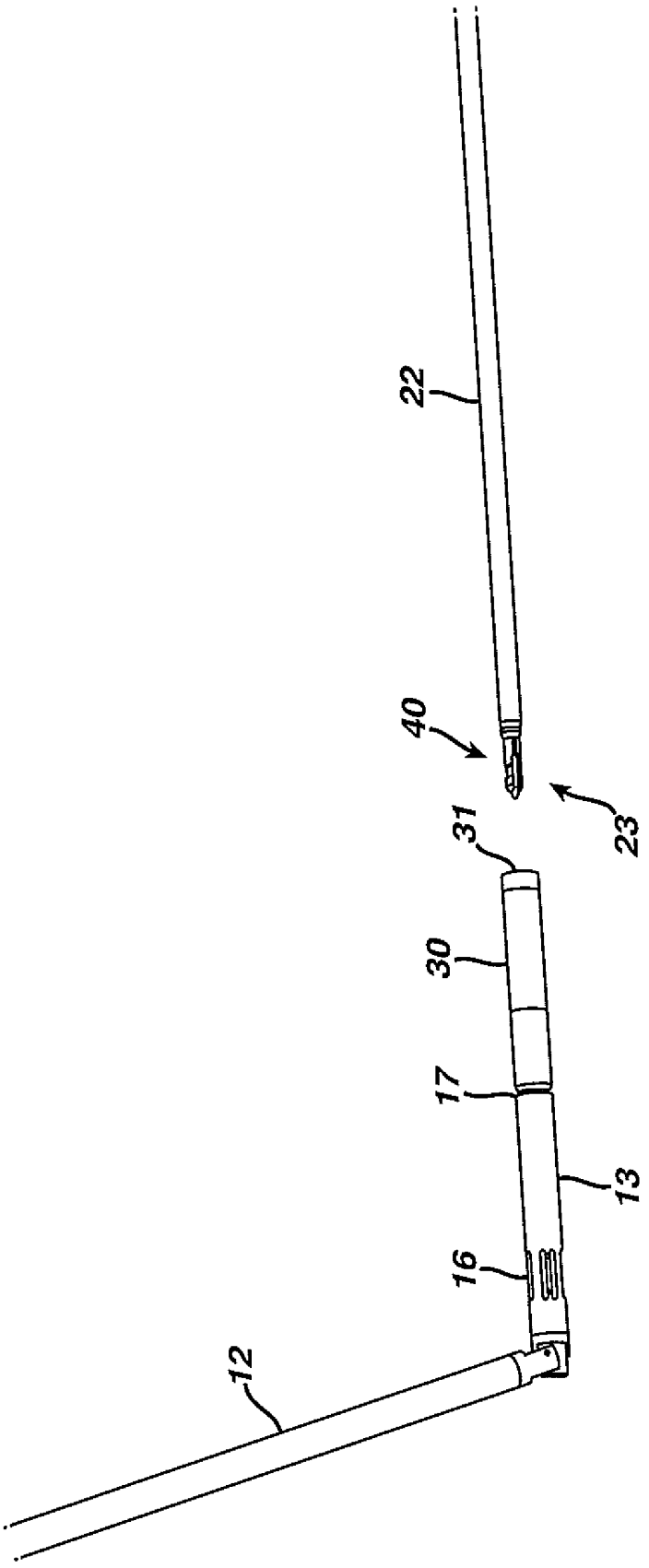


FIG. 2

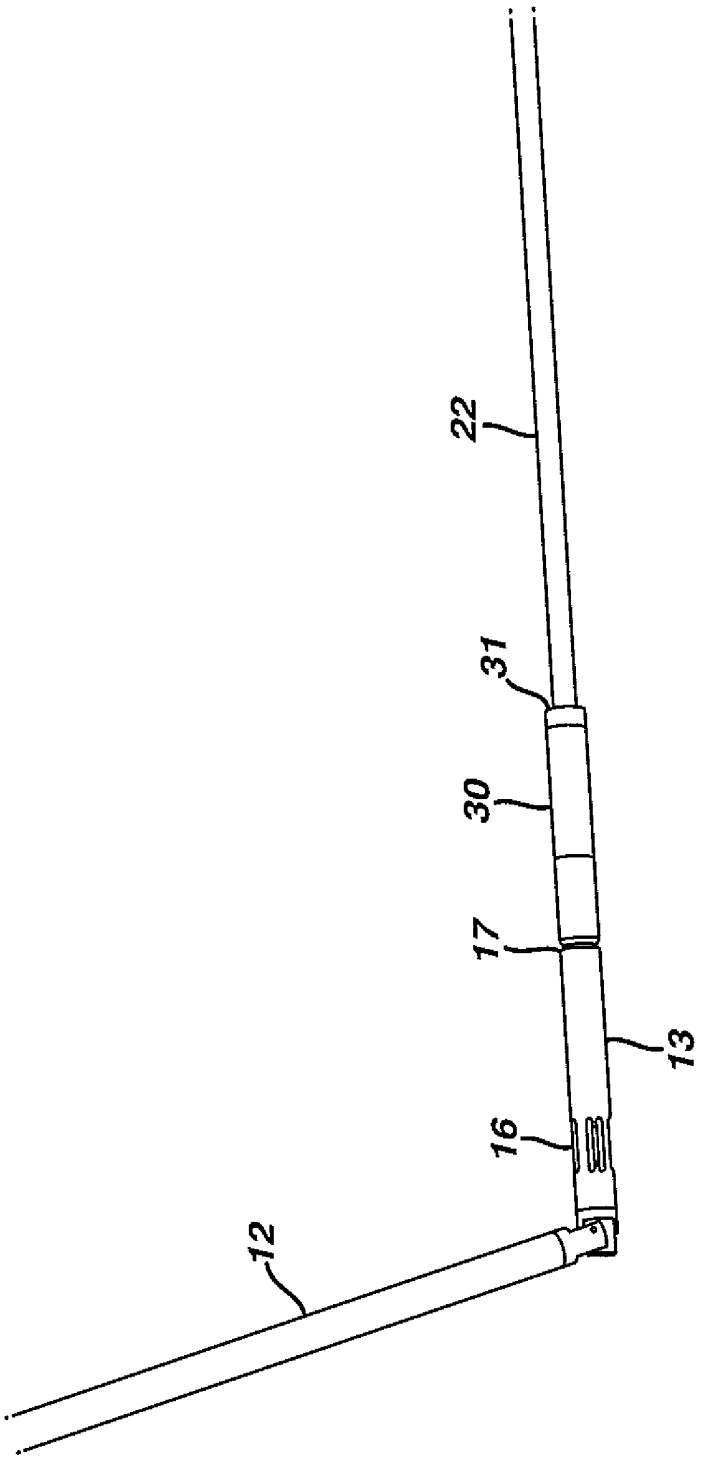


FIG. 3

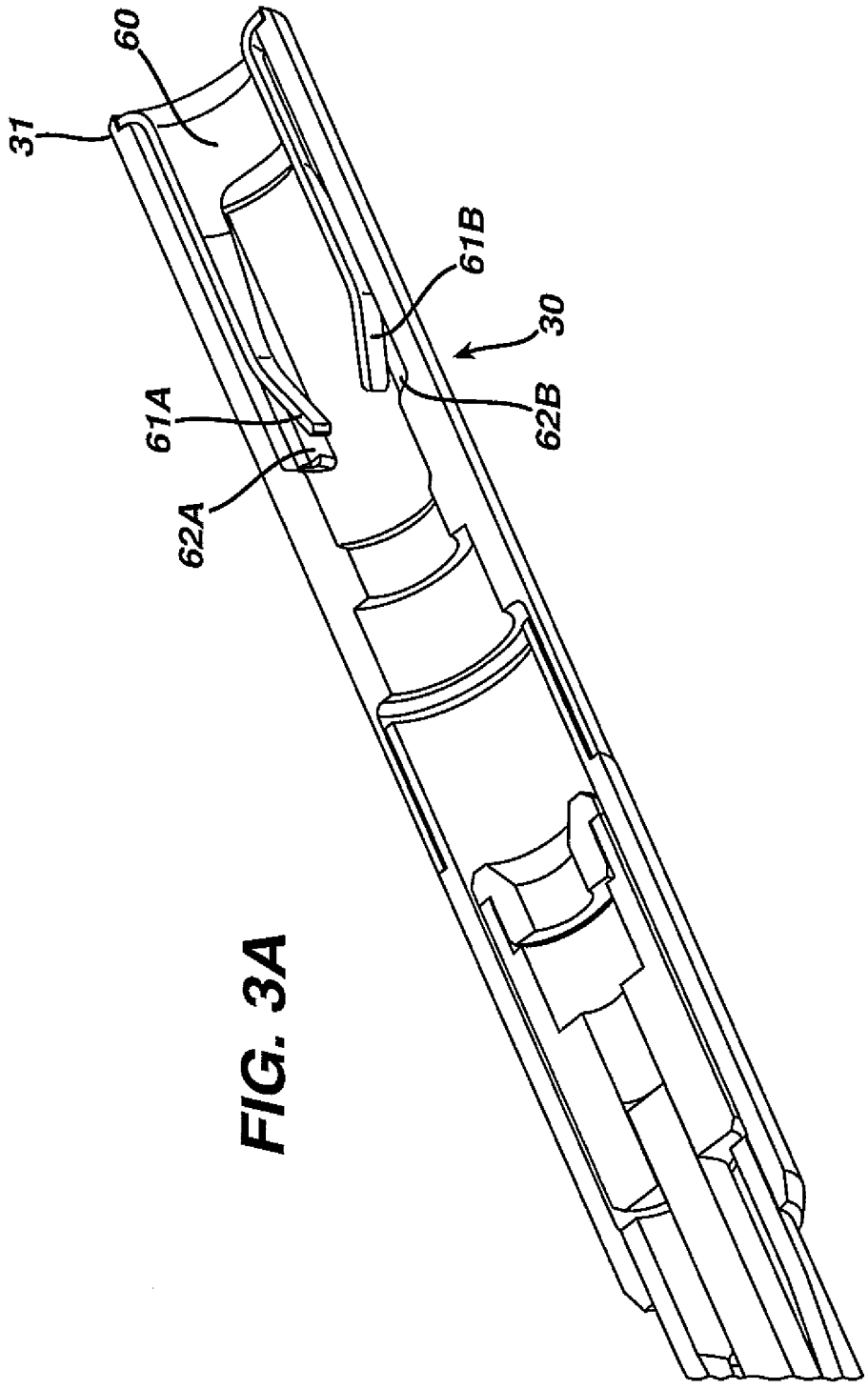


FIG. 3A

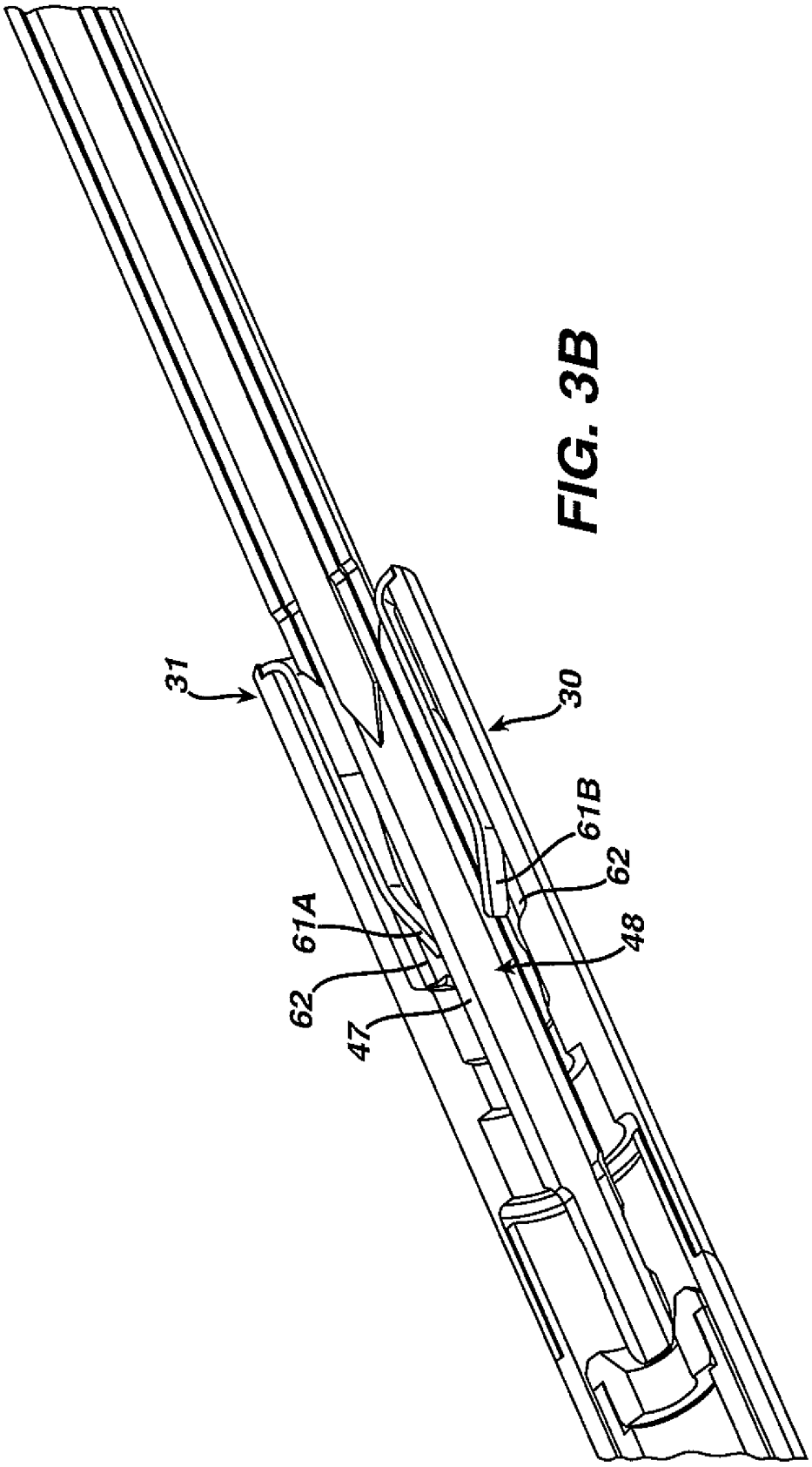


FIG. 3B

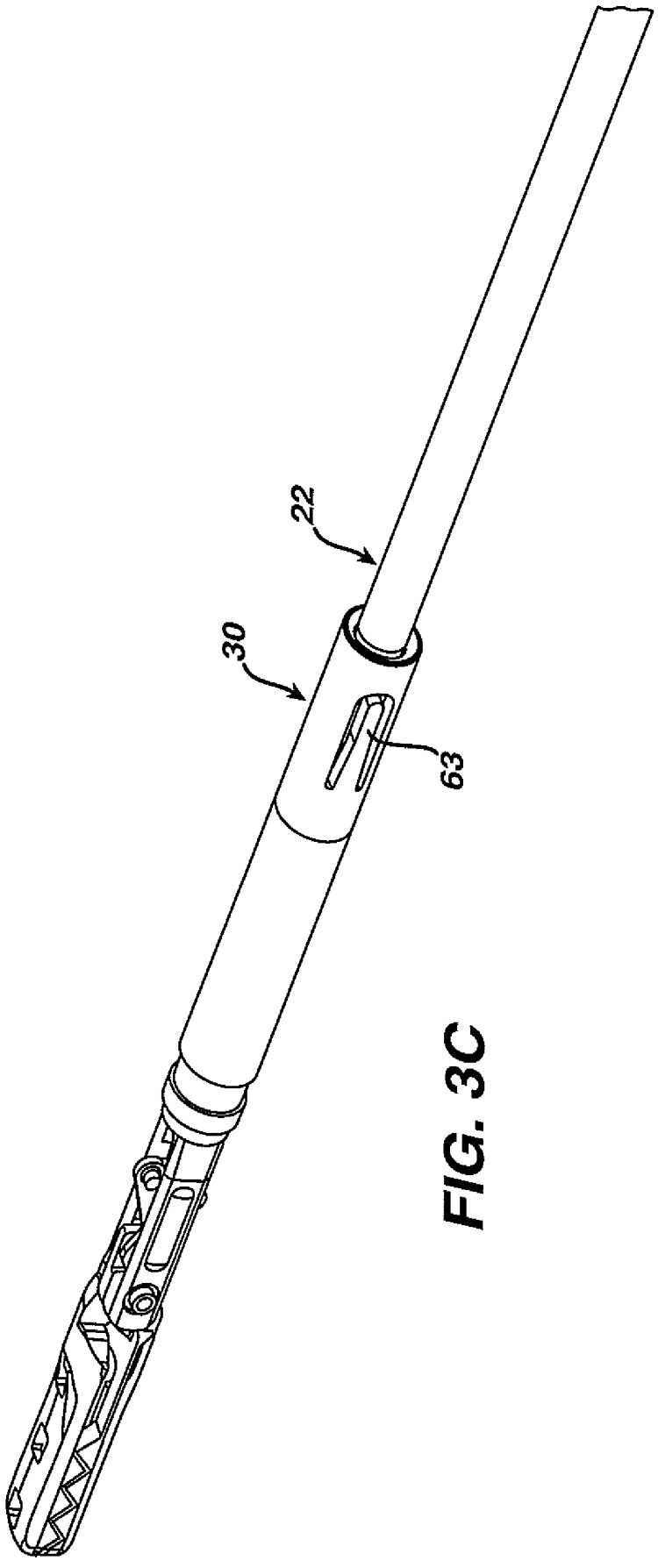


FIG. 3C

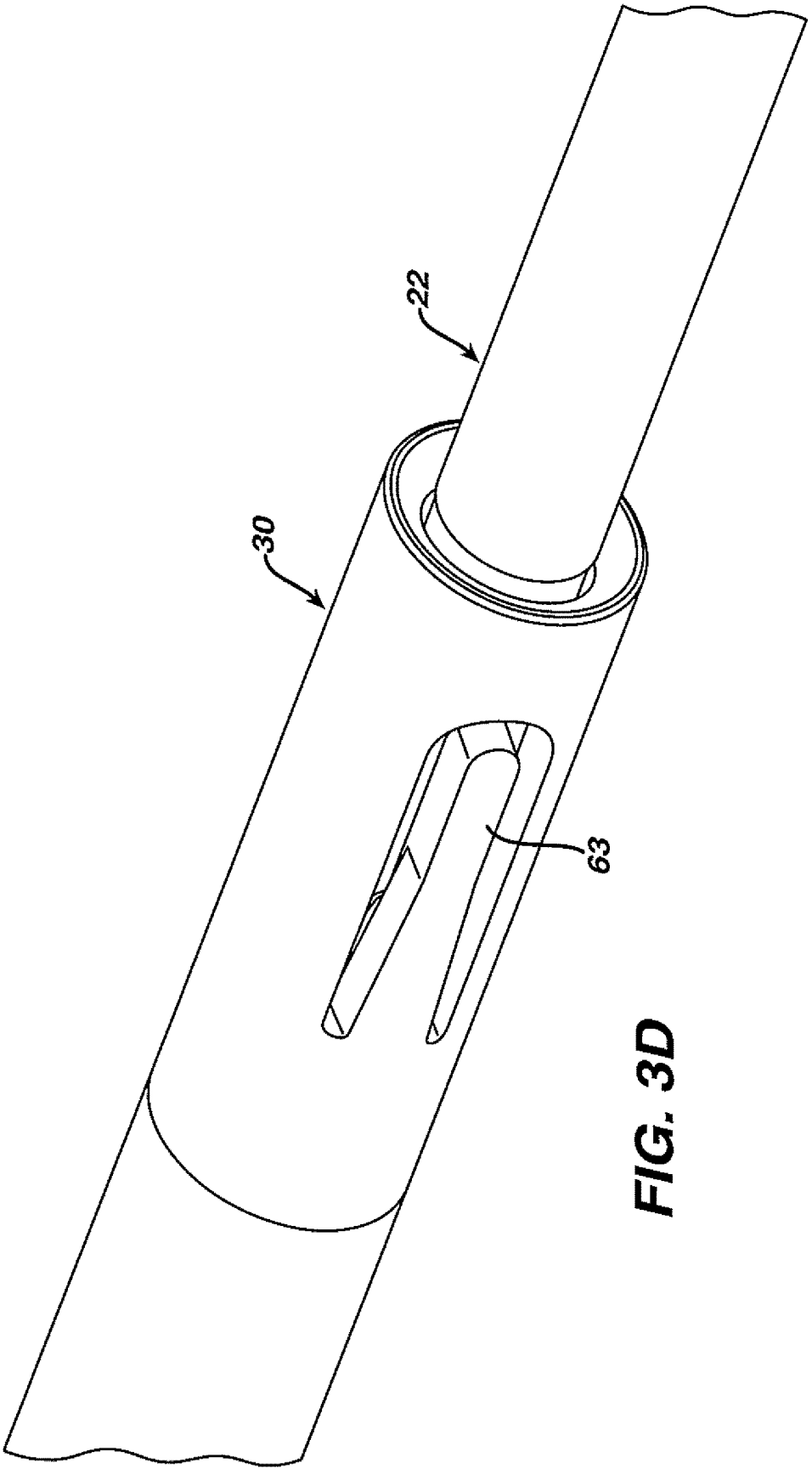


FIG. 3D

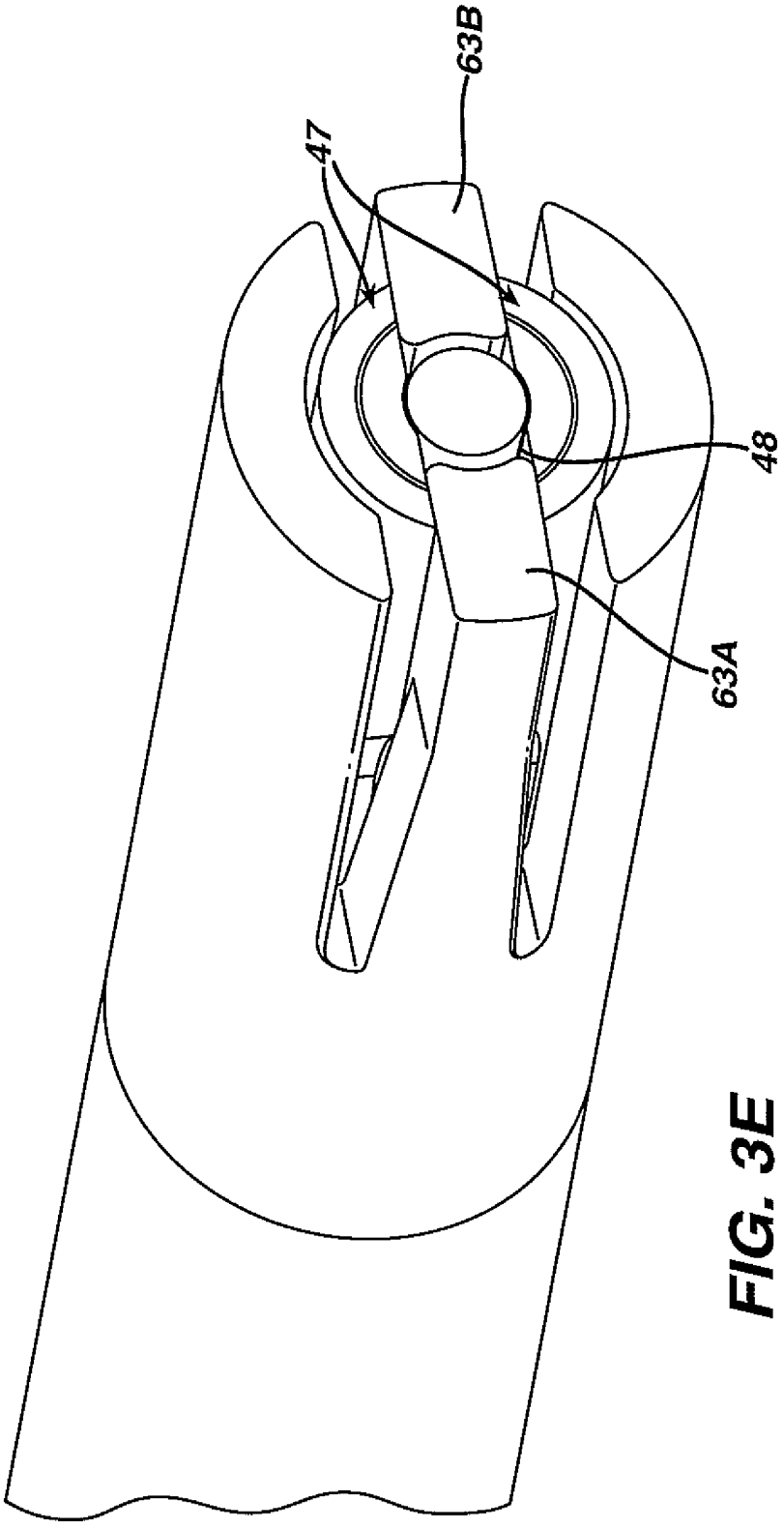


FIG. 3E

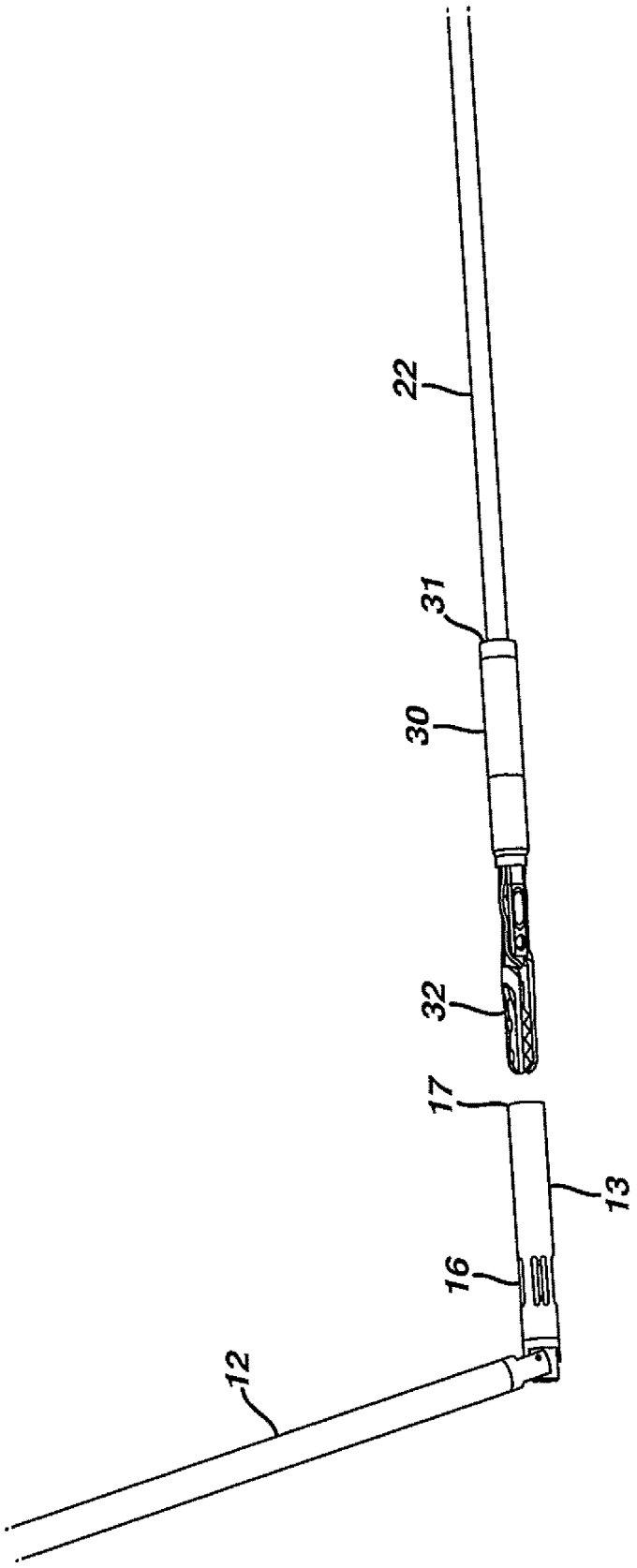


FIG. 4

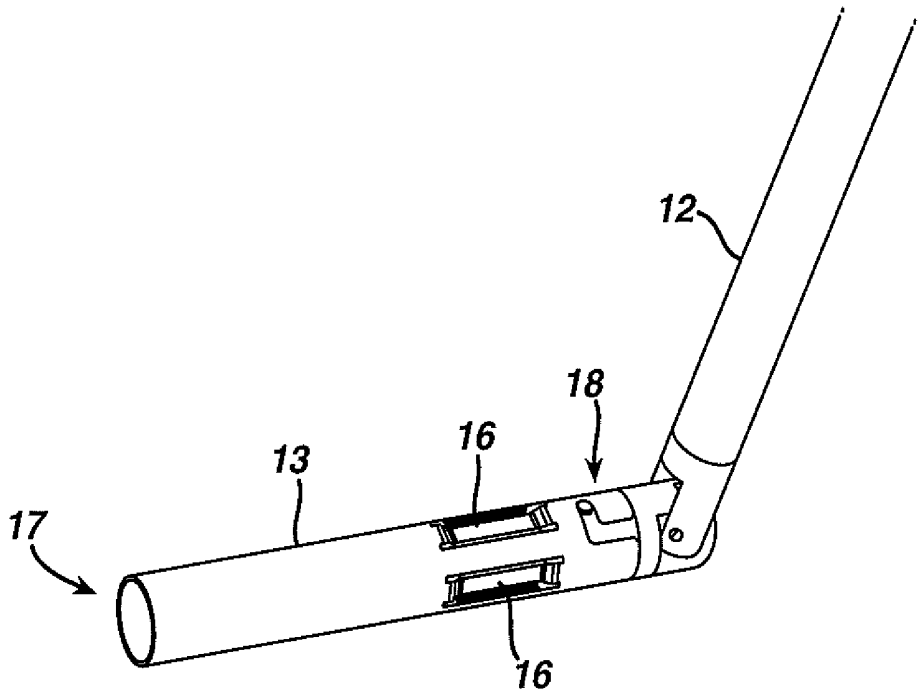


FIG. 4A

FIG. 5

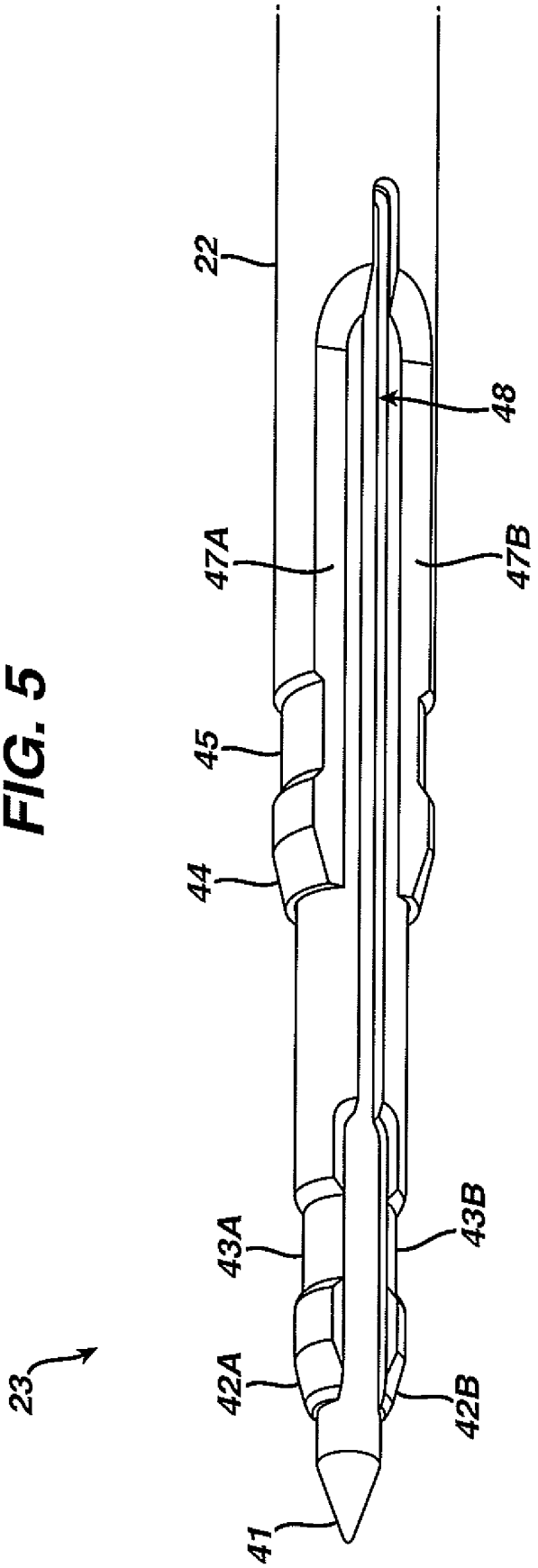
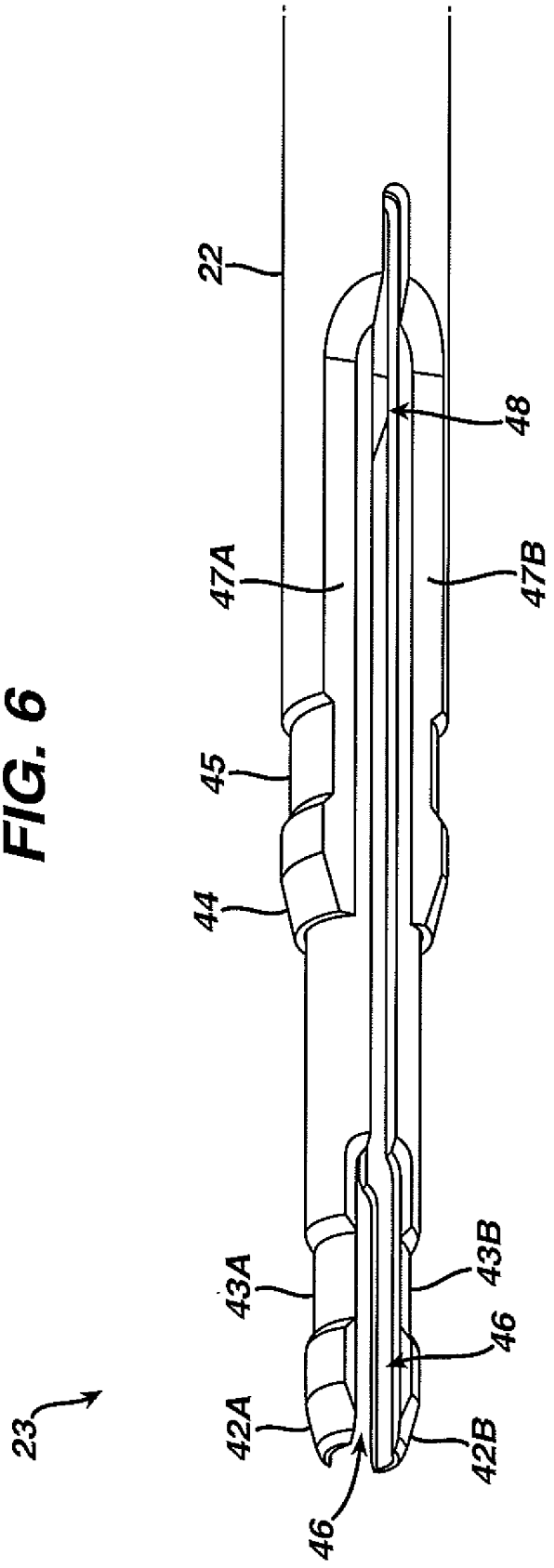


FIG. 6



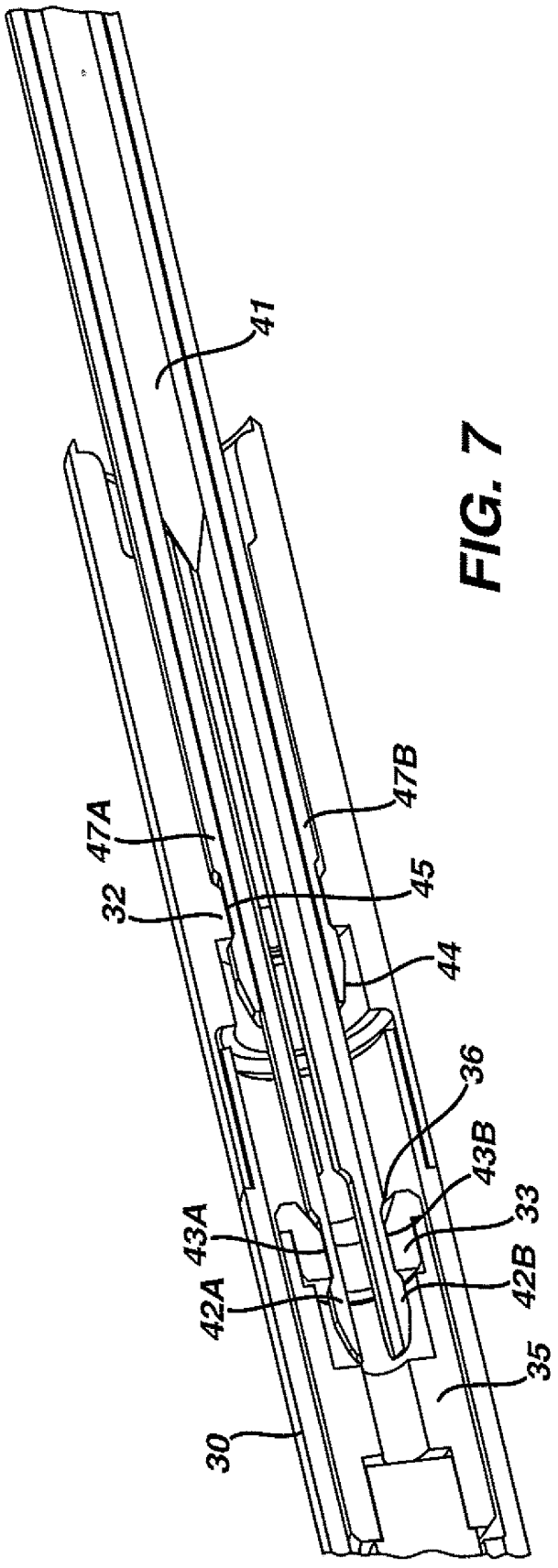


FIG. 7

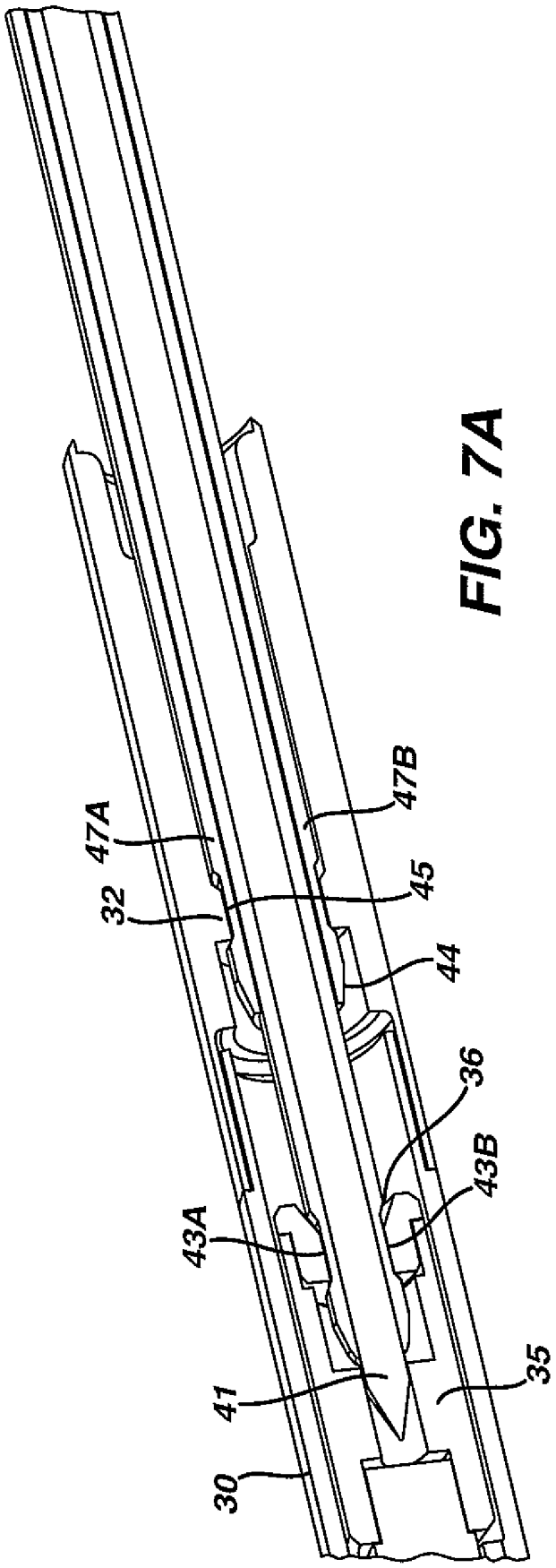


FIG. 7A

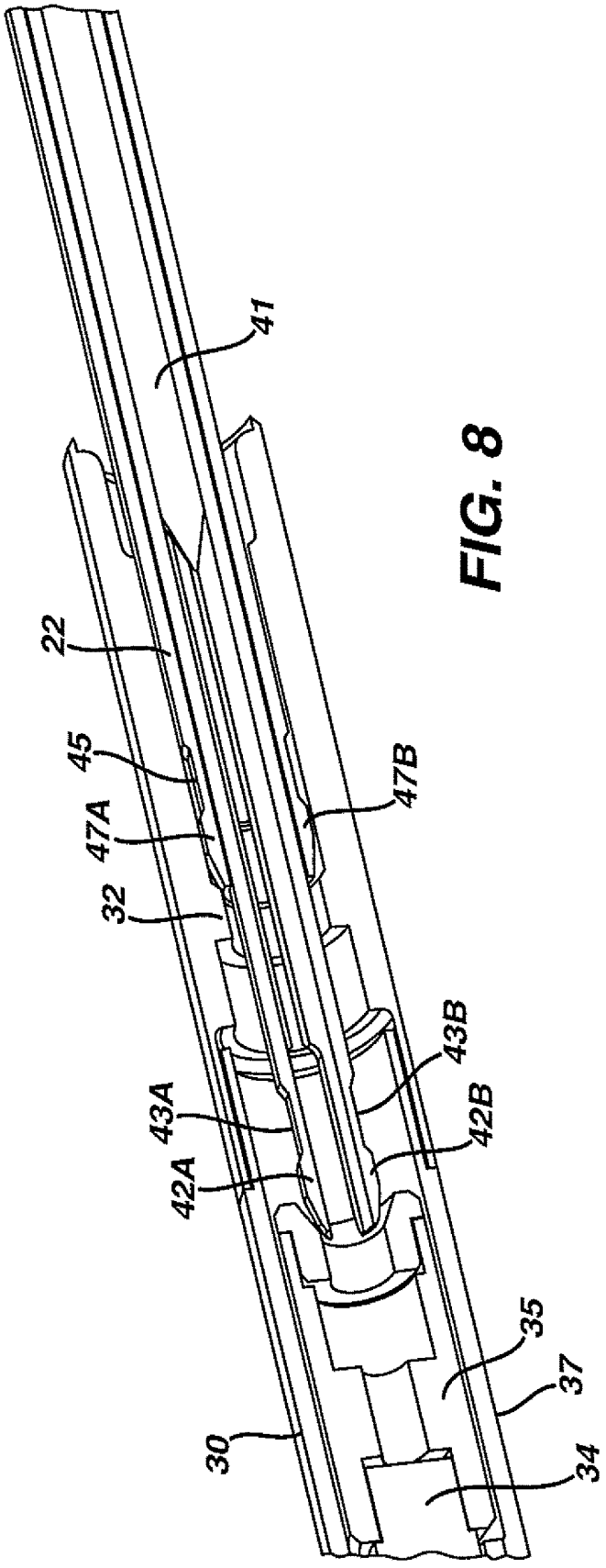
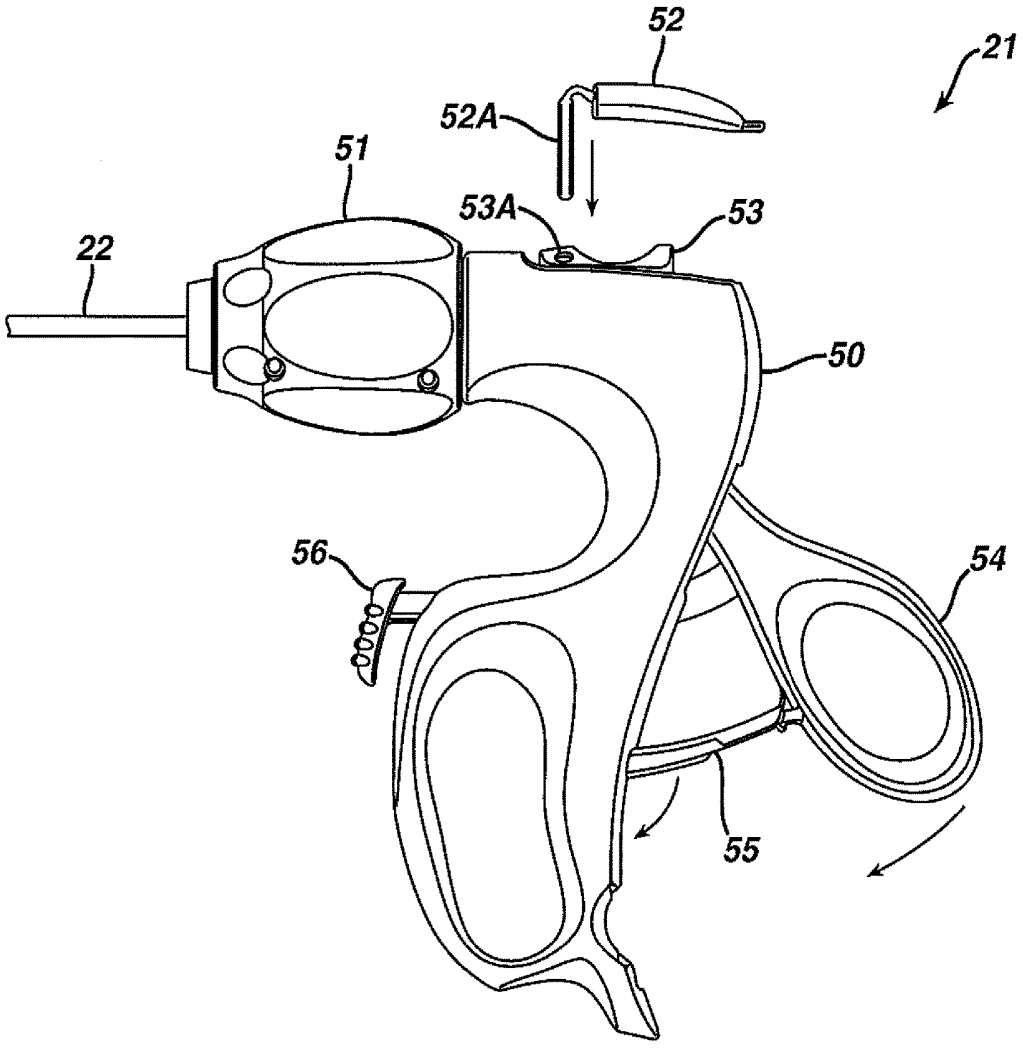


FIG. 8

FIG. 9



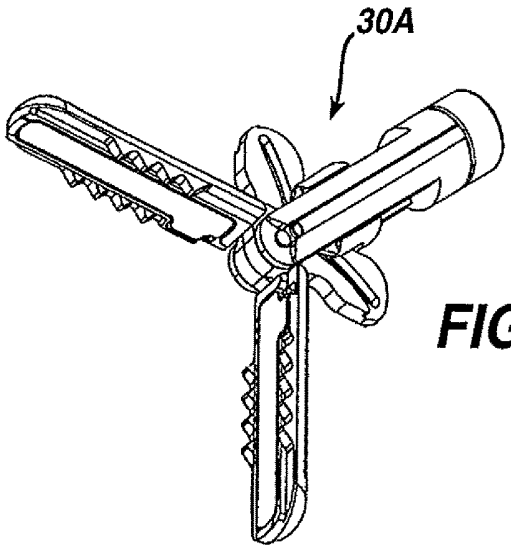


FIG. 10

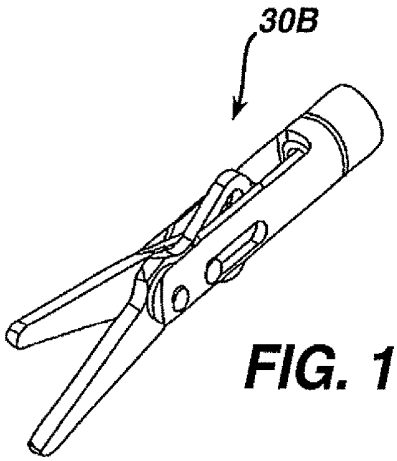


FIG. 11

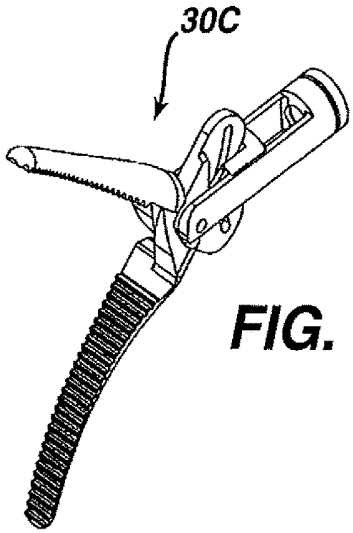


FIG. 12

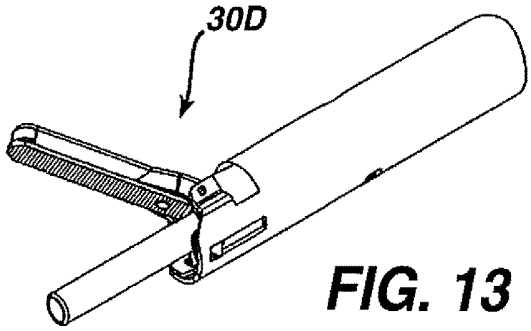


FIG. 13

LAPAROSCOPIC INSTRUMENT WITH ATTACHABLE END EFFECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application under 35 U.S.C. §120 of U.S. patent application Ser. No. 12/889,458, entitled LAPAROSCOPIC INSTRUMENT WITH ATTACHABLE END EFFECTOR, filed Sep. 24, 2010.

BACKGROUND

[0002] The present invention relates in general to surgical devices and procedures, and more particularly to minimally invasive surgery.

[0003] Surgical procedures are often used to treat and cure a wide range of diseases, conditions, and injuries. Surgery often requires access to internal tissue through open surgical procedures or endoscopic surgical procedures. The term "endoscopic" refers to all types of minimally invasive surgical procedures including laparoscopic, arthroscopic, natural orifice intraluminal, and natural orifice transluminal procedures. Endoscopic surgery has numerous advantages compared to traditional open surgical procedures, including reduced trauma, faster recovery, reduced risk of infection, and reduced scarring. Endoscopic surgery is often performed with an insufflatory fluid present within the body cavity, such as carbon dioxide or saline, to provide adequate space to perform the intended surgical procedures. The insufflated cavity is generally under pressure and is sometimes referred to as being in a state of pneumoperitoneum. Surgical access devices are often used to facilitate surgical manipulation of internal tissue while maintaining pneumoperitoneum. For example, trocars are often used to provide a port through which endoscopic surgical instruments are passed. Trocars generally have an instrument seal, which prevents the insufflatory fluid from escaping while an instrument is positioned in trocar.

[0004] While surgical access devices are known, no one has previously made or used the surgical devices and methods in accordance with the present invention.

SUMMARY

[0005] A surgical device is provided that comprises an elongate shaft defining a longitudinal axis, where the shaft comprises a distal end and a proximal end. The surgical device has an arm comprising a mating feature, where the arm is medially deflectable. An elongate pin is positioned medially relative the arm, the elongate pin being axially slideable relative the arm between a locked position preventing medial deflection of the arm and an unlocked position allowing medial deflection of the arm. The device has a surgical end effector selectively attachable and detachable to the mating feature of the arm, the end effector having a torque arm to engage the elongate shaft. The surgical device shaft is provided with an opening adapted to receive the torque arm. The opening in the shaft may extend from the lateral outer surface of the elongate shaft through the elongate shaft's medial inner surface. The torque arm in the end effector may comprise a cantilevered leaf spring. The surgical device may comprise two or more arms. The surgical device further comprises a lateral notch on the distal end of the arm and a mating feature on the surgical end effector, wherein the mating feature comprises a ring dimensioned to mate with the arm lateral notch.

[0006] Another surgical device is provided, comprising an elongate shaft defining a longitudinal axis, the shaft comprising a distal end and a proximal end and having a raised projection on the distal end. The surgical device has an arm comprising a mating feature, the arm being medially deflectable and an elongate pin positioned medially relative the arm, the elongate pin being axially slideable relative the arm between a locked position preventing medial deflection of the arm and an unlocked position allowing medial deflection of the arm. The surgical device has a surgical end effector selectively attachable and detachable to the mating feature of the arm, the end effector having a recess to engage the elongate shaft raised projection. The raised projection on the shaft may be a leaf spring and the shaft may be provided with two or more raised projections. The recess may extend from the end effector medial surface through the end effector lateral surface. The end effector may be provided with a torque arm wherein the recess is located on a medial surface of the torque arm. The torque arm may comprise a cantilevered leaf spring.

[0007] A surgical device, comprising an elongate shaft defining a longitudinal axis, the shaft comprising a distal end and a proximal end and having a recess on the distal end. The surgical device has an arm comprising a mating feature, the arm being medially deflectable. The surgical device has an elongate pin positioned medially relative the arm, the elongate pin being axially slideable relative the arm between a locked position preventing medial deflection of the arm and an unlocked position allowing medial deflection of the arm. The surgical device further has a surgical end effector selectively attachable and detachable to the mating feature of the arm, the end effector having a leaf spring torque arm to engage the elongate shaft recess. The surgical device leaf spring torque arm is cantilevered. The surgical device leaf spring torque arm may be disposed medially to the exterior surface of the end effector. The torque arm may be provided with a medial deflection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] While the specification concludes with claims which particularly point out and distinctly claim the invention, it is believed the invention will be better understood from the following description taken in conjunction with the accompanying drawings illustrating some non-limiting examples of the invention. Unless otherwise indicated, the figures are not necessarily drawn to scale, but rather to illustrate the principles of the invention.

[0009] FIG. **1** depicts surgical procedure with an instrument and loader holding an end effector;

[0010] FIG. **2** depicts a close-up view of the distal ends of the instrument and loader in FIG. **1**,

[0011] FIG. **3** depicts an instrument being inserted into an end effector;

[0012] FIG. **3**A depicts an isometric cross-sectional view of an end effector;

[0013] FIG. **3**B depicts an isometric cross-sectional view of an instrument partially inserted into an end effector;

[0014] FIG. **3**C depicts an end effector with torque arms provided in the lateral surface of the end effector;

[0015] FIG. **3**D depicts a close-up of the end effector of FIG. **3**C;

[0016] FIG. **3**E depicts a cross section of the FIG. **3**D end effector with an instrument inserted in the end effector;

[0017] FIG. **4** depicts an instrument attached to an end effector being withdrawn from a loader;

[0018] FIG. **4**A depicts a loader with removable distal end;

[0019] FIG. **5** depicts an isometric close-up view of the distal end of an instrument in a locked position;

[0020] FIG. **6** depicts an isometric close-up view of the distal end of an instrument in an unlocked position;

[0021] FIG. **7** depicts an isometric cross-sectional view if the distal end of an instrument attached to an end effector;

[0022] FIG. **7**A depicts an isometric cross-sectional view of the distal end of an instrument attached to an end effector with the pin advanced distally;

[0023] FIG. **8** depicts an isometric cross-sectional view of the distal end of an instrument attached to an end effector in a pushed-off configuration;

[0024] FIG. **9** depicts an instrument handle;

[0025] FIG. **10** depicts a bi-polar jawed end effector;

[0026] FIG. **11** depicts a cutting shears end effector;

[0027] FIG. **12** depicts a Maryland dissector end effector; and

[0028] FIG. **13** depicts an ultrasonic shears end effector.

DETAILED DESCRIPTION

[0029] As shown in FIG. **1** instrument (**20**) comprises an elongate shaft (**22**) passing through an incision (**8**) of a tissue wall (**6**). A loader (**10**) comprises an elongate shaft (**12**) passing through an incision (**4**) of a tissue wall (**2**). The surgical end effector (**30**) is selectively attachable in vivo and detachable in vivo to the attachment mechanism (**40**) located at the distal end (**23**) of the instrument (**20**). In this example, the end effector is a jawed tissue grasper, but a variety of other end effectors could also be used. The end effector (**30**) may be loaded ex vivo into the distal end (**13**) of the shaft (**12**), and then introduced into the surgical field through the incision (**4**). The loader (**10**) holds the end effector (**30**) during the in vivo attachment to and in vivo detachment from the instrument (**20**). The loader (**10**) and instrument (**20**) each includes ex vivo handles (**11**, **21**) attached to the proximal ends of the shafts (**12**, **22**) that enable surgeons to use the devices.

[0030] The tissue wall (**2**, **6**) anatomies will be vary based on the surgical procedure, but some non-limiting examples include percutaneous incisions into the abdomen, thorax, or pelvis. The incisions (**4**, **8**) may be created with a cutting or puncturing instrument, and will typically be spaced from one another. The tissue walls (**2**, **6**) may be the same or different anatomies. For instance, tissue walls (**2**, **6**) may both be the abdominal wall. In another example, tissue wall (**2**) could be an organ (e.g. stomach, colon, esophagus, etc.) accessed through a natural orifice, while the incision (**8**) in tissue wall (**6**) could be percutaneous. In yet another example, incision (**4**) may provide access to the abdomen, while the incision (**8**) may provide access to the pelvis. If pneumoperitoneum is desired, the incisions may include instrument seals, such as those commonly found in trocars. In this example, the instrument seal (**5**) is schematically shown in incision (**4**) with the loader (**10**) passing through the seal (**5**), while the shaft (**22**) seals directly with the tissue wall (**6**) by virtue of the resilience of the tissue without the aid of a sealing device.

[0031] The loader shaft (**12**) in this embodiment is rigid and straight, but the shaft (**12**) could be curved or flexible, which would be beneficial for natural orifice transluminal introduction of the distal end (**13**) to the surgical field. The loader (**10**) may include an articulating distal end (**13**) controlled by the knob (**14**). The distal end (**13**) will typically be introduced and removed through the incision (**4**) in-line with the shaft (**12**), and then articulated in vivo to facilitate alignment between the end effector (**30**) and the shaft (**22**). The arm (**15**) is rigidly connected the handle (**11**) to facilitate grasping of the handle and rotational orientation of the articulated distal end (**13**) about the shaft (**12**) axis. In this embodiment, the distal end (**13**) of the loader (**10**) comprises a tube opening at the distal tip (**17**). The tube is dimensioned to receive the end effector (**32**). The tube (**30**) includes an engagement feature (**16**) for holding the end effector (**32**). While the engagement feature (**16**) may vary, in this embodiment a plurality of leaf springs provide an interference fit with the end effector (**30**) to frictionally hold the end effector in the tube. In this embodiment, when the end effector (**30**) is loaded in the tube, the distal end (**32**) is positioned in the tube and the proximal end (**31**) extends from the tube opening (**17**). This arrangement prevents the jaws of the end effector from opening. After the distal end (**23**) of the instrument (**20**) is attached to the proximal end (**31**) of the end effector (**30**), the end effector (**3**) can be pulled from the distal end (**13**) of the loader (**10**).

[0032] FIG. **3**A depicts an example of an end effector provided with a torque key (**60**). The torque key, in one expression, is fixedly attached to proximal end (**31**) of end effector (**30**). Torque key (**60**) is provided with torque arms (**61**A, **61**B). Torque arms (**61**) may be provided with a medial angular bend. End effector (**30**) may also be provided with torque arm recesses (**62**A, **62**B) that permit the torque arms (**61**) are aligned with flat surfaces of the shaft arms (**47**) and protrude medially into an opening (**48**). When aligned with the opening (**48**), torque arms (**61**) permit transfer of rotational force from the shaft to the end effector.

[0033] FIGS. **3**C and **3**D depict another expression of the end effector (**30**). The proximal end of the end effector (**30**) is provided with flexible torque arm (**63**) formed from the lateral surface of end effector (**30**). When shaft (**22**) is inserted into end effector (**30**), torque arm (**63**) may deflect laterally where the opening (**48**) is not aligned with torque arm (**63**). To facilitate engagement with shaft (**22**) torque arm (**63**) may be provided with a chamfered surface. Upon rotation of the shaft (**22**), the torque arm will align with opening (**48**). When aligned with the opening (**48**), torque arm (**63**) permits transfer of rotational force from the shaft (**22**) to the end effector (**30**).

[0034] FIG. **3**E depicts a cross sectional view of shaft (**22**) inserted into end effector (**30**). In this expression, end effector (**30**) is provided with two torque arms (**63**A, **63**B). Torque arms (**63**) are aligned to opening (**48**) defined by shaft arms (**47**) creating an interference fit.

[0035] In another expression of the surgical instrument, the torque arms (**63**) may be provided with recessed inner portions that mate with projections on the lateral surface of the shaft (not shown). The shaft projections may be flexible to facilitate entry of the shaft into the end effector. In yet another expression, the end effector may be provided with recesses (not shown) located on the medial surface of the end effector that mate with the projections on the lateral surface of the shaft.

[0036] FIG. **4** depicts an instrument (**20**) attached to an end effector (**32**) being withdrawn from a loader (**13**). FIG.

4A depicts an alternative embodiment of a loader (10) where the distal end (13) is selectively attachable and detachable to the shaft (12). As shown in this example, this feature is enabled with a bayonet connection (18), but other connections are also contemplated including snap connections, threaded connections, and the like. One advantage of this alternative embodiment is that different distal end (13) configurations may be used to hold end effectors that may not be accommodated by a single sized tube.

[0037] FIGS. 5 and 6 depict a detailed view of one embodiment of an attachment mechanism (40) located at the distal end (23) of the shaft (22). The attachment mechanism (40) comprises a mating feature on the shaft (22), which in this embodiment is a circumferential groove (45) positioned on the lateral surface of shaft arms (47A, 47B). Shaft arms (47A, 47B) may be resiliently flexible into opening (48). The attachment mechanism (40) also comprises second arms (42A, 42B) projecting distally from the distal end (44) of the shaft (22). The second arms may be axially slideable relative the shaft (22) and are resiliently deflectable medially into the gap (46). The second arms each comprise a mating feature, which I this embodiment comprises a stepped lateral notch (43A, 43B). An elongate pin (41) is positioned medially relative the second arms (42) and shaft arms (47) and is axially slideable relative the second arms (42) and shaft arms (47) between a locked position preventing medial deflection of the arms (42 and 47) (an example of which is shown in FIG. 5) and an unlocked position allowing medial deflection of the arms (an example of which is shown in FIG. 6). The pin (41) and second arms (42) may each slide independently relative the shaft (22) and shaft arms (47). FIG. 6 shows the pin (41) fully retracted inside shaft (22) allowing medial deflection of shaft arms (47).

[0038] As shown in the embodiment of FIG. 5, the elongate pin (41) may include a pointed obturator tip. In this configuration, the distal end (23) may be used to puncture through the tissue wall (6). The distal ends of the second arms (42) and distal end (44) of the shaft arms (47A, 47B) include tapered surfaces to facilitate passing through the incision (8).

[0039] FIG. 7 shows the attachment mechanism (40) attached to the end effector (30). The groove (45) of the shaft arms *47) mates the rib (32) of the end effector (30) preventing relative axial motion. The lateral grooves (43A, 43B) of the second arms (42) mate the ring (33) of the end effector (30) preventing relative axial motion. The rib (32) is rigidly connected to the outer housing (37) of the end effector (30), and the ring (33) is rigidly connected to the jaw actuator (34) via the coupling (35). When the elongate pin (41) is fully advanced, medial deflection of the second arms (42) and the shaft arms (47) is inhibited (see FIG. 7A). Accordingly, axial movement of the arms (42) relative the shaft (22) will cause axial movement of the jaw actuator (34) relative the housing (37), thereby causing the jaws to open and close.

[0040] FIG. 9 shows an example of the handle (21) for the instrument (20). The handle (21) includes a base (50). A knob (51) rotates the attachment mechanism (40) about the axis of the shaft (22), which will also rotate an attached end effector (30). The trigger (54) pivots relative the base (50) causing axial movement of the second arms (42) and the pin (41) relative the shaft (22). Operation of the trigger (54) will operate the jaws on an attached end effector (30). The latch (55) pivots relative the base (50) between a locked position (as shown in figure) to prevent operation of the trigger (54) and an unlocked position recessed in the base (50). During seating with the end effector (30), the latch (55) may be locked to maintain the same relative axial spacing of the corresponding the mating features (43, 45) as the mating features (33, 32), resulting in a single "snap" feedback. The trigger lock (56) can lock/unlock the trigger in/from its depressed position. An actuator (53), which in this embodiment is a slider, controls axial movement of the pin (41) relative the second arms (42). The distal most position of the actuator (53) relative the base (as shown in the figure) places the pin (41) in its locked position, and the proximal most position places the pin (41) in its unlocked position. The pin lock (52) includes a pin (52A) which went inserted into the hole (53A) maintains the pin (41) and second arms (42) in the extended and locked positions as shown in FIG. 5.

[0041] The following describes one method for attaching the end effector (30) to the shaft (22). The distal end (23) is introduced in into the proximal end (31) of the end effector (30) with the pin (41) in the unlocked position. The shaft (22) deflects the torque arms (61) laterally into recesses (62) when the torque arms are not aligned with the opening (48). In another expression, torque arm (63) deflects laterally upon shaft (22) insertion into the end effector (30). When the torque arm (61, 63) are aligned with the opening (48), they do not reflect and rest adjacent to opening (48) on the lateral surfaces of shaft arms (47) permitting rotation of the end effector. As the arms (42) are advanced axially into the end effector (30), the chamfered lead (36) of the ring (33) medially deflects the arms (42) until the ring (33) is seated into the lateral notches (43). Simultaneously the shaft arms (47) advance axially into the end effector (30), and the tapered end (44) aligns the rib (32) to seat into the groove (45). In both cases, the surgeon may feel a tactile "click" indicating proper engagement. Once fully seated in the end effector (30), the pin (41) may be slid to the locked position thereby attaching the end effector (30) to the instrument (20). Once attached, the surgeon may pull the end effector from the loader (10), and the loader (10) may then be removed from the surgical field. When the end effector (30) is attached to the shaft (22) and the torque arm (61, 63) are not aligned with the opening (48), the surgeon may grip tissue or another instrument and rotate the knob (51) until the torque arms (61) seat in the opening (48). The surgeon may then manipulate tissue with the end effector (30) as needed for the surgical procedure.

[0042] FIGS. 10-13 illustrate some non-limiting examples of alternative end effectors (30A-D) that may attach to the distal end (23) of the instrument (20). In addition to the loader (10) and instrument (20), all or a portion of the end effectors (30, 30A, 30B, 30C, 30D) may be bundled as part of a kit so the surgeon may interchange the attached end effector as needed for a surgical procedure. All the end effectors examples shown here have cooperating jaws; however, non-jawed end effectors could also be employed such as hook knives, snares, and the like. In the case of end effectors that require energy, appropriate energy transmission mechanisms known in the art should be added to the handle (21) and shaft (22). For instance, appropriate electrical connections can be added for the bi-polar forceps end effector (30A). Similarly, an ultrasonic transducer and waveguide can be added for the ultrasonic shears end effector (30D).

[0043] The following describes one method for using the devices during a laparoscopic surgical procedure. An instrument (**20**) is obtained and passed through incision (**8**). The incision (**8**) may be a percutaneous incision formed at least partially by a puncture formed with the obturator on the pin (**41**) in the configuration shown in FIG. **5**. The pin lock (**52**) and latch (**55**) may be secured to the slider (**53**) and trigger (**54**), respectively. After the puncture, the pin lock (**52**) may be removed.

[0044] A loader (**10**) and end effector (**30**) are obtained. The end effector (**30**) may be selected from a plurality of end effectors provided in a kit. The end effector (**30**) is loading ex vivo into the distal end (**13**) of the loader (**10**). The distal end (**13**) of the loader (**10**) with the loaded end effector (**30**) is passed through incision (**4**). The second incision (**4**) may also be percutaneous incision spaced from the first incision (**8**), and may include passing the distal end (**13**) with the loaded end effector (**30**) through a trocar. The distal end (**13**) may be articulated to facilitate orientation between the proximal end (**31**) of the end effector (**30**) and the attachment mechanism (**40**). The actuator (**53**) is slid proximally to move the pin (**41**) to its unlocked position. The distal end (**23**) of the instrument (**20**) is advanced into the proximal end (**31**) of the end effector (**30**) until the respective mating features of the instrument (**20**) and end effector (**30**) are engaged. The actuator (**53**) may then be slid distally thus advancing the pin (**41**) to its locked position. The end effector (**30**) has now been attached in vivo to the instrument (**20**). The end effector (**30**) may then be pulled from the loader (**10**) and the latch (**55**) disengaged from the trigger (**54**). Tissue is then manipulating by actuating the trigger (**54**) of the handle (**21**) to operate the jaws of the end effector (**30**).

[0045] After completing the surgical procedure, the end effector (**30**) may be detached from the shaft (**22**). If previously removed, the loader (**10**) may be reintroduced through the incision (**4**) into the surgical field. The distal end (**32**) of the end effector (**30**) is seated into the distal end (**13**) of the loader (**10**), and the pin (**41**) moved to its unlocked position. The second arms (**42**) then proximally withdrawn from the ring (**33**), deflecting medially as the chamfered portions of the second arms (**42**) slide over the ring (**33**) medial surfaces. Accordingly, the device will be in the configuration depicted in FIG. **8**. Distally advancing the arms (**42**) will cause the shaft arms (**47**) to deflect medially into the opening (**48**) as the chamfered portions of shaft arms (**47**) to deflect medially into the gap (**46**) facilitating easier separation of the end effector (**30**) from the shaft (**22**). The distal advancement of the shaft (**22**) continues until the rib (**32**) unseats from the groove (**45**). This unseating may be facilitated by the jaws of the end effector (**30**) being held in a closed position by the tube in the loader distal end (**13**). The distal end (**23**) may then be withdrawn from the end effector (**30**) thus detaching the end effector (**30**) from the instrument (**20**). The end effector will be held in the loader (**10**) by virtue of the engagement feature (**16**). Removal of the loader (**10**) from the surgical field will remove the end effector (**30**). A different end effector may then be attached to the instrument (**20**), or the instrument (**20**) may be withdrawn from the surgical field.

[0046] Without limitation, the following describe some of the benefits and advantages of the foregoing devices and methods over the prior art. The end effector (**30**) may have a much larger diameter than the shaft (**22**); accordingly, the incision (**8**) can be smaller compared to more traditional laparoscopic instruments resulting in less pain and scarring, and quicker recovery. This also facilitates a smaller diameter shaft (**22**) (even less than 3 mm), thus potentially eliminating a trocar in the incision (**8**). The attachment mechanism (**40**) provides quick end effector (**30**) exchanges with the instrument (**20**), thus decreasing surgical time. The loader (**10**) also facilitates quick end effector (**30**) exchanges. A kit of multiple end effectors may reduce instrument costs by consolidating a single shaft (**22**) and handle (**21**) for all instruments. May other benefits will be apparent to those skilled in the art.

[0047] Having shown and described various embodiments and examples of the present invention, further adaptations of the methods and devices described herein can be accomplished by appropriate modifications by one of ordinary skill in the art without departing from the scope of the present invention. Several of such potential modifications have been mentioned, and others will be apparent to those skilled in the art. For instance, the specific materials, dimensions, and the scale of drawings will be understood to be non-limiting examples. Accordingly, the scope of the present invention should be considered in terms of the following claims and is understood not to be limited to the details of structure, materials, or acts shown and describe in the specification and drawings.

1. A surgical device, comprising:

a. An elongate shaft defining a longitudinal axis, the shaft comprising a distal end and a proximal end, the elongate shaft further comprising:

i. Two arms on the distal end of the elongate shaft, each arm comprising a mating feature and being adapted to medially deflect, the arms defining a longitudinal opening between the arms, wherein the longitudinal opening extends from a lateral outer surface of the elongate shaft through a medial inner surface of the elongate shaft; and

ii. An elongate pin positioned medially relative the arms, the elongate pin being axially slideable relative the arms between a locked position preventing medial deflection of the arms and an unlocked position allowing medial deflection of the arms; and

b. A surgical end effector selectively attachable and detachable to the mating feature of the arms when the elongate pin is in its unlocked position, and wherein the surgical end effector is secured to the mating feature of the arms when the elongate pin is in its locked position, the end effector having a torque key adapted to project into the longitudinal opening thereby torsionally coupling the end effector the elongate shaft.

2. The surgical device of claim **1**, wherein the torque key comprises a torque arm adapted to engage the longitudinal opening.

3. The surgical device of claim **2**, wherein the torque arm comprises a cantilevered spring adapted to deflect laterally.

4. The surgical device of claim **3**, wherein the surgical end effector further comprises a recess aligned with the cantilever spring, the recess being adapted to permit the torque arm to laterally deflect.

5. The surgical device of claim **1**, further comprising a lateral notch on the distal end of the arms and a mating feature on the surgical end effector.

6. The surgical device of claim **5**, wherein the mating feature comprises a ring dimensioned to mate with the arm lateral notch.

7. The surgical device of claim **1**, wherein the elongate pin extends between the proximal and distal ends of the elongate shaft.

8. The surgical device of claim **7**, further comprising a handle connected to the proximal end of the elongate shaft, the handle comprising an actuator connected to elongate pin and operative to slide the elongate pin between the locked and unlocked positions.

* * * * *

专利名称(译)	具有可连接末端执行器的腹腔镜仪器		
公开(公告)号	US20180028210A1	公开(公告)日	2018-02-01
申请号	US15/727980	申请日	2017-10-09
[标]申请(专利权)人(译)	ETHICON，LLC		
申请(专利权)人(译)	ETHICON LLC		
当前申请(专利权)人(译)	ETHICON LLC		
[标]发明人	NOBIS IV RUDOLPH H SPIVEY JAMES T HESS CHRISTOPHER J HUEY KEVIN M		
发明人	NOBIS, IV, RUDOLPH H. SPIVEY, JAMES T. HESS, CHRISTOPHER J. HUEY, KEVIN M.		
IPC分类号	A61B17/29 A61B17/00 A61B17/34		
CPC分类号	A61B2017/3454 A61B2017/2946 A61B2017/294 A61B17/29 A61B2017/00477 A61B2017/00362 A61B2017/2931		
外部链接	Espacenet USPTO		

摘要(译)

腹腔镜手术装置包括限定纵向轴线的细长轴，该轴包括远端和近端。多个臂从细长轴的远端向远侧突出，每个臂包括侧向凹口。臂可相对于细长轴轴向滑动并且可在中间偏转。细长销相对于臂在中间定位。细长销可相对于臂在可防止臂的内侧偏转的锁定位置和允许臂的内侧偏转的解锁位置之间轴向滑动。外科端部执行器可选择性地附接在体内并且可在体内拆卸到臂的配合特征，外科端部执行器包括扭矩传递装置和组织接触装置，其在附接时响应于两个臂的轴向运动而打开和闭合。到外科末端执行器。