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(54) **SINGLE PORT INSTRUMENTS**

INSTRUMENTE FÜR SINGULÄREN ZUGANG

INSTRUMENT POUR ACCÈS SINGULAIRE

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Description

BACKGROUND OF THE INVENTION

[0001] The present application relates to devices for use in general or laparoscopic surgery, and, more particularly, to surgical devices useful in single port surgeries.

DESCRIPTION OF THE RELATED ART

[0002] Various single port surgical procedures can be performed using a single incision in the body of the patient and passing all instruments used during the surgery through that incision. While a single, relatively small incision site has various advantages for the patient, the single access port can often lead to difficulty in handling of the instruments.

[0003] With a single incision site, the handles of various surgical instruments, for example the scissor type handles of the instrument disclosed in US 2006/0079933 A1, compete for the limited space outside of the incision, and the elongated instrument shafts are positioned almost parallel to each other in a limited space inside the incision. This substantially parallel instrument shaft configuration often leads to limited visibility of the surgical site as the laparoscope is positioned along the other instrument shafts, limiting the angle in which the tips of the instruments are visible. The novel devices described herein are designed to ease the restrictions posed by single port surgeries and make it easier for the operating surgeon to perform the surgery.

SUMMARY OF THE INVENTION

[0004] According to the present invention a surgical instrument is provided as recited in Claim 1 of the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

Figure 1 is a side view of an embodiment of surgical instrument, in accordance with the present invention, having a low-profile handle assembly;

Figure 2A is a top view of a jaw assembly of an embodiment of surgical dissector having a curved jaw configuration;

Figure 2B is a perspective view of the jaw assembly of Figure 2A;

Figure 3 is a cut away top view of the low profile handle assembly of Figure 1 with a linkage mechanism in an open position;

Figure 4 is a cut away top view of the low profile handle assembly of Figure 1 with the linkage mechanism in a toggle position;

Figure 5 is a top view of various embodiments of jaw assembly for a surgical instrument having various curved jaw profiles;

Figure 6 is a top view of an angled shaft and jaw assembly for a surgical instrument having an independently rotatable jaw assembly;

Figure 7 is a partial cut away view of a handle assembly for the surgical instrument, in accordance with the present invention, of Figure 6;

Figure 8 is a partial cut away view of an embodiment of handle assembly having a constant force spring for a surgical instrument in accordance with the present invention;

Figure 9A is a partial cut away view of an embodiment of handle assembly having a ratchet mechanism for a surgical instrument in accordance with the present invention;

Figure 9B is a partial cut away view of another embodiment of handle assembly for a surgical instrument in accordance with the present invention;

Figure 9C is a partial cut away view of another embodiment of handle assembly for a surgical instrument in accordance with the present invention;

Figure 9D is a partial cut away view of another embodiment of handle assembly having a ratchet mechanism for a surgical instrument in accordance with the present invention;

Figure 10 is a partial cut away view of a handle assembly having a pin slot linkage mechanism for a surgical instrument in accordance with the present invention; and

Figure 11 is a partial cut away view of a handle assembly having a hydraulic actuation mechanism for a surgical instrument not in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0006] With reference to Figure 1, an embodiment of surgical instrument 10, in accordance with the present invention, that can be used in single port surgical procedures is illustrated. The surgical instrument 10 comprises a handle assembly 12, an elongate shaft 14 extending from a distal end of the handle assembly 12, and an end effector assembly 16 coupled to a distal end of the elon-

gate shaft. In various embodiments of surgical instrument, the end effector assembly 16 can comprise grasping jaws, dissecting jaws, or cutting scissors or another surgical tool. In some embodiments, the surgical instrument 10 can

Figure 9A is a partial cut away view of an embodiment of handle assembly having a ratchet mechanism for a surgical instrument;

Figure 9B is a partial cut away view of another embodiment of handle assembly for a surgical instrument;

Figure 9C is a partial cut away view of another embodiment of handle assembly for a surgical instrument;

Figure 9D is a partial cut away view of another embodiment of handle assembly having a ratchet mechanism for a surgical instrument;

Figure 10 is a partial cut away view of a handle assembly having a pin slot linkage mechanism for a surgical instrument; and

Figure 11 is a partial cut away view of a handle assembly having a hydraulic actuation mechanism for a surgical instrument.

DETAILED DESCRIPTION OF THE INVENTION

[0007] With reference to Figure 1, an embodiment of surgical instrument 10 that can be used in single port surgical procedures is illustrated. The surgical instrument 10 comprises a handle assembly 12, an elongate shaft 14 extending from a distal end of the handle assembly 12, and an end effector assembly 16 coupled to a distal end of the elongate shaft. In various embodiments of surgical instrument, the end effector assembly 16 can comprise grasping jaws, dissecting jaws, or cutting scissors or another surgical tool. In some embodiments, the surgical instrument 10 can include an electrical connector 11 electrically coupled to the end effector assembly 16, wherein the end effector assembly 16 includes an electrosurgical tool.

[0008] In some embodiments, the elongate shaft 14 and end effector assembly 16 can be sized to pas through an access port such as a trocar cannula having a predetermined size. For example, the surgical instruments 10 described herein can be sized for use in conjunction with a 5mm trocar cannula, a 10mm trocar cannula, a 12 mm trocar cannula, a 15mm trocar cannula, or another trocar cannula size.

[0009] In some embodiments, the handle assembly 12 has a low-profile configuration extending generally longitudinally with respect to a longitudinal axis defined by the elongate shaft 14 of the surgical instrument 10 in an in-line configuration. In some embodiments, the handle assembly 12 can extend generally longitudinally with a curved ergonomic grip portion (Figures 9A-9D) to facilitate user gripability and further enhance user comfort. Advantageously, the low-profile handle minimizes the size of the instrument extending proximally from the incision site, thus reducing the incidence of interference with other surgical tools adjacent the incision site.

[0010] With reference to Figures 2A and 2B, one embodiment of end effector assembly 16 with dissector jaws 18 having a curved profile is illustrated. Advantageously, the curved profile of the dissector jaws 18 allows the end effector assembly to grasp tissue offset from other surgical instruments inserted through a single insertion site. The jaws with the curved profile can move the distal end of the device off the centerline of the elongate shaft and improve the visualization of the distal end. The curve of the distal end also improves access to the tissue structures that are positioned behind other body formations.

[0011] In some embodiments, the curved profile can define an angular arc of about 60 degrees. Desirably, the curved profile can define an angular arc of greater than about 35 degrees. In other embodiments, the curved profile can define an angular arc of between about 35 degrees and about 110 degrees, desirably, the curved profile can define an angular arc of between about 45 degrees and about 95 degrees, and more desirably, the curved profile can define an angular arc of between about 55 degrees and about 65 degrees.

[0012] With reference to Figures 3 and 4, the opening and closing of the end effector assembly 16 of the device 10 can be accomplished by alternately pushing a shuttle-like trigger 20 from one side of the handle assembly 12 to the other. The handle body 22 of the handle assembly 12 includes a first aperture 112 and a second aperture 114 generally diametrically opposed to the first aperture 112. The trigger 20 comprises a first actuation surface 122 and a second actuation surface 124 opposite the first actuation surface. A pivot such as a pivot pin couples the trigger 20 to the handle body 22 at a point between the first actuation surface 122 and the second actuation surface 124. With the trigger in a first, or open position, the first actuation surface 122 extends out of and protrude from the first aperture 112, as illustrated in Figure 3. With the trigger in a second, or toggle position, the second actuation surface 124 extends out of and protrude from the second aperture 114, as illustrated in Figure 4.

[0013] With continued reference to Figures 3 and 4, in some embodiments, the instrument 10 can comprise a rotation mechanism rotatably coupling the end effector assembly 16 to the handle assembly 12. In some embodiments, the handle assembly 12 can include a rotatable knob 17 that is coupled to the elongate shaft 14 and can be used to rotate the elongate shaft 14 and the end effector assembly 16 about the central longitudinal axis of the elongate shaft 14. In the illustrated embodiment, the rotatable knob 17 is disposed at the distal end of the handle assembly 12. In some embodiments, the rotatable

knob 17 and the elongate shaft 14 are rotatable 360 degrees with respect to the handle assembly 12. In other embodiments, the handle assembly 12 can include stops to define the rotatable motion of the rotatable knob 17 and the elongate shaft to an angular range less than 360 degrees. In some embodiments, as described further herein, the handle assembly can include an additional rotation mechanism to rotate the end effector assembly 16 up to 360 degrees independently with respect to the elongate shaft 14 as well.

[0014] In some embodiments, the handle of the laparoscopic surgical instrument 10 can be symmetrical, which would allow for the rotation of the end effector assembly 16 to be accomplished by the rotation of the handle assembly 12 itself. In other embodiments, the handle assembly 12 can have a non-symmetrical ergonomic shape. With non-symmetrical handles, the surgical instrument can desirably include a rotatable knob as described above such that rotation of the end effector assembly can be accomplished by rotating the rotatable knob in the handle assembly. The in-line, symmetrical, handle configuration allows for placement and movement of two or more handles close to each other, without creating undue handle interference due to their sizes. The handle can be rotated 360 degrees in the palm of the user allowing for the comparable rotation of the distal end effector assembly 16, without using the rotating knob 17. The rotating knob 17 can also be used for the same purpose, if necessary. In some embodiments, the shuttle trigger 20 design protrudes only slightly outside of the low profile handle assembly 12, without taking much space and it is connected by the linkage mechanism to the actuating rod.

[0015] With continued reference to Figures 3 and 4, the handle assembly 12 can include a linkage mechanism to actuate the end effector assembly. The linkage mechanism is coupled to the handle body 22 of the handle assembly 12. As illustrated, the linkage mechanism comprises a trigger 20, pivotably coupled to the handle body 22, an actuation link 24 pivotably coupled to the trigger 20 at a first end of the actuation link 24, and an actuation shaft 26 pivotably coupled to the actuation link 24 at a second end of the actuation link 24. In the illustrated embodiment, the trigger 20 is pivotably coupled to the handle body 22 near a distal end of the handle body, the actuation link 24 is pivotably coupled to the trigger proximal of the coupling between the trigger 20 and handle body 22, and the actuation link 24 is pivotably coupled to the actuation shaft 26 proximal of the coupling between the trigger 20 and the actuation link 24. In other embodiments, the trigger, actuation link, and actuation shaft could have different geometries and arrangements to operatively couple to the end effector assembly.

[0016] The actuation shaft 26 can be either a rigid member such as a metal or a plastic rod or tube, or a flexible member such as a wire or a cable. Movement of the trigger 20 to actuate the linkage mechanism between the open position and the toggle position longitudinally slides the actuation shaft 26 with respect to the elongate shaft 14. The actuation shaft 26 can extend at least partially within the elongate shaft 14 and can be operatively coupled to the end effector assembly 16.

[0017] Figure 3 illustrates the linkage mechanism in an open position such that the end effector assembly 16 is open (e.g., jaws of a grasper or blades of scissors are spaced apart from one another). Figure 4 illustrates the linkage mechanism in a toggle position such that the end effector assembly 16 is closed (e.g., jaws of a grasper or blades of scissors are contacting one another). With the linkage mechanism in the toggle position, movement of the trigger 20 pivots the actuation link 24 into a toggle position to lock the end effector assembly 16 in the closed position. Thus, advantageously, the linkage mechanism described herein can include a locking mechanism that can be used to prevent the end effector assembly 16 from opening inadvertently.

[0018] An advantage of the illustrated linkage mechanism design is that the same shuttle trigger 20 can be used to close/open as well as to lock/unlock the end effector assembly 16 of the device. The lock is activated by actuating the shuttle trigger 20, closing the end effector assembly 16 on the tissue, and exerting the additional pressure on the trigger 20 to push the connected linkage over the centerline of the device, moving the linkage mechanism into the toggle position. The linkage or shaft deformation can be utilized to limit end effector assembly pressure exerted during the toggle creation. The end effector assembly 16 can be opened again by pushing the shuttle trigger in the opposite direction. As discussed in greater detail with reference to Figure 9, in some embodiments, an additional or separate locking mechanism can be positioned in the handle assembly.

[0019] Advantageously, with a surgical instrument having a low-profile handle and linkage mechanism as illustrated in Figures 1, 3, and 4, a medical practitioner is provided with relatively free and unrestricted movement of the handles proximal to the surgical incision and good tip visibility at the surgical site distal to the surgical incision. These advantages are particularly evident in surgical procedures with limited space within the operation site such as procedures that utilize a single access port.

[0020] With reference to Figure 5, in some embodiments of surgical device having end effector assemblies 16 with jaws, the jaws can be manufactured with different size curves and/or with different lengths. For example, as discussed above with reference to Figure 2, the angle of curvature of the jaws with reference to the elongate shaft can include an arcuate profile between about 35 degrees and about 110 degrees, desirably, the curved profile can define an angular arc of between about 45 degrees and about 95 degrees, and more desirably, the curved profile can define an angular arc of between about 55 degrees and about 65 degrees. Moreover, in the illustrated embodiments, an offset distance, L1, L2, L3, L4 between a tip of the jaws and a central longitudinal

axis, A of the elongate shaft of the surgical instrument can range between approximately 1,16 cm (0.457 inches) and approximately 1,94 cm (0.763 inches). In certain embodiments, the offset distance can be at least approximately 0,76 cm (0.3 inches). In some embodiments, the offset distance can be between approximately 0,76 cm (0.3 inches) and 2,54 cm (1.0 inches), desirably, the offset distance can be between approximately 1,14 cm (0.45 inches) and 2,16 cm (0.85 inches), and more desirably, the offset distance can be between 1,4 cm (0.55 inches) and 1,78 cm (0.70 inches). Tip visualization and access to the tissue structures can be optimized by varying the curved profile and offset distance of jaws of an end effector assembly.

[0021] With reference to Figure 6, in some embodiments, the elongate shaft 14' can comprise an angled segment 40 that would allow for better tip visualization and improved access to the tissue structures that are positioned behind other body formations. Thus, the elongate shaft 14' can comprise a proximal segment 132 extending from a proximal end of the elongate shaft along a central longitudinal axis, an angled segment 40 between the proximal end and the distal end of the elongate shaft, and a distal segment 134 extending transversely to the central longitudinal axis from the angled segment to the distal end of the elongate shaft. The angled segment 40 has a bend angle defining the transverse relationship of the distal segment 134 to the central longitudinal axis. In some embodiments, the bend angle can be greater than about 20 degrees. In some embodiments, the bend angle can be between about 20 degrees and about 45 degrees.

[0022] With continued reference to Figure 6, advantageously, a surgical instrument having an angled elongate shaft 14' can be used in a single port procedure in conjunction with another surgical instrument having a straight elongate shaft 14 such that a surgeon can position the end effector assemblies of the instruments in close proximity to one another while the handle assemblies of the instruments are spaced apart from one another to facilitate manipulation of the surgical instruments.

[0023] With reference to Figure 7, an embodiment of handle assembly 12 that can be used with the angled elongate shaft 14' of Figure 6 is illustrated. The handle assembly 12 can include a first rotation mechanism rotatably coupling the end effector assembly 16 to the elongate shaft 14' and a second rotation mechanism rotatably coupling the elongate shaft 14' to the handle assembly 12. In the illustrated embodiment, the handle assembly 12 includes a first rotation mechanism having a rotatable actuator such as a rotatable knob 17 positioned between the proximal end and the distal end of the handle assembly 12 and rotatably coupled to the handle assembly. As illustrated, rotatable knob 17 rotates a clevis/jaw assembly within the angled shaft 14' to rotate the end effector assembly 16 relative to the shaft 14'. In some embodiments, the end effector assembly can be rotated 360 degrees relative to the elongate shaft 14' using rotatable knob 17. In other embodiments, rotation of the end effector assembly relative to the elongate shaft 14' can be restricted to a predetermined angular range.

[0024] With continued reference to Figure 7, as illustrated, the handle assembly 12 also includes a second rotation mechanism having a rotatable knob 27 positioned at the distal end of the handle assembly 12 and rotatably coupled to the handle assembly 12. The rotatable knob 27 rotates the angled elongate shaft 14' relative to the handle assembly 12. In some embodiments, the elongate shaft 14' can be rotated and fixed at predetermined stops in predetermined angular increments, such as, for example 180 degree angle increments. Thus, the second rotation mechanism can be rotated to a first position at a first predetermined stop that positions the angled elongate shaft 14' such that the surgical instrument can be used in a surgeon's right hand while another instrument is in the surgeon's left hand. The second rotation mechanism can be selectively rotated to a second position at a second predetermined stop rotationally 180 degrees angularly spaced from the first predetermined stop that positions the angled elongate shaft 14' such that the surgical instrument can be used in a surgeon's left hand while another instrument is in the surgeon's right hand. In other embodiments, the predetermined stops can be arranged as desired in different angular spacings. For example, in some embodiments, a second rotation mechanism can have four predetermined stops, angularly spaced 90 degrees apart from one other to define an orientation of the elongate shaft 14' for right handed operation, an orientation of the elongate shaft 14' for left handed orientation, an orientation of the elongate shaft 14' allowing positioning above another surgical instrument, and an orientation of the elongate shaft 14' allowing positioning below another surgical instrument.

[0025] With continued reference to Figure 7, in some embodiments, the predetermined stops of the second rotation mechanism are defined by selectively engageable features formed on the rotatable knob 27 and the handle assembly 12. The rotatable knob 27 can comprise a latch member 127 coupled thereto which is engageable with one or more recesses, such as detents 129 formed at the distal end of the handle assembly to define a predetermined stop.

[0026] With continued reference to Figure 7, in some embodiments, the handle assembly 12 can include an electrical connector 11' that is recessed into the body of the handle. As illustrated, an electrical connection pin does not extend distally beyond a distal end of the handle assembly, and the electrical connection pin is positioned within a recess in the body of the handle. Advantageously, such a recessed electrical connector 11' can enhance user safety when working with electrosurgical devices. Also, advantageously, the recessed electrical connector 11' can enhance the low profile configuration of the handle assembly, reducing the risk of collisions between the electrical connector and hands or fingers of medical prac-

titioners or collisions with other surgical instruments at the surgical site.

[0027] With reference to Figure 8, an embodiment of handle assembly for surgical instrument is illustrated. The end effector assembly of the surgical instrument can be locked in place upon placing trigger 20 and the linkage mechanism in the toggle position as described above with reference to Figures 3 and 4. In the embodiment of Figure 8, the linkage mechanism includes a spring 60 that can be placed between the actuation shaft 26 and the actuation linkage 24, facilitating the toggle position creation. The spring 60 would compress (or extend) when the tension or compression forces reach a predetermined value, associated with the spring rate, limiting the jaw's clamping force and establishing the force required to place the linkage in the toggle position. For example, once the shaft pulling force reaches predetermined amount (i.e. 70lbs), the spring starts compressing (or extending), limiting amount of force applied to the jaws. Any additional linkage and trigger movement stretches (or compresses) the spring only, without applying more force to the actuating rod. Thus, advantageously, a predetermined constant force can be applied to tissue retained by the end effector assembly 16 using the illustrated linkage mechanism. Once the linkage is pushed over the actuating rod's centerline, the linkage is in the toggle position, preventing the jaws from opening. Pressing on the shuttle trigger 20 in the opposite direction, stretches (or compresses) the spring 60 again, which allows the linkage to be pushed back over the rod's centerline, releasing the end effector assembly 16.

[0028] With reference to Figures 9A and 9D, in some embodiments of handle assembly 12', instead of or in addition to using the toggle mechanism described above to lock the end effector assembly 16 in a closed position, a shuttle trigger ratchet mechanism 70 on the linkage mechanism can be used to lock the end effector assembly 16. The ratchet mechanism 70 comprises a ratchet 72 having at least one latched position that can prevent the shuttle trigger 20 from moving towards an open position with respect to the handle assembly 12, preventing movement of the linked actuation shaft 26 and locking the jaws or other end effector. The ratchet mechanism 70 is movable to a free position in which the trigger 20 can be moved freely towards the open or closed position. The ratchet 72 of the ratchet mechanism can comprise one or more teeth positioned on the handle body. A corresponding spring loaded pawl 74 can be positioned on the shuttle trigger 20. The pawl 74 can be configured to engage the teeth of the ratchet 72, defining the one or more latched positions. As illustrated, the ratchet 72 has multiple teeth, allowing incremental latched positions between a fully open and a fully closed end effector assembly.

[0029] With continued reference to Figures 9A and 9D, the pawl 74 can be operatively coupled to a release button 76, 76' positioned on the trigger 20. By pressing the release button 76, 76', the pawl 74 is moved away from the ratchet 72 teeth, allowing for free movement of the trigger 20. For example, with the ratchet mechanism 70 in a latched position, the release button 76, 76' can be pressed to allow movement of the trigger 20 to the open position. Moreover, in some instances, it can be desirable to allow free movement of the trigger from the open position to the closed position without the spring loaded pawl engaging the ratchet. Thus, the release button 76, 76' can be pressed during actuation of the trigger towards a closed position. If desired, the pressure on the release button can be removed to engage the ratchet during such a closing actuation.

[0030] With continued reference to Figures 9A and 9D, desirably, the release button 76, 76' can be positioned on an actuation surface of the trigger 20. In the illustrated embodiment, the release button 76 is positioned on a second or upper actuation surface of the shuttle trigger 20. As illustrated, a user will naturally press the upper actuation surface to move the trigger 20 towards an open configuration. Thus, advantageously, this placement of the release button 76, 76' facilitates release of the ratchet mechanism to a free position when it is desired to open the end effector assembly. The release button 76, 76' can be biased such that the pawl 74 is biased towards engagement with the ratchet 72 teeth. For example, a biasing member such as a coil spring 78, 78' can bear on the trigger 20 and the release button 76, 76' to urge the pawl 74 into engagement with the ratchet 72 teeth.

[0031] Various assemblies can be used to couple the release button 76, 76' to the trigger 20 at the upper actuation surface to allow this disengagement. For example, in the embodiments of handle assembly 12' illustrated in Figure 9A, the release button 76 is slidably coupled to the trigger 20. The illustrated slidable coupling includes posts or pins coupled to the trigger 20 sliding in slots formed in the release button 76, although in other embodiments, other sliding assemblies are contemplated. In the embodiment of handle assembly 12' illustrated in Figure 9D, the release button 76 is pivotably coupled to the trigger 20 about a pivot point at a distal corner of the upper actuation surface of the trigger 20.

[0032] With reference to Figures 9A-9D, in certain embodiments of surgical instrument, the handle assembly 12', while extending generally longitudinally, can include a curved grip portion to enhance the ergonomic experience to a user without substantially diminishing the ability of multiple surgical instruments to be positioned within a single surgical port. Thus, advantageously, in some embodiments, the handle assembly 12' can be slightly asymmetric, providing improved comfort to the user, without any substantial size increase. Moreover, various features discussed herein with respect to certain embodiments of the surgical instruments can be combined in various embodiments of handle assembly. For example, Figure 9B illustrates a handle assembly 12' with no ratchet mechanism and Figure 9C illustrates a handle assembly 12' with no ratchet mechanism for use with an angled elongate shaft having two rotation mechanisms and two

corresponding rotatable knobs 17, 27, similar to those discussed above with respect to Figure 7 as certain surgical instruments, for example, scissors and dissectors can be effective without the use of a ratchet, while other instruments, for example, graspers can advantageously include a ratchet mechanism. In the embodiments of Figures 9B and 9C, the handle assembly 12' includes ratchet teeth to provide manufacturing efficiencies and commonality of parts with other surgical instruments including ratchet mechanisms. In other embodiments of surgical instruments without a ratchet mechanism, the handle assembly can be free of ratchet teeth. Figure 9D illustrates a handle assembly 12' having an ergonomic curved grip portion, a ratchet mechanism 70, and no electrical connector. It is contemplated that various other combinations of the features discussed herein can be made in various other embodiments of surgical instruments within the scope of the present application.

[0033] With reference to Figures 9A and 9B in certain embodiments, electrical coupling of the electrical connector 11' to the actuation shaft 26 can comprise an electrically conductive member such as an electrically conductive wire 15 or an electrically conductive spring 15'. In some embodiments, the electrically conductive member electrically contacts the electrical connector 11' and the actuation rod 26 and is sized to maintain electrical contact with the electrical connector 11' and the actuation rod 26 throughout an actuation cycle of the actuation rod 26 from an open position of the end effector assembly to a closed position of the end effector assembly.

[0034] With reference to Figure 10, another embodiment of handle assembly having a linkage mechanism is illustrated. In the illustrated embodiment, the opening and closing of the end effector assembly of the instrument can be accomplished by means of a slotted trigger 20' and a pin 80 connected to the actuation shaft 26 of the device. The pin 80 travels inside and is constrained by the slot 82 in the trigger 20. By pressing the shuttle trigger 20 in either direction, the pin 80 and the connected actuation shaft 26 follows the profile of the slot in the trigger 20, opening and closing the end effector assembly of the instrument.

[0035] With reference to Figure 11, in some embodiments, the opening and closing of the end effector assembly 16 of a surgical instrument can be accomplished by means of hydraulic action provided by an incompressible fluid 100 such as saline, mineral oil, or a gel. The fluid can be stored inside the handle 90 and moved by pulling a small diameter piston 92 coupled with a movable handle 102. The pressure created by the fluid movement would push a large diameter piston connected to the actuation shaft, which is connected to the jaws of the instrument, causing the jaws to close. The hydraulic circuit can be sealed at appropriate locations with gaskets or other seals 104 such as O-rings. The incompressible fluid can be used to generate a high tensile force on the actuation shaft with a minimal user input force. The force multiplier in the handle is equal to the ratio of the areas of the pistons. The hydraulic action enables the handle to deliver the appropriate jaw actuation force and to be designed in a small compact configuration to fit in the palm of a surgeon's hand. The handle could also be designed to push the actuation rod to close the instrument jaws. The handle could also include a compression spring 106 to return the instrument jaws to an open configuration.

[0036] In some embodiments, a smoke evacuation channel/path can be added to the instrument design. A connector can be added to the handle to which a vacuum line can be attached. The connector can be placed onto a handle or on top of the shaft. The smoke generated during electrosurgery can then be drawn inside the instrument shaft and out through the connector in the shaft or in the handle. The instruments could alternatively include a vent cap with a manual valve to enable smoke generated during electrosurgery to be vented though the shaft.

[0037] During clinical use, an access device such as a trocar or Gelpoint TM is first placed through a body wall creating an opening across the body wall. The instrument is then inserted through the seal of the access device until the distal end of the instrument extends beyond the body wall opening and positioned adjacent to the operating site. The grasper/dissector jaws or scissors are then used to manipulate or cut tissue by pressing on the shuttle trigger.

[0038] In some embodiments, a method of manufacture of the novel instruments is injection molding of the plastic components and machining or casting of the metal components.

[0039] Although this application discloses certain preferred embodiments and examples, it will be understood by those skilled in the art that the present inventions extend beyond the specifically disclosed embodiments to other alternative embodiments .

Further, the various features of these inventions can be used alone, or in combination with other features of these inventions other than as expressly described above. Thus, it is intended that the scope of the present inventions herein disclosed should not be limited by the particular disclosed embodiments described above, but should be determined only by the claims which follow.

Claims

1. A surgical instrument (10) comprising:

a handle assembly (12, 12')having a proximal end and a distal end;

an elongate shaft (14) extending from the distal end of the handle assembly along a central longitudinal axis, the elongate shaft (14) having a distal end opposite the handle assembly (12, 12'); and

an end effector assembly (16) disposed at the

distal end of the elongate shaft (14);
wherein the handle assembly (12, 12') has an in-line configuration extending generally linearly from the proximal end to the distal end thereof; and wherein the handle assembly (12, 12') further comprises:

a handle body (22); and
a linkage mechanism comprising:

a trigger (20) pivotably coupled to the handle body (22) and pivotable between an open position in which the end effector assembly (16) is in an open state, and a toggle position in which the end effector assembly (16) is locked in a closed state;
an actuation link (24) pivotably coupled to the trigger (20) and extending generally proximally within the handle body (22); and
an actuation shaft (26) pivotably coupled to the actuation link (24) and longitudinally slidable with respect to the elongate shaft (14) responsive to pivotal movement of the trigger (20), the actuation shaft (26) operatively coupled to the end effector assembly (16);

characterized in that the handle body (22) comprises a first aperture (112) and a second aperture (114) generally diametrically opposed to the first aperture (112); and
the trigger (20) has a first actuation surface (122) and a second actuation surface (124) opposite the first actuation surface, and wherein the trigger (20) is alternately pushable from the first aperture (112) to the second aperture (114) such that the first actuation surface (122) of the trigger (20) protrudes from the first aperture (112) of the handle body (22) when the trigger (20) is in the open position and the second actuation surface (124) of the trigger (20) protrudes from the second aperture (114) of the handle body (22) when the trigger (20) is in the toggle position.

2. The surgical instrument of Claim 1, further comprising a rotation mechanism rotatably coupling the end effector assembly (16) to the handle assembly (12, 12').

3. The surgical instrument of Claim 2, wherein the rotation mechanism comprises a rotatable knob (17) disposed at the distal end of the handle assembly (12, 12').

4. The surgical instrument of Claim 1, wherein the handle assembly (12, 12') further comprises an electrical connector (11) electrically coupled to the end effector assembly (16).

5. The surgical instrument of Claim 4, wherein the electrical connector (11) is recessed into the handle body (22).

6. The surgical instrument of Claim 4, wherein the electrical coupling between the electrical connector (11) and the end effector assembly (16) comprises an electrically conductive spring electrically (15') contacting the electrical connector (11) and the actuation shaft (26).

7. The surgical instrument of Claim 1, wherein the linkage mechanism further comprises a ratchet mechanism (70) having at least one latched position in which the trigger (20) is prevented from moving towards the open position and a free position in which the trigger (20) can be freely moved towards the open position or towards the toggle position.

8. The surgical instrument of Claim 7, wherein the ratchet mechanism (70) comprises:

one or more ratchet (72) teeth disposed on the handle body (12'); and
a pawl (74) positioned on the trigger (20), the pawl (74) configured to engage the one or more ratchet (72) teeth to define the latched position of the ratchet (72).

9. The surgical instrument of Claim 8, wherein the ratchet mechanism (70) comprises a release button (76, 76') operatively coupled to the pawl (74) such that actuation of the release button (76, 76') disengages the pawl (74) from the ratchet (72) teeth to define the free position of the ratchet (72).

10. The surgical instrument of Claim 9, wherein the release button (76, 76') is positioned on one of the first actuation surface and the second actuation surface of the trigger (20).

11. The surgical instrument of Claim 10, wherein the release button (76, 76') is pivotably coupled to the trigger (20).

12. The surgical instrument of Claim 1, wherein the handle body (22) comprises a curved grip portion.

Patentansprüche

1. Ein chirurgisches Instrument (10), das Folgendes beinhaltet:

eine Handgriffbaugruppe (12, 12') mit einem proximalen Ende und einem distalen Ende;
einen länglichen Schaft (14), der sich von dem distalen Ende der Handgriffbaugruppe entlang einer zentralen länglichen Achse erstreckt, wobei der längliche Schaft (14) ein distales Ende gegenüber der Handgriffbaugruppe (12, 12') aufweist; und
eine Endeffektorbaugruppe (16), die an dem distalen Ende des länglichen Schafts (14) angeordnet ist;
wobei die Handgriffbaugruppe (12, 12') eine Inline-Konfiguration aufweist, die sich im Allgemeinen linear von dem proximalen Ende zu dem distalen Ende davon erstreckt; und wobei die Handgriffbaugruppe (12, 12') ferner beinhaltet:

einen Handgriffkörper (22); und
einen Verbindungsmechanismus, der Folgendes beinhaltet:

einen Auslöser (20), der schwenkbar an den Handgriffkörper (22) gekoppelt ist und zwischen einer offenen Position, in der die Endeffektorbaugruppe (16) sich in einem offenen Zustand befindet, und einer Feststellposition, in der die Endeffektorbaugruppe (16) in einem geschlossenen Zustand verriegelt ist, schwenkbar ist;
eine Betätigungsverbindung (24), die schwenkbar an den Auslöser (20) gekoppelt ist und sich im Allgemeinen proximal innerhalb des Handgriffkörpers (22) ersteckt; und
einen Betätigungsschaft (26), der schwenkbar an die Betätigungsverbindung (24) gekoppelt ist und als Reaktion auf die Schwenkbewegung des Auslösers (20) längs gegenüber dem länglichen Schaft (14) verschiebbar ist, wobei der Betätigungsschaft (26) betriebsfähig an die Endeffektorbaugruppe (16) gekoppelt ist;

dadurch gekennzeichnet, dass der Handgriffkörper (22) eine erste Öffnung (112) und eine zweite Öffnung (114), die im Allgemeinen der ersten Öffnung (112) diametral entgegengesetzt ist, beinhaltet; und
der Auslöser (20) eine erste Betätigungsoberfläche (122) und eine zweite Betätigungsoberfläche (124) gegenüber der ersten Betätigungsoberfläche aufweist, und wobei der Auslöser (20) abwechselnd von der ersten Öffnung (112) zu der zweiten Öffnung (114) geschoben werden kann, so dass die erste Betätigungsoberfläche (122) des Auslösers (20) aus der ersten Öffnung (112) des Handgriffkörpers (22) hervorragt, wenn der Auslöser (20) sich in der offenen Position befindet, und die zweite Betätigungsoberfläche (124) des Auslösers (20) aus der zweiten Öffnung (114) des Handgriffkörpers (22) hervorragt, wenn sich der Auslöser (20) in der Feststellposition befindet.

2. Das chirurgische Instrument gemäß Anspruch 1, das ferner einen Drehmechanismus, der die Endeffektorbaugruppe (16) drehbar an die Handgriffbaugruppe (12, 12') koppelt, beinhaltet.

3. Das chirurgische Instrument gemäß Anspruch 2, wobei der Drehmechanismus einen drehbaren Knopf (17) beinhaltet, der an dem distalen Ende der Handgriffbaugruppe (12, 12') angeordnet ist.

4. Das chirurgische Instrument gemäß Anspruch 1, wobei die Handgriffbaugruppe (12, 12') ferner einen elektrischen Anschluss (11) beinhaltet, der elektrisch an die Endeffektorbaugruppe (16) gekoppelt ist.

5. Das chirurgische Instrument gemäß Anspruch 4, wobei der elektrische Anschluss (11) in den Handgriffkörper (22) eingelassen ist.

6. Das chirurgische Instrument gemäß Anspruch 4, wobei die elektrische Kopplung zwischen dem elektrischen Anschluss (11) und der Endeffektorbaugruppe (16) eine elektrisch leitende Feder beinhaltet, die den elektrischen Anschluss (11) und den Betätigungsschaft (26) elektrisch (15') kontaktiert.

7. Das chirurgische Instrument gemäß Anspruch 1, wobei der Verbindungsmechanismus ferner ein Klinkenschaltwerk (70) beinhaltet, das mindestens eine eingeklinkte Position, in der der Auslöser (20) daran gehindert wird, sich zu der offenen Position hin zu bewegen, und eine freie Position, in der sich der Auslöser (20) frei zu der offenen Position oder der Feststellposition hin bewegen kann, aufweist.

8. Das chirurgische Instrument gemäß Anspruch 7, wobei das Klinkenschaltwerk (70) Folgendes beinhaltet:

einen oder mehrere Zähne der Klinke (72), die auf dem Handgriffkörper (12') angeordnet sind; und
eine Klinkensperre (74), die auf dem Auslöser (20) positioniert ist, wobei die Klinkensperre (74) dazu konfiguriert ist, den einen oder die mehreren Zähnen der Klinke (72) einzuklinken, um die eingeklinkte Position der Klinke (72) zu definieren.

9. Das chirurgische Instrument gemäß Anspruch 8, wobei das Klinkenschaltwerk (70) eine Freigabetaste (76, 76') beinhaltet, die betriebsfähig an die Klinkensperre (74) gekoppelt ist, so dass die Betätigung der Freigabetaste (76, 76') die Klinkensperre (74) aus dem Zahn der Klinke (72) ausklinkt, um die freie Position der Klinke (72) zu definieren.

10. Das chirurgische Instrument gemäß Anspruch 9, wobei die Freigabetaste (76, 76') auf einer von der ersten Betätigungsoberfläche und der zweiten Betätigungsoberfläche des Auslösers (20) positioniert ist.

11. Das chirurgische Instrument gemäß Anspruch 10, wobei die Freigabetaste (76, 76') schwenkbar an den Auslöser (20) gekoppelt ist.

12. Das chirurgische Instrument gemäß Anspruch 1, wobei der Handgriffkörper (22) einen gebogenen Greifabschnitt beinhaltet.

Revendications

1. Un instrument chirurgical (10) comprenant :

un ensemble poignée (12, 12') comprenant une extrémité proximale et une extrémité distale ;
une tige allongée (14) qui s'étend depuis l'extrémité distale de l'ensemble poignée et le long d'un axe longitudinal central, la tige allongée (14) ayant une extrémité distale opposée à l'ensemble poignée (12, 12') ; et
un ensemble d'organes terminaux effecteurs (16) placé à l'extrémité distale de la tige allongée (14);
dans lequel l'ensemble poignée (12, 12') présente une configuration en ligne qui s'étend de manière linéaire de l'extrémité proximale à l'extrémité distale et dans lequel l'ensemble poignée (12, 12') comprend de plus :

un corps de poignée (22) ; et
un mécanisme de liaison comprenant :

un déclencheur (20) couplé de manière pivotante au corps de poignée (22) et pivotant entre une position ouverte lors de laquelle l'ensemble d'organes terminaux effecteurs (16) est ouvert et une position de bascule lors de laquelle l'ensemble d'organes terminaux effecteurs (16) est verrouillé et fermé ;
une liaison d'actionnement (24) couplée de manière pivotante au déclencheur (20) et s'étendant généralement de manière proximale dans le corps de poignée (22) ; et
une tige d'actionnement (26) couplée de manière pivotante à la liaison d'actionnement (24) et pouvant coulisser dans le sens longitudinal par rapport à la tige allongée (14) en réaction au mouvement pivotant du déclencheur (20), la tige d'actionnement (26) étant couplée de manière fonctionnelle à l'ensemble d'organes terminaux (16) ;
caractérisé par le fait que le corps de poignée (22) comprenne une première ouverture (112) et une seconde ouverture (114) diamétralement opposées ; et
le déclencheur (20) est doté d'une première (122) et d'une seconde (124) surface d'actionnement opposées l'une à l'autre, dans lequel le déclencheur (20) peut être poussé alternativement entre la première ouverture (112) et la seconde (114) de telle manière que la première surface d'actionnement (122) du déclencheur (20) ressorte de la première ouverture (112) du corps de poignée (22) lorsque le déclencheur (20) est en position ouverte et que la seconde surface d'actionnement (124) du déclencheur (20) ressorte de la seconde ouverture (114) du corps de poignée (22) lorsque le déclencheur (20) est en position de bascule.

2. L'instrument chirurgical de la revendication 1, comprenant de plus un mécanisme de rotation couplant de manière rotative l'ensemble des organes terminaux effecteurs (16) à l'ensemble poignée (12, 12').

3. L'instrument chirurgical de la revendication 2, dans lequel le mécanisme de rotation comprend un bouton tournant (17) placé à l'extrémité distale de l'ensemble poignée (12, 12').

4. L'instrument chirurgical de la revendication 1, dans lequel l'ensemble poignée (12, 12') comprend de plus un connecteur électrique (11) couplé de manière électrique à l'ensemble de terminaux effecteurs (16).

5. L'instrument chirurgical de la revendication 4, dans lequel le connecteur électrique (11) est inséré dans un renfoncement du corps de poignée (22).

6. L'instrument chirurgical de la revendication 4, dans lequel le couplage électrique entre le connecteur électrique (11) et l'ensemble de terminaux effecteurs (16) comprend un ressort conducteur (15') établissant le contact électrique entre le connecteur électrique (11) et la tige d'actionnement (26).

7. L'instrument chirurgical de la revendication 1, dans lequel le mécanisme d'articulation comprend de plus un mécanisme à cliquet (70) disposant d'au moins

une position verrouillée empêchant le déclencheur (20) de passer en position ouverte et une position libre permettant au déclencheur (20) de passer librement en position ouverte ou de bascule.

8. L'instrument chirurgical de la revendication 7, dans lequel le mécanisme à cliquet (70) comprend : une ou plusieurs dent(s) à cliquet (72) placée(s) sur le corps de poignée (12') ; et
un cliquet (74) placé sur le déclencheur (20), le cliquet (74) étant configuré pour enclencher une ou plusieurs dent(s) à cliquet (72) permettant d'enclencher la position verrouillée du cliquet (72).

9. L'instrument chirurgical de la revendication 8, dans lequel le mécanisme à cliquet (70) comprend un bouton de déverrouillage (76, 76') couplé de manière fonctionnelle au cliquet (74) de telle manière que le bouton de déverrouillage (76, 76') libère le cliquet (74) de la dent à cliquet (72) pour enclencher la position libre du cliquet (72).

10. L'instrument chirurgical de la revendication 9, dans lequel le bouton de déverrouillage (76, 76') est placé sur l'une des deux surfaces d'actionnement du déclencheur (20).

11. L'instrument chirurgical de la revendication 10, dans lequel le bouton de déverrouillage (76, 76') est couplé de manière pivotante au déclencheur (20).

12. L'instrument chirurgical de la revendication 1, dans lequel le corps de poignée (22) comprend une zone de prise en main arrondie.

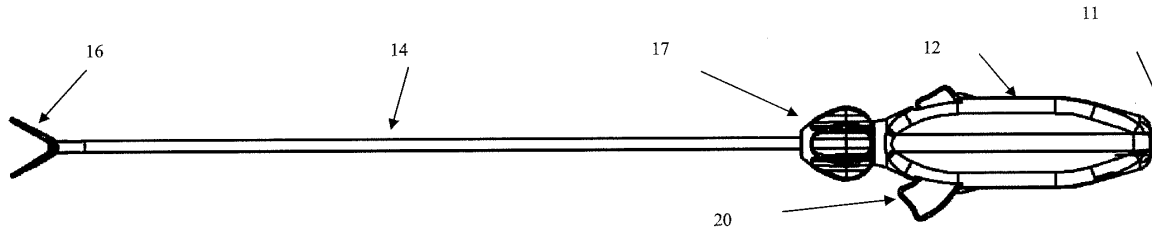


Figure 1

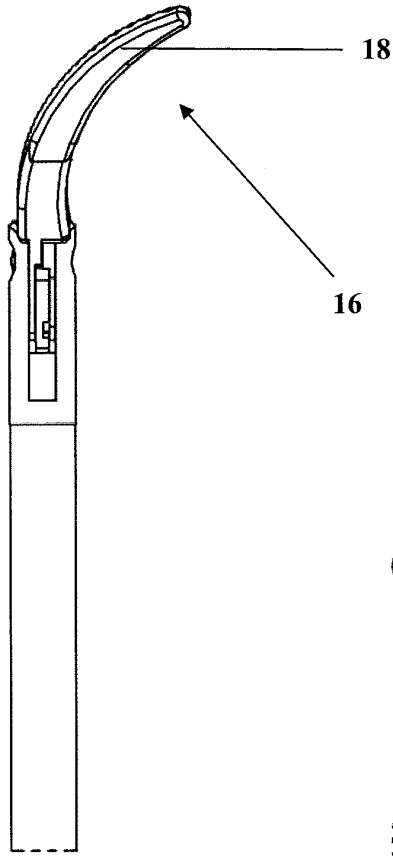


Figure 2A

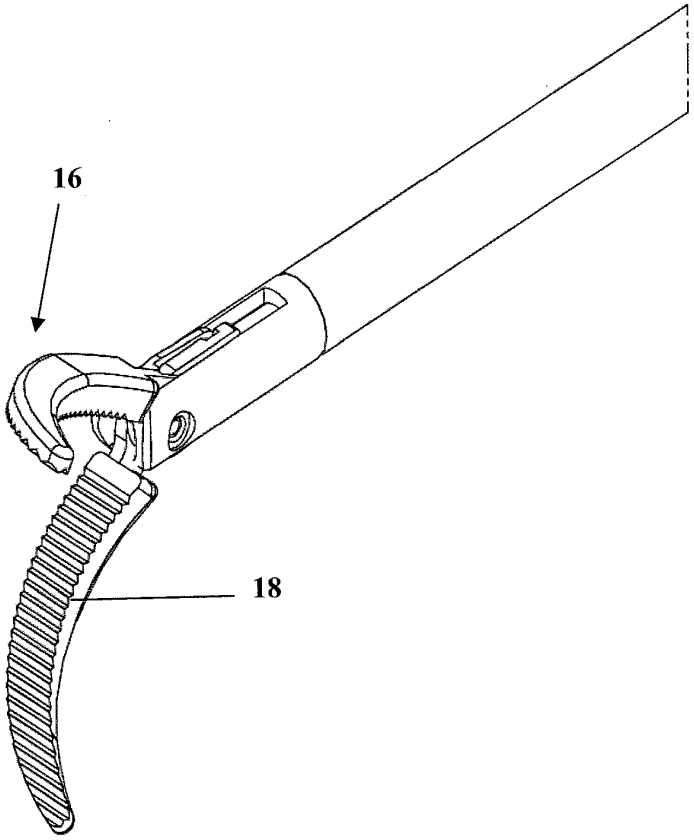


Figure 2B

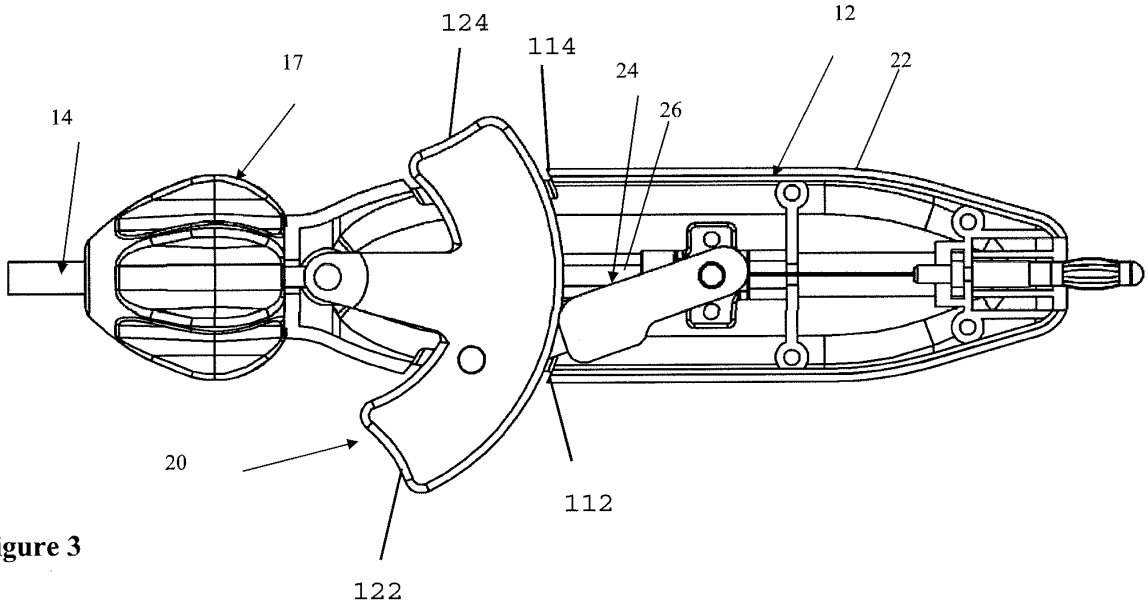


Figure 3

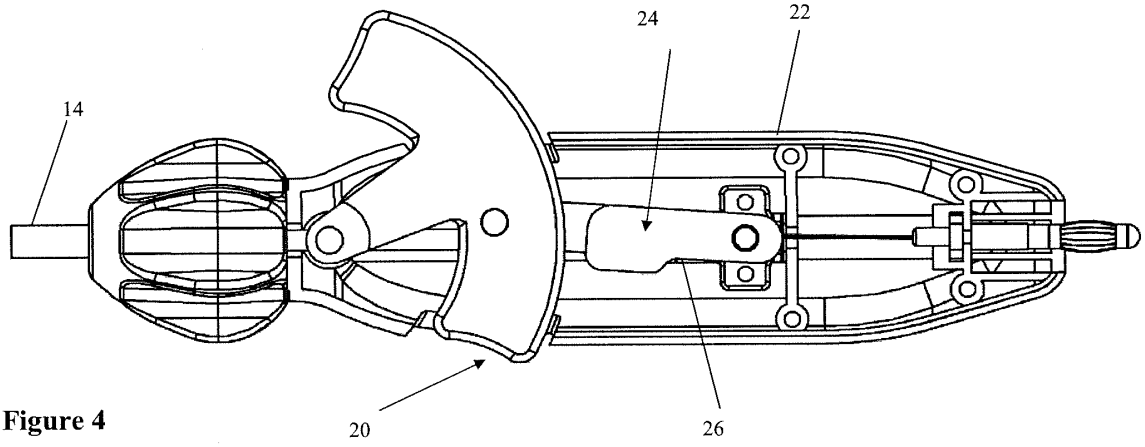
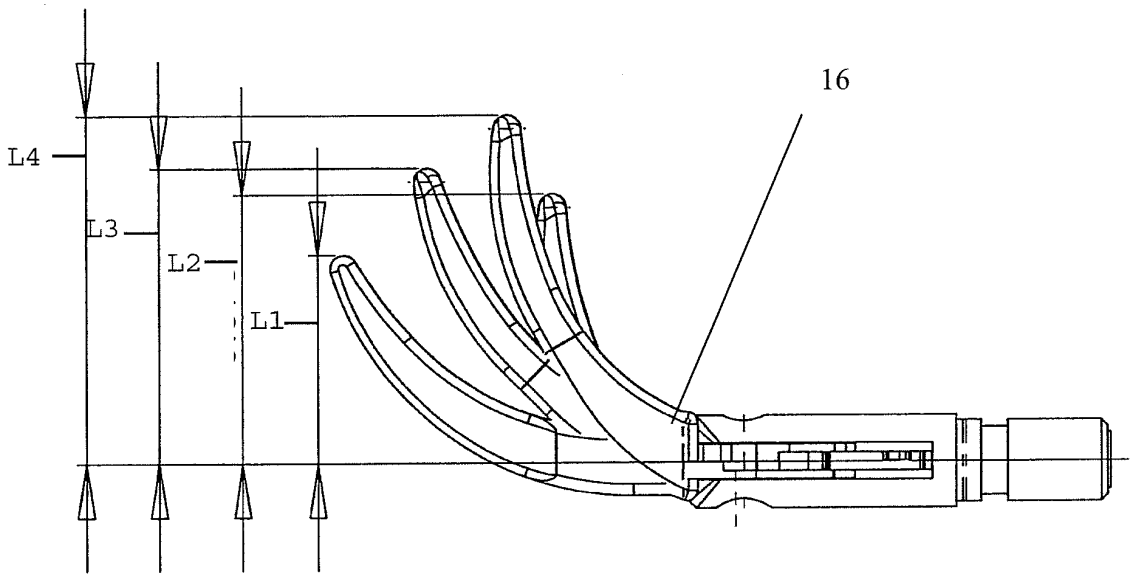


Figure 4



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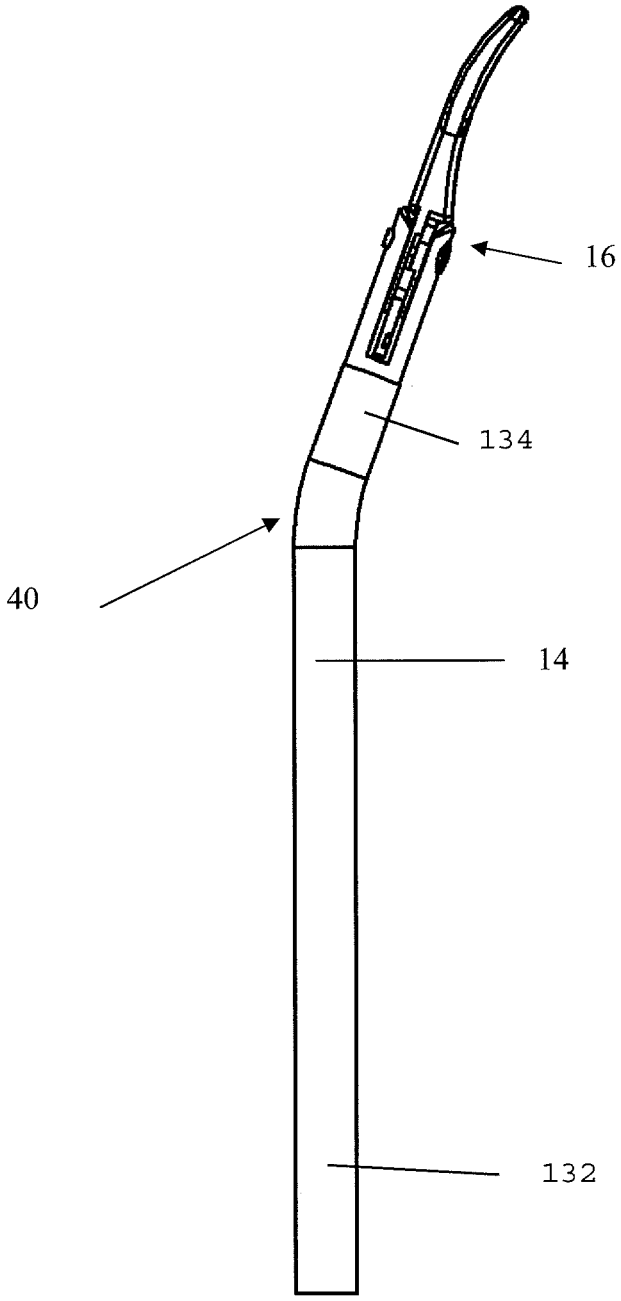

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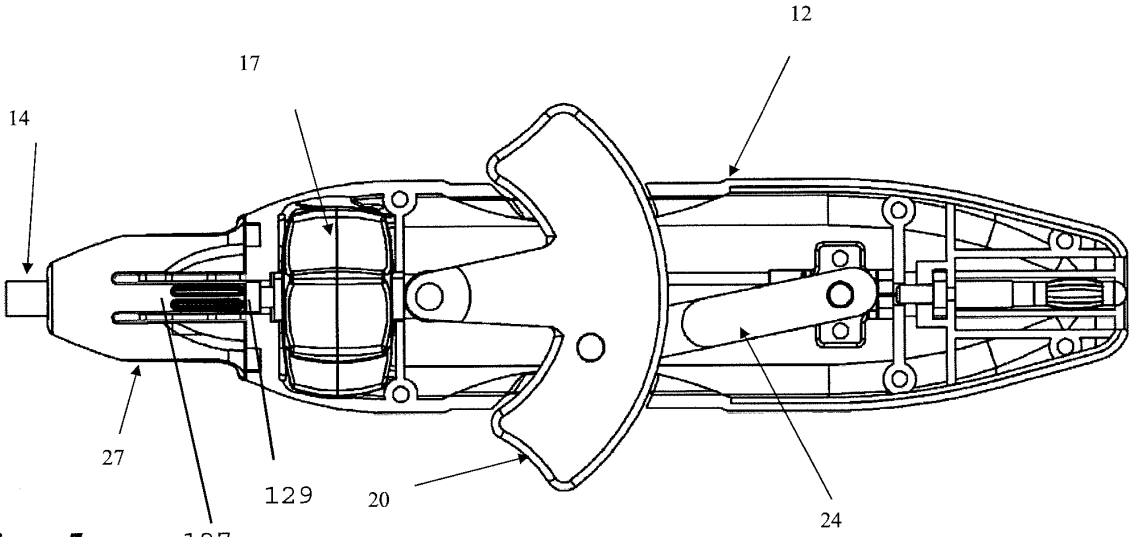

Figure 7

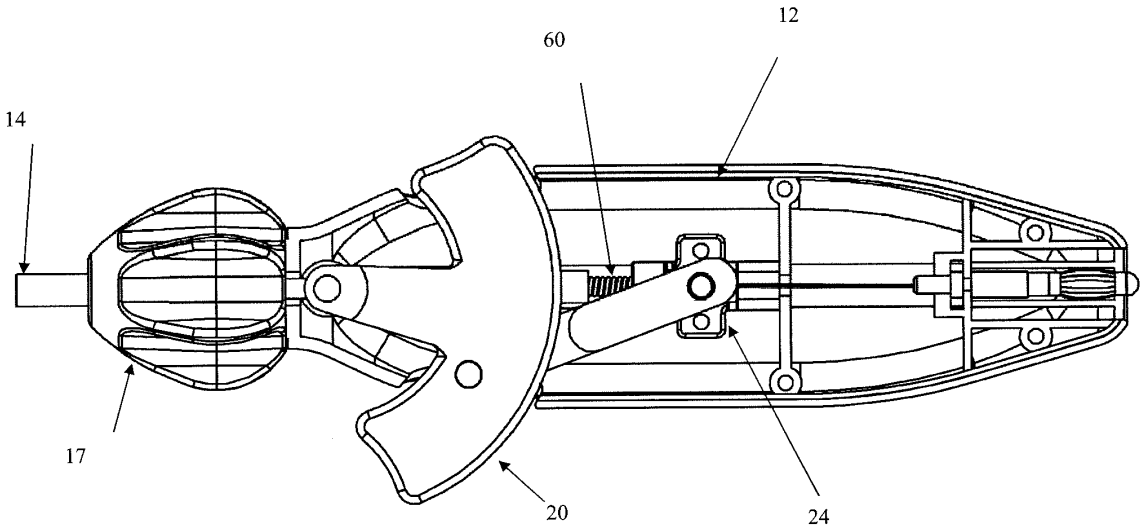

Figure 8

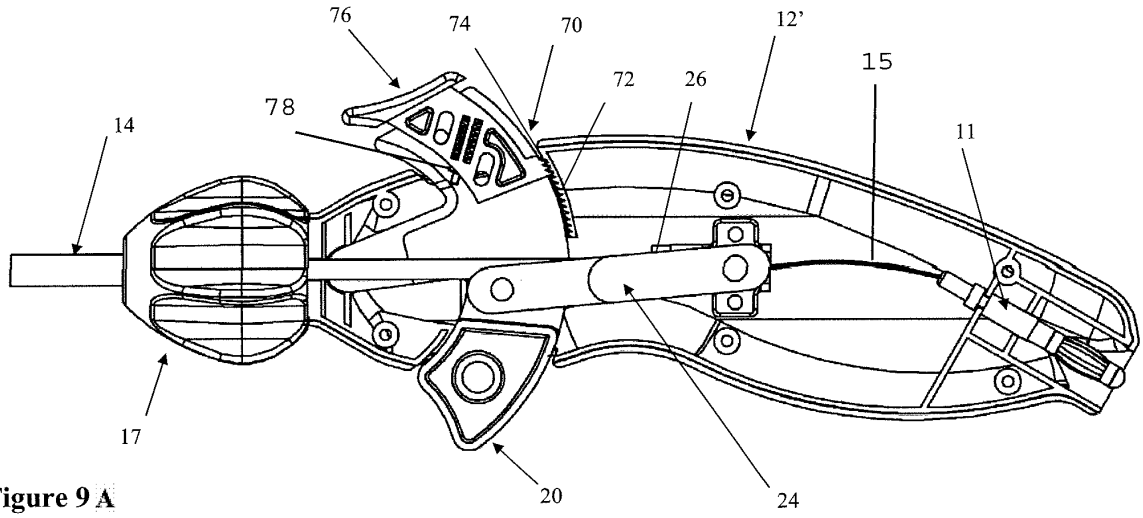

Figure 9 A

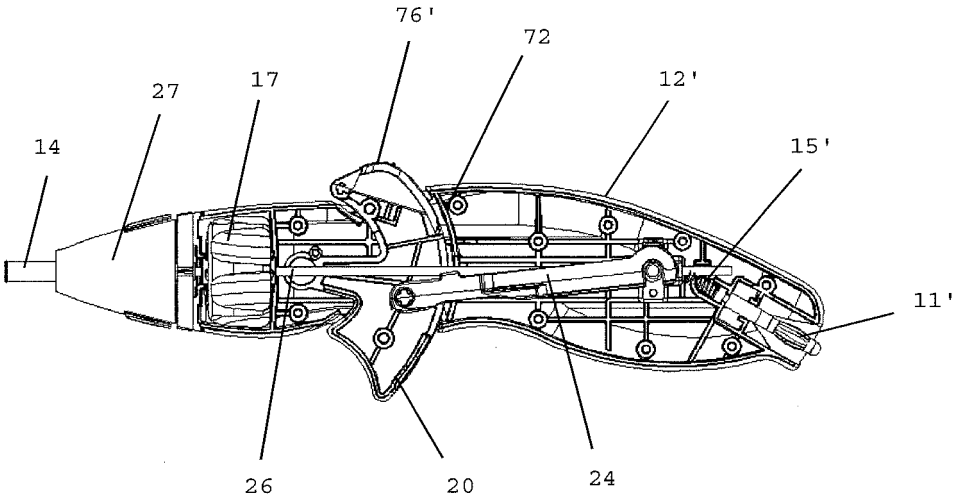

Figure 9B

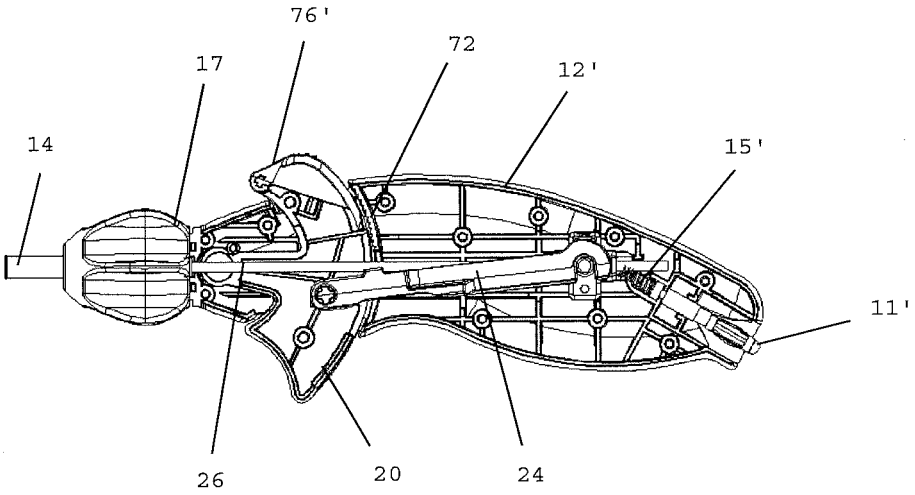

Figure 9C

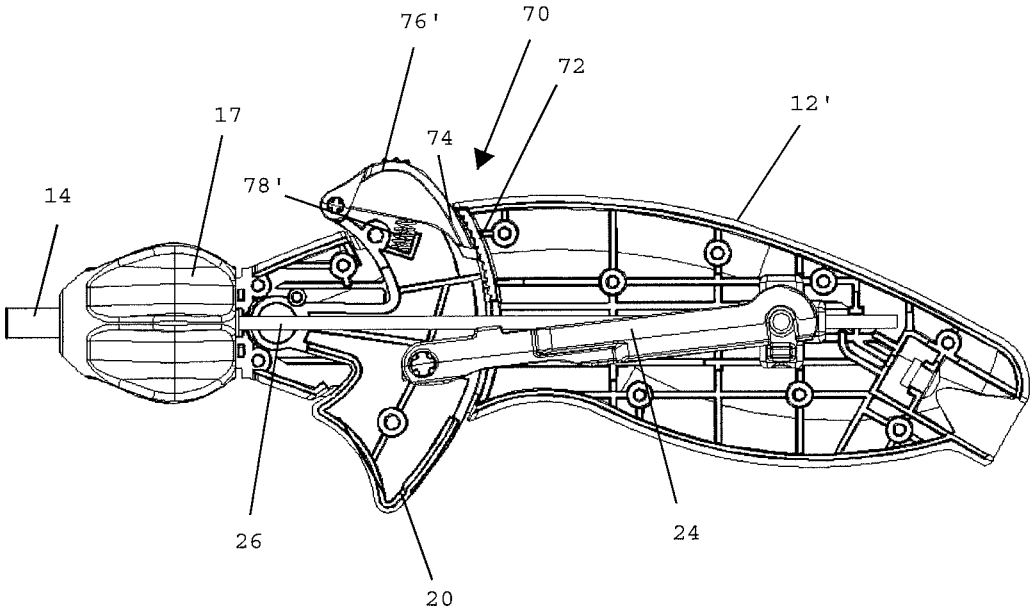

Figure 9D

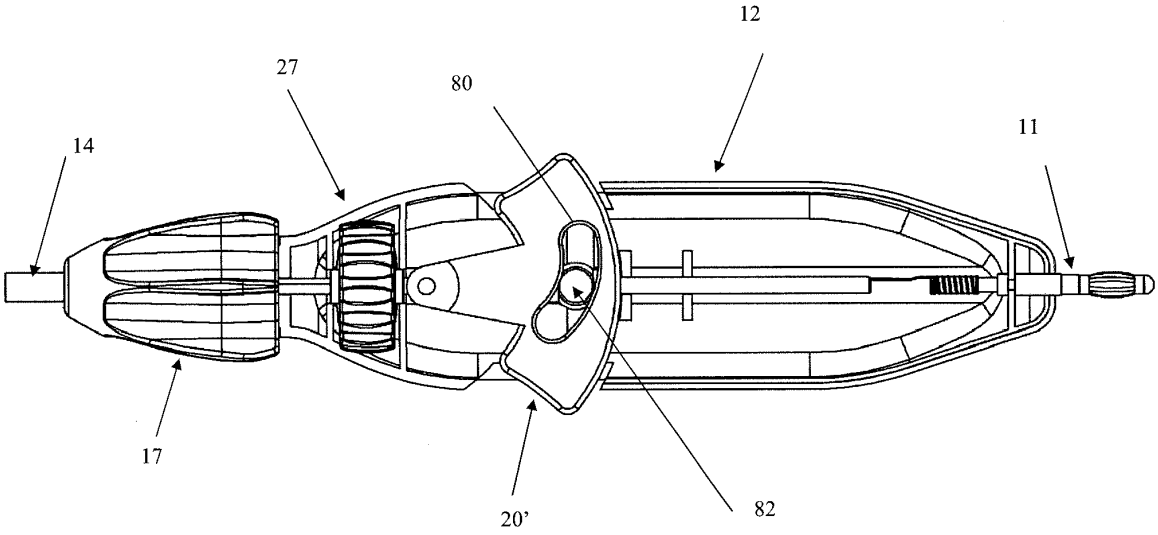

Figure 10

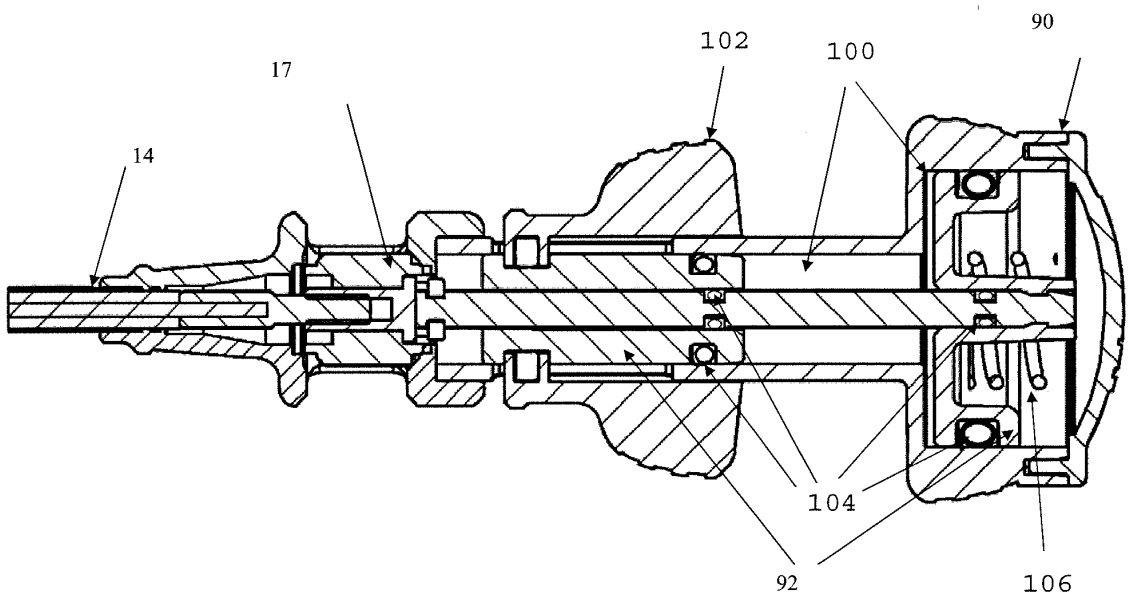

Figure 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20060079933 A1 **[0003]**

专利名称(译)	单端口仪器		
公开(公告)号	EP2485662B1	公开(公告)日	2015-09-09
申请号	EP2010771260	申请日	2010-10-11
[标]申请(专利权)人(译)	应用医疗资源		
申请(专利权)人(译)	应用医疗资源CORPORATION		
当前申请(专利权)人(译)	应用医疗资源CORPORATION		
[标]发明人	STROKOSZ ARKADIUSZ OKIHISA DAVID T DECKER STEVEN E DEALDAY PHILLIP TAYLOR SCOTT V KAHLE HENRY		
发明人	STROKOSZ, ARKADIUSZ OKIHISA, DAVID, T. DECKER, STEVEN, E. DEALDAY, PHILLIP TAYLOR, SCOTT, V. KAHLE, HENRY		
IPC分类号	A61B17/29 A61B17/00 A61B19/00 A61B17/44 A61B17/28		
CPC分类号	A61B17/2909 A61B90/03 A61B2017/00407 A61B2017/00424 A61B2017/00539 A61B2017/2837 A61B2017/2904 A61B2017/291 A61B2017/2922 A61B2017/2926 A61B2017/2929 A61B2017/2946 A61B2017/447 A61B2090/0811		
优先权	61/250411 2009-10-09 US		
其他公开文献	EP2485662A2		
外部链接	Espacenet		

摘要(译)

可用于单端口腹腔镜手术的手术工具可包括低轮廓手柄组件，以最小化切口部位附近的工具干扰。例如，用于手术器械的手柄组件可以具有沿着器械的细长轴的中心纵向轴线线性延伸的大致直线构型。包括触发器，致动连杆和致动轴的连杆机构可以位于在线手柄内。连杆机构可在其中器械的端部执行器打开的打开位置和其中端部执行器锁定关闭的肘节位置之间枢转。诸如棘轮机构的锁定机构也可以用于锁定端部执行器。外科解剖器可以包括具有弯曲轮廓或成角度细长轴的夹爪，以最小化工具干涉并且使手术部位内的可见性最大化。

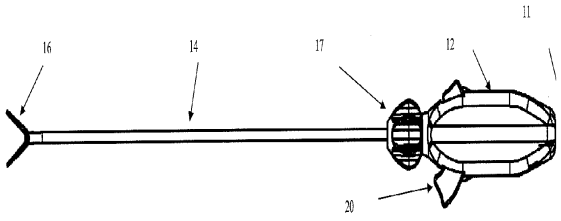

Figure 1