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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

(54) Title: POSITIVE SHAFT ROTATION LOCK ACTIVATED BY JAW CLOSURE

(57) Abstract: A surgical instrument includes a housing, a shaft assembly, and a rotation locking mechanism. The shaft assembly extends distally from the housing and includes a shaft portion defining a longitudinal axis, and an end effector extending distally from the shaft portion, wherein the end effector and the shaft portion are axially rotatable relative to the housing about the longitudinal axis. The end effector includes a first jaw and a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration. The rotation locking mechanism is configured to prevent an axial rotation of the end effector and the shaft portion relative to the housing in the closed configuration. The rotation locking mechanism is configured to permit the axial rotation of the end effector and the shaft portion relative to the housing in the open configuration.

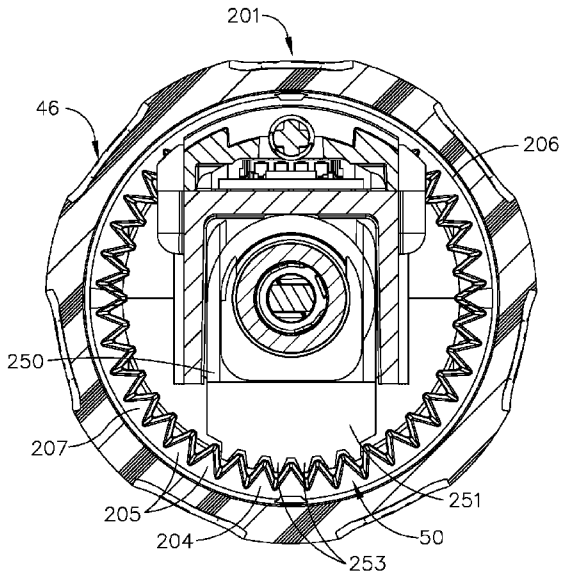

FIG. 7

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TITLE

POSITIVE SHAFT ROTATION LOCK ACTIVATED BY JAW CLOSURE

BACKGROUND

[0001] The present invention relates to surgical instruments and, in various arrangements, to surgical stapling and cutting instruments and staple cartridges for use therewith that are designed to staple and cut tissue.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Various features of the embodiments described herein, together with advantages thereof, may be understood in accordance with the following description taken in conjunction with the accompanying drawings as follows:

[0003] FIG. 1 illustrates a perspective view of a surgical instrument in accordance with at least one aspect of the present disclosure;

[0004] FIG. 2 illustrates is a partial perspective view of an interchangeable shaft assembly and a perspective view of a handle of the surgical instrument of FIG. 1 in an unassembled configuration;

[0005] FIG. 3 illustrates a perspective view of an end effector of the surgical instrument of FIG. 1;

[0006] FIG. 4 illustrates a partial exploded view of an interchangeable shaft assembly in accordance with at least one aspect of the present disclosure;

[0007] FIG. 5 illustrates a partial longitudinal cross-sectional view of an interchangeable shaft assembly in accordance with at least one aspect of the present disclosure;

[0008] FIG. 6 illustrates a partial longitudinal cross-sectional view of an interchangeable shaft assembly in accordance with at least one aspect of the present disclosure;

[0009] FIG. 7 illustrates a partial transverse cross-sectional view of the interchangeable shaft assembly of FIG. 6.

[0010] FIG. 8 illustrates a partial transverse cross-sectional view of an interchangeable shaft assembly in accordance with at least one aspect of the present disclosure;

[0011] FIG. 9 illustrates a partial longitudinal cross-sectional view of an interchangeable shaft assembly in accordance with at least one aspect of the present disclosure;

[0012] FIG. 10 illustrates a partial longitudinal cross-sectional view of an interchangeable shaft assembly in accordance with at least one aspect of the present disclosure; and

[0013] FIG. 11 illustrates a partial transverse cross-sectional view of the interchangeable shaft assembly of FIG. 9.

DETAILED DESCRIPTION

[0014] Numerous specific details are set forth to provide a thorough understanding of the overall structure, function, manufacture, and use of the embodiments as described in the specification and illustrated in the accompanying drawings. Well-known operations, components, and elements have not been described in detail so as not to obscure the embodiments described in the specification. The reader will understand that the embodiments described and illustrated herein are non-limiting examples, and thus it can be appreciated that the specific structural and functional details disclosed herein may be representative and illustrative. Variations and changes thereto may be made without departing from the scope of the claims.

[0015] The terms "comprise" (and any form of comprise, such as "comprises" and "comprising"), "have" (and any form of have, such as "has" and "having"), "include" (and any form of include, such as "includes" and "including") and "contain" (and any form of contain, such as "contains" and "containing") are open-ended linking verbs. As a result, a surgical system, device, or apparatus that "comprises," "has," "includes" or "contains" one or more elements possesses those one or more elements, but is not limited to possessing only those one or more elements. Likewise, an element of a system, device, or apparatus that "comprises," "has," "includes" or "contains" one or more

features possesses those one or more features, but is not limited to possessing only those one or more features.

[0016] The terms “proximal” and “distal” are used herein with reference to a clinician manipulating the handle portion of the surgical instrument. The term “proximal” refers to the portion closest to the clinician and the term “distal” refers to the portion located away from the clinician. It will be further appreciated that, for convenience and clarity, spatial terms such as “vertical”, “horizontal”, “up”, and “down” may be used herein with respect to the drawings. However, surgical instruments are used in many orientations and positions, and these terms are not intended to be limiting and/or absolute.

[0017] Various exemplary devices and methods are provided for performing laparoscopic and minimally invasive surgical procedures. However, the reader will readily appreciate that the various methods and devices disclosed herein can be used in numerous surgical procedures and applications including, for example, in connection with open surgical procedures. As the present Detailed Description proceeds, the reader will further appreciate that the various instruments disclosed herein can be inserted into a body in any way, such as through a natural orifice, through an incision or puncture hole formed in tissue, etc. The working portions or end effector portions of the instruments can be inserted directly into a patient’s body or can be inserted through an access device that has a working channel through which the end effector and elongate shaft of a surgical instrument can be advanced.

[0018] Although various aspects of the present disclosure have been described herein in connection with linear staplers, these aspects can be similarly implemented in other surgical staplers such as, for example, circular staplers and/or curved staplers. Also although various aspects of the present disclosure are described in connection with a hand-held instrument, these aspects can be similarly implemented in robotic surgical systems. Various suitable robotic surgical systems are disclosed in U.S. Patent No. 2012/0298719, entitled SURGICAL STAPLING INSTRUMENTS WITH ROTATABLE STAPLE DEPLOYMENT ARRANGEMENTS, filed May 27, 2011, now U.S. Patent No. 9,072,535, the entire disclosure of which is incorporated by reference herein.

[0019] Referring primarily to FIG. 1-3, a surgical stapling instrument 10 comprises an interchangeable shaft assembly 46 including a shaft portion 11 and an end effector 12

extending from the shaft portion 11. The end effector 12 comprises a first jaw 14 and a second jaw 15. The first jaw 14 comprises a staple cartridge 16. The staple cartridge 16 is insertable into and removable from a cartridge pan or channel 17 of the first jaw 14; however, other embodiments are envisioned in which the staple cartridge 16 is not removable from, or at least readily replaceable from, the first jaw 14. The second jaw 15 comprises an anvil 18 configured to deform staples ejected from the staple cartridge 16. The second jaw 15 is pivotable relative to the first jaw 14 about a closure axis; however, other embodiments are envisioned in which the first jaw 14 is pivotable relative to the second jaw 15.

[0020] The pivoting of at least one of the first jaw 14 and the second jaw 15 relative to the other transitions the end effector 12 between an open configuration and a closed configuration. In the open configuration, a jaw aperture 9 is defined between the first jaw 14 and the second jaw 15. The jaw aperture 9 is sized to receive tissue between the first jaw 14 and the second jaw 15. In the closed configuration, the first jaw 14 and the second jaw 15 are approximated around the tissue.

[0021] Referring to FIG. 2, in various examples, the surgical instrument 10 includes a housing 8 that comprises a handle assembly 29 that is configured to be grasped, manipulated, and actuated by the clinician. The housing 8 is configured for operable attachment to the interchangeable shaft assembly 46, which includes the end effector 12 and the shaft portion 11. In accordance with the present disclosure, various forms of interchangeable shaft assemblies may be effectively employed in connection with robotically controlled surgical systems as well hand-held instruments. The term “housing” may encompass a housing or similar portion of a robotic system that houses or otherwise operably supports at least one drive system configured to generate and apply at least one control motion that could be used to actuate interchangeable shaft assemblies. The term “frame” may refer to a portion of a hand-held surgical instrument. The term “frame” also may represent a portion of a robotically controlled surgical instrument and/or a portion of the robotic system that may be used to operably control a surgical instrument. For example, the interchangeable shaft assemblies disclosed herein may be employed with various robotic systems, instruments, components and methods disclosed in U.S. Patent Application Serial No. 13/118,241, entitled

SURGICAL STAPLING INSTRUMENTS WITH ROTATABLE STAPLE DEPLOYMENT ARRANGEMENTS, now U.S. Patent No. 9,072,535. U.S. Patent Application Serial No. 13/118,241, entitled SURGICAL STAPLING INSTRUMENTS WITH ROTATABLE STAPLE DEPLOYMENT ARRANGEMENTS, now U.S. Patent No. 9,072,535, is incorporated by reference herein in its entirety.

[0022] Referring primarily to FIG. 3, the staple cartridge 16 comprises a cartridge body 21. The cartridge body 21 includes a proximal end 22, a distal end 23, and a deck 24 extending between the proximal end 22 and the distal end 23. In use, the staple cartridge 16 is positioned on a first side of the tissue to be stapled and the anvil 18 is positioned on a second side of the tissue. The anvil 18 is moved toward the staple cartridge 16 to compress and clamp the tissue against the deck 24. Thereafter, staples removably stored in the cartridge body 21 can be deployed into the tissue. The cartridge body 21 includes staple cavities 26 defined therein wherein staples are removably stored in the staple cavities 26. The staple cavities 26 are generally arranged in six longitudinal rows. Three rows of the staple cavities 26 are positioned on a first side of a longitudinal slot 27 and three rows of staple cavities are positioned on a second side of the longitudinal slot 27. Other arrangements of the staple cavities 26 and staples may be possible.

[0023] As described in greater detail below, the surgical instrument 10 staples and cuts tissue by employing a firing mechanism carefully orchestrated to perform the tissue stapling ahead of the tissue cutting. To ensure avoidance of an instance where the tissue cutting occurs ahead of, or without, tissue stapling, the surgical instrument 10 is equipped with various safety features.

[0024] The staples of the staple cartridge 16 are generally supported by staple drivers in the cartridge body 21. The drivers are movable between a first, or unfired position, and a second, or fired, position to eject the staples from the staple cavities 26. The drivers are retained in the cartridge body 21 by a pan or retainer which extends around the bottom of the cartridge body 21 and includes resilient members configured to grip the cartridge body 21 and hold the retainer to the cartridge body 21. The drivers are movable between their unfired positions and their fired positions by a sled. The sled is movable between a proximal position adjacent the proximal end 22 and a distal position

adjacent the distal end 23. The sled comprises a plurality of ramped surfaces configured to slide under the drivers and lift the drivers, and the staples supported thereon, toward the anvil 18.

[0025] Further to the above, the sled is moved distally by a firing member. The firing member is configured to contact the sled and push the sled from a proximal position adjacent the proximal end 22 toward a distal position adjacent the distal end 23. The longitudinal slot 27 defined in the cartridge body 21 is configured to receive the firing member. The anvil 18 also includes a slot configured to receive the firing member. The firing member further comprises a first cam which engages the first jaw 14 and a second cam which engages the second jaw 15. As the firing member is advanced distally, the first cam and the second cam can control the distance, or tissue gap, between the deck 24 of the staple cartridge 16 and the anvil 18. The firing member also comprises a knife configured to incise the tissue captured intermediate the staple cartridge 16 and the anvil 18.

[0026] The shaft portion 11 encompasses and guides a firing motion from the housing 8 through a longitudinally-reciprocating laminated firing bar extending proximally from the firing member. In particular, the shaft portion 11 includes a longitudinal firing bar slot that receives the firing bar.

[0027] The housing 8 depicted in FIGS. 1-3 is shown in connection with the interchangeable shaft assembly 46 that includes the end effector 12 that comprises a surgical cutting and fastening device that is configured to operably support the staple cartridge 16 therein. The housing 8 may be configured for use in connection with interchangeable shaft assemblies that include end effectors that are adapted to support different sizes and types of staple cartridges, have different shaft lengths, sizes, and types, etc. In addition, the housing 8 may also be effectively employed with a variety of other interchangeable shaft assemblies including those assemblies that are configured to apply other motions and forms of energy such as, for example, radio frequency (RF) energy, ultrasonic energy and/or motion to end effector arrangements adapted for use in connection with various surgical applications and procedures. Furthermore, the end effectors, shaft assemblies, handles, surgical instruments, and/or surgical instrument systems can utilize any suitable fastener, or fasteners, to fasten tissue. For instance, a

fastener cartridge comprising a plurality of fasteners removably stored therein can be removably inserted into and/or attached to the end effector of a shaft assembly.

[0028] Referring to FIGS. 1-3, the surgical instrument 10 further comprises an articulation joint 20 configured to permit the end effector 12 to be rotated, or articulated, relative to the shaft 11. The end effector 12 is rotatable about a longitudinal articulation axis 19, defined by the shaft portion 11, between an unarticulated, or home, configuration and an articulated configuration. An articulation driver 34 is configured to drive the articulation of the end effector 12 relative to the shaft portion 11.

[0029] Referring to FIGS. 1-3, the handle assembly 29 may further include a frame that operably supports a plurality of drive systems such as, for example, a closure drive system, generally designated as 30, which may be employed to apply closing and opening motions to the interchangeable shaft assembly 46 that is operably attached or coupled thereto. In at least one form, the closure drive system 30 may include an actuator in the form of a closure trigger 32 that is pivotally supported by the handle assembly 29. In various forms, the closure drive system 30 further includes a closure linkage assembly that is pivotally coupled to the closure trigger 32. As can be seen in FIG. 2, the closure linkage assembly may include a closure link 38 that is pivotally coupled to the closure trigger 32. The closure link 38 may also be referred to herein as an "attachment member" and include a transverse attachment pin 37.

[0030] Referring primarily to FIGS. 3 and 4, the interchangeable shaft assembly 46 includes a closure shuttle 250 that is slidably supported within a chassis 240 such that it may be axially moved relative thereto. The closure shuttle 250 includes a pair of proximally-protruding hooks 252 that are configured for attachment to the attachment pin 37 that is attached to the closure link 38. A proximal end 261 of a closure tube 260 is coupled to the closure shuttle 250 for relative rotation thereto. For example, a U shaped connector 263 is inserted into an annular slot 262 in the proximal end 261 of the closure tube 260 and is retained within vertical slots in the closure shuttle 250. Such an arrangement serves to attach the closure tube 260 to the closure shuttle 250 for axial travel therewith while enabling the closure tube 260 to rotate relative to the closure shuttle 250 about a longitudinal axis 19. A closure spring 268 is journaled on the closure tube 260 and serves to bias the closure tube 260 in the proximal direction "PD"

which can serve to pivot the closure trigger into the unactuated position when the shaft assembly is operably coupled to the handle assembly 29.

[0031] In use, the closure tube 260 is translated distally (direction "DD") to close the anvil 18, for example, in response to the actuation of the closure trigger 32. The anvil 18 is closed by distally translating the closure tube 260 and thus a shaft closure sleeve assembly 272, causing it to strike a proximal surface on the anvil 18 in the manner described in the aforementioned reference U.S. Patent Application Serial No. 13/803,086, now U.S. Patent Application Publication No. 2014/0263541. As was also described in detail in that reference, the anvil 18 is opened by proximally translating the closure tube 260 and the shaft closure sleeve assembly 272, causing a tab 276 and a horseshoe aperture 275 to contact and push against the anvil tab to lift the anvil 18. In the anvil-open position, the closure tube 260 is moved to its proximal position. Various other components and operational features of the closure drive system 30 are disclosed in U.S. Patent Application No. 14/226,142, titled SURGICAL INSTRUMENT COMPRISING A SENSOR SYSTEM, and filed March 26, 2014, now U.S. Patent Application Publication No. 2015/0272575, which is hereby incorporated by reference herein in its entirety.

[0032] Furthermore, the shaft portion 11 of the interchangeable shaft assembly 46 can further include a proximal housing or nozzle 201 comprised of nozzle portions 202 and 203. The nozzle 201 is coupled to the closure tube 260 such that rotation of the nozzle 201 about the longitudinal axis 19 causes a corresponding rotation in the shaft portion 11 and the end effector 12 about the longitudinal axis 19. U.S. Patent Application No. 14/226,142, titled SURGICAL INSTRUMENT COMPRISING A SENSOR SYSTEM, and filed March 26, 2014, now U.S. Patent Application Publication No. 2015/0272575, which is hereby incorporated by reference herein in its entirety, includes additional details about the nozzle 201 and the rotation of the interchangeable shaft assembly 46.

[0033] Rotation of end effector 12 about the longitudinal axis 19 allows a clinician a great deal of flexibility in orienting the end effector 12 with respect to tissue. However, once the tissue is captured by the end effector 12, an additional rotation of the end effector 12 may lead to undesirable tissue damage. The present disclosure presents

several solutions that permit an axial rotation of the end effector 12 while the end effector 12 is in an open configuration, but prevent, or at least resist, the axial rotation of the end effector 12 while the end effector 12 is in a closed configuration.

[0034] Referring generally to FIGS. 4-7, the interchangeable shaft assembly 46 includes a rotation locking mechanism 50 configured to prevent the axial rotation of the end effector 12 and the shaft portion 11 relative to the housing 8 and the closure shuttle 250 while the end effector 12 is in the closed configuration. On the other hand, the rotation locking mechanism 50 is configured to permit the axial rotation of the end effector 12 and the shaft portion 11 relative to the housing 8 and the closure shuttle 250 while the end effector 12 is in the closed configuration.

[0035] The end effector 12 and the shaft portion 11 are axially rotatable together as a unit about the longitudinal axis 19. The closure shuttle 250 and the housing 8 are not rotated with the end effector 12 and the shaft portion 11 about the longitudinal axis 19.

[0036] Furthermore, the rotation locking mechanism 50 can be transitioned between unlocked configuration (FIG. 5) and a locked configuration (FIG. 6). In the unlocked configuration, the axial rotation of the shaft portion 11 and the end effector 12 relative to the housing 8 and the closure shuttle 250 is permitted. In the locked configuration, the axial rotation of the shaft portion 11 and the end effector 12 relative to the housing 8 and the closure shuttle 250 is prevented by the rotation locking mechanism 50.

[0037] The rotation locking mechanism 50 is synchronized to the closure drive system 30 such that the rotation locking mechanism 50 is in an unlocked configuration while the end effector 12 is in an open configuration, and the rotation locking mechanism 50 is in a locked configuration while the end effector 12 is in a closed configuration. In some examples, as illustrated in FIGS. 5 and 6, this is accomplished by the closure shuttle 250 and the nozzle 201. The nozzle 201 is prevented from the axial rotation by the closure shuttle 250 in the closed configuration.

[0038] As described above, the closure shuttle 250 is translated distally in a closure motion of the closure drive system 30 that transitions the end effector 12 to the closed configuration. In its distal position, as illustrated in FIG. 6, the closure shuttle 250 lockingly engages the nozzle 201 preventing its axial rotation. To transition the end effector back to its open configuration, the closure shuttle 250 is translated proximally in

an opening motion of the closure drive system 30. In its proximal position, as illustrated in FIG. 5, the closure shuttle 250 is disengaged from the nozzle 201 permitting the nozzle 201, the shaft portion, and the end effector 12 to axially rotate freely relative to the housing 8 and the closure shuttle 250.

[0039] The closure shuttle 250 comprises an engagement portion 251 configured for locking engagement with an engagement portion 204 of the nozzle 201 while the closure shuttle 250 is in its distal position and the end effector 12 in the closed configuration. The engagement portions 204, 251 include a plurality of projections 205, 253 which are configured for locking engagement in the locked configuration.

[0040] In the example illustrated in FIGS. 6 and 7, the projections 205, 253 are in the form of teeth that are meshingly engaged in the locked configuration and are disengaged in the unlocked configuration. Attempting to axially rotate the nozzle 201 while the end effector 12 is in the closed configuration would require the projections 253 of the engagement portion 251 of the closure shuttle 250 to be rotated. However, since the closure shuttle 250 is unable to rotate axially relative to the housing 8, the nozzle 201 and, consequently, the shaft portion 11 and the end effector 12 are also unable to rotate axially relative to the housing 8 in the closed configuration.

[0041] As illustrated in FIG. 5, in the open configuration, the closure shuttle 250 is in its proximal position. Consequently, the projections 253 are out of meshing engagement with the projections 205 allowing the nozzle 201 and, consequently, the shaft portion 11 and the end effector 12 to be freely rotated relative to the housing 8. To reestablish a meshing engagement between the projections 205 and the projections 253, the projections 253 need to be advanced distally. This is achieved by advancing the closure shuttle 250 distally, which causes the end effector 12 to be transitioned to the closed configuration.

[0042] In various examples, the rotation locking mechanism 50 can be implemented in other suitable portions of the interchangeable shaft assembly 46. The engagement portion 251 of the closure shuttle 250 can be implemented in other portions of the closure drive system 30 that, like the closure shuttle 250, are translatable axially to close the end effector 12 but are not rotated with the shaft portion 11 and the end effector 12 relative to the longitudinal axis 19. Likewise, the engagement portion 204 of

the nozzle 201 can be implemented in other portions of the interchangeable shaft assembly 46 that are axially rotated with the shaft portion 11 and the end effector 12.

[0043] Further to the above, in the example illustrated in FIG. 7, the engagement portion 204 defines an annular body 207 in an inner surface 206 of the nozzle 201. The projections 253 protrude from the annular body toward the longitudinal axis 19. In the example of FIG. 7, the projections 253 are arranged circumferentially about the inner surface 206 of the nozzle 201.

[0044] Referring again to FIG. 7, the engagement portion 251 defined a curved body comprising a radius of curvature that matches, or at least substantially, matches the radius of curvature of the annular body 207 of the engagement portion 251. This arrangement permits the projections 253 to meshingly engage the projections 205 as the closure shuttle 250 reaches its distal position. To prevent the closure shuttle 250 from retreating from its distal position prematurely, a closure locking mechanism can be employed. Suitable closure locking mechanisms are described in U.S. Patent Application No. 14/226,142, titled SURGICAL INSTRUMENT COMPRISING A SENSOR SYSTEM, and filed March 26, 2014, now U.S. Patent Application Publication No. 2015/0272575, which is hereby incorporated by reference herein in its entirety.

[0045] In various instances, a clinician may desire to make subtle additional changes to an orientation of an end effector after the rotation is locked in the closed configuration. FIG. 8 illustrates an example an interchangeable shaft assembly 146 that permits such changes. The interchangeable shaft assembly 146 is similar in many respects to the to the interchangeable shaft assembly 46. For example, the interchangeable shaft assembly 146 includes the end effector 12, the shaft portion 11, and the nozzle 201.

[0046] The interchangeable shaft assembly 146, however, includes a rotation locking mechanism 150 that is slightly different than the rotation locking mechanism 50. In one aspect, the engagement portion 251 is spaced apart from the closure shuttle 250. A biasing member 255 extends between, and connects, the engagement portion 251 and the closure shuttle 250, as illustrated in FIG. 8.

[0047] The biasing member 255 includes a first end 257 attached to the closure shuttle 250 and a second end 258 attached to the engagement portion 251. The biasing

member 255 sets a predetermined torque beyond which the nozzle 201 will be rotated axially relative to the housing 8. A clinician can force an axial rotation of the nozzle 201, and consequently the shaft portion 11 and the end effector 12, by applying a torque to the nozzle 201 that is greater than or equal to the predetermined torque.

[0048] Such torque application, in the closed configuration, causes the projections 205 to fall out of meshing engagement with the projections 253, thus moving the engagement portion 251 toward the closure shuttle 250 and, in the process, compressing the biasing member 255. When the torque applied by the clinician falls below the predetermined torque, the projections 253 are returned into a meshing engagement with the projections 205 at a different section of the annular body 207.

[0049] An alternative embodiment that may permit a clinician to make subtle changes to an orientation of an end effector in the closed configuration is depicted in FIGS. 9-11. FIG. 9 illustrates an example of an interchangeable shaft assembly 346 that permits such changes. The interchangeable shaft assembly 346 is similar in many respects to the interchangeable shaft assemblies 46 and 146. For example, the interchangeable shaft assembly 346 includes the end effector 12, the shaft portion 11, and the nozzle 201.

[0050] The interchangeable shaft assembly 346 further includes a closure shuttle 350, which is similar in many respects to the closure shuttle 250. The interchangeable shaft assembly 346 also includes one or more brake assemblies 360. Engagement portions 351 of the closure shuttle 350 are configured to motivate the brake assemblies 360 to apply a predetermined load against the nozzle 201 in the closed configuration.

[0051] The predetermined load causes a frictional force to be applied to the nozzle 201. In result, as illustrated in FIG. 10, a first predetermined torque is required to rotate the nozzle 201 in the closed configuration owing to the predetermined load applied by the brake assemblies 360 to the nozzle 201. In addition, as illustrated in FIG. 9, a second predetermined torque, less than the first predetermined torque, is required to rotate the nozzle 201 in the open configuration while the brake assemblies 360 are not applied to the nozzle 201.The increased torque in the closed configuration allows the clinician to fine tune the orientation of the end effector 12 by making subtle additional changes to the axial rotational position of the nozzle 201.

[0052] The brake assemblies 360 each include a cam wedge 361, a plurality of biasing members 362, and a brake shoe 363 arranged laterally in the nozzle 201. The brake shoe 363 is positioned closest to the inner surface 206 of the nozzle 201 and furthest from the longitudinal axis 19. The cam wedge 361 is positioned furthest from the inner surface 206 and closest to the longitudinal axis 19. The biasing members 362 are nestled between the cam wedge 361 and the brake shoe 363.

[0053] In the example of FIGS. 9-11, two brake assemblies 360 are depicted on opposite sides of the nozzle 201. In alternative embodiments, more or less than two brake assemblies 360 can be employed to apply a predetermined load to the inner surface 206 in the closed configuration. The brake assemblies 360 are spaced apart, and are spatially arranged circumferentially.

[0054] In the example of FIGS. 9-11, each brake assembly 360 includes three biasing members 362 that extend laterally between the brake shoe 363 and the cam wedge 361. In alternative embodiments, more or less than three biasing members 362 can be utilized. The biasing members 362 maintain a predetermined spacing between the cam wedge 361 and the brake shoe 363 in the open configuration, as illustrated in FIG. 11. In the closed configuration, however, the engagement portions 351 press the cam wedges 361 against the brake shoes 363 compressing the biasing members 362 and causing a predetermined frictional force to be applied by the brake shoes 363 against the inner surface 206 of the nozzle 201.

[0055] Furthermore, as illustrated in FIGS. 9 and 10, the engagement portions 351 include ramps 353 that are configured to lift the cam wedges 361, toward the inner surface 206 and away from the longitudinal axis 19, as the closure shuttle 350 is advanced distally to transition the end effector 12 into the closed configuration.

[0056] Although various devices have been described herein in connection with certain embodiments, modifications and variations to those embodiments may be implemented. Particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments. Thus, the particular features, structures, or characteristics illustrated or described in connection with one embodiment may be combined in whole or in part, with the features, structures or characteristics of one ore more other embodiments without limitation. Also, where materials are disclosed for

certain components, other materials may be used. Furthermore, according to various embodiments, a single component may be replaced by multiple components, and multiple components may be replaced by a single component, to perform a given function or functions. The foregoing description and following claims are intended to cover all such modification and variations.

[0057] The devices disclosed herein can be designed to be disposed of after a single use, or they can be designed to be used multiple times. In either case, however, a device can be reconditioned for reuse after at least one use. Reconditioning can include any combination of the steps including, but not limited to, the disassembly of the device, followed by cleaning or replacement of particular pieces of the device, and subsequent reassembly of the device. In particular, a reconditioning facility and/or surgical team can disassemble a device and, after cleaning and/or replacing particular parts of the device, the device can be reassembled for subsequent use. Those skilled in the art will appreciate that reconditioning of a device can utilize a variety of techniques for disassembly, cleaning/replacement, and reassembly. Use of such techniques, and the resulting reconditioned device, are all within the scope of the present application.

[0058] The devices disclosed herein may be processed before surgery. First, a new or used instrument may be obtained and, when necessary, cleaned. The instrument may then be sterilized. In one sterilization technique, the instrument is placed in a closed and sealed container, such as a plastic or TYVEK bag. The container and instrument may then be placed in a field of radiation that can penetrate the container, such as gamma radiation, x-rays, and/or high-energy electrons. The radiation may kill bacteria on the instrument and in the container. The sterilized instrument may then be stored in the sterile container. The sealed container may keep the instrument sterile until it is opened in a medical facility. A device may also be sterilized using any other technique known in the art, including but not limited to beta radiation, gamma radiation, ethylene oxide, plasma peroxide, and/or steam.

[0059] While this invention has been described as having exemplary designs, the present invention may be further modified within the spirit and scope of the disclosure.

This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles.

[0060] Any patent, publication, or other disclosure material, in whole or in part, that is said to be incorporated by reference herein is incorporated herein only to the extent that the incorporated materials do not conflict with existing definitions, statements, or other disclosure material set forth in this disclosure. As such, and to the extent necessary, the disclosure as explicitly set forth herein supersedes any conflicting material incorporated herein by reference. Any material, or portion thereof, that is said to be incorporated by reference herein, but which conflicts with existing definitions, statements, or other disclosure material set forth herein will only be incorporated to the extent that no conflict arises between that incorporated material and the existing disclosure material.

[0061] *Examples*

Example 1 - A surgical instrument that comprises a housing, a shaft assembly extending distally from the housing, and a rotation locking mechanism. The shaft assembly comprises a shaft portion defining a longitudinal axis and an end effector extending distally from the shaft portion. The end effector and the shaft portion are axially rotatable relative to the housing about the longitudinal axis. The end effector comprises a first jaw and a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration. The rotation locking mechanism is configured to prevent an axial rotation of the end effector and the shaft portion relative to the housing in the closed configuration. The rotation locking mechanism is configured to permit the axial rotation of the end effector and the shaft portion relative to the housing in the open configuration.

Example 2 - The surgical instrument of Example 1, wherein the rotation locking mechanism comprises a closure member movable from a first position to a second position to transition the end effector to the closed configuration and the rotation locking mechanism to a locked configuration.

Example 3 - The surgical instrument of Example 2, wherein the closure member is movable from the second position to the first position to transition the end effector to the open configuration and the rotation locking mechanism to an unlocked configuration.

Example 4 - The surgical instrument of Example 2 or 3, wherein the shaft portion comprises a first plurality of teeth, wherein the closure member comprises a second plurality of teeth configured to lockingly engage the first plurality of teeth in the locked configuration.

Example 5 - The surgical instrument of Example 4, wherein the second plurality of teeth are configured to disengage from the first plurality of teeth as the closure member is moved from the second position to the first position.

Example 6 - The surgical instrument of Example 2, 3, 4, or 5, wherein the second position is distal to the first position.

Example 7 - The surgical instrument of Example 1, 2, 3, 4, 5, or 6, wherein the first jaw comprises a staple cartridge.

Example 8 - The surgical instrument of Example 7, wherein the second jaw comprises an anvil movable by the closure member to capture tissue between the staple cartridge and the anvil in the closed configuration.

Example 9 - A surgical instrument that comprises a housing, a shaft assembly extending distally from the housing, and a rotation locking mechanism. The shaft assembly comprises a shaft portion defining a longitudinal axis and an end effector extending distally from the shaft portion. The end effector and the shaft portion are axially rotatable relative to the housing about the longitudinal axis. The end effector comprises a first jaw and a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration. The rotation locking mechanism is configured to resist an axial rotation of the end effector and the shaft portion relative to the housing in the closed configuration up to a predetermined torque. The rotation locking mechanism is configured to permit the axial rotation of the end effector and the shaft portion relative to the housing in the open configuration.

Example 10 - The surgical instrument of Example 9, wherein the rotation locking mechanism comprises a closure member movable from a first position to a second position to transition the end effector to the closed configuration and the rotation locking mechanism to a locked configuration.

Example 11 - The surgical instrument of Example 10, wherein the closure member is movable from the second position to the first position to transition the end effector to the open configuration and the rotation locking mechanism to an unlocked configuration.
Example 12 - The surgical instrument of Example 9 or 10, wherein the second position is distal to the first position.
Example 13 - The surgical instrument of Example 10, 11, or 12, wherein the shaft portion comprises a first plurality of teeth. The rotation locking mechanism comprises an engagement member comprising a second plurality of teeth and a biasing member. The biasing member comprises a first end attached to the closure member and a second end attached to the engagement member. The biasing member is configured to bias the second plurality of teeth into a meshing engagement with the first plurality of teeth.
Example 14 - The surgical instrument of Example 13, wherein the second plurality of teeth are configured to disengage from the first plurality of teeth as the closure member is moved from the second position to the first position.
Example 15 - The surgical instrument of Example 9, 10, 11, 12, 13, or 14, wherein the first jaw comprises a staple cartridge.
Example 16 - The surgical instrument of Example 15, wherein the second jaw comprises an anvil movable by the closure member to capture tissue between the staple cartridge and the anvil in the closed configuration.
Example 17 - A surgical instrument that comprises a housing, a shaft assembly extending distally from the housing, and a rotation braking system. The shaft assembly comprises a shaft portion defining a longitudinal axis and an end effector extending distally from the shaft portion. The shaft portion and the end effector are axially rotatable relative to the housing about the longitudinal axis. The end effector comprises a first jaw and a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration. The rotation braking system is configured to selectively apply a rotation braking force against the shaft portion.
Example 18 - The surgical instrument of Example 17, wherein the rotation braking system is configured to apply the rotation braking force against the shaft portion in the closed configuration.

Example 19 - The surgical instrument of Example 17 or 18, wherein the rotation braking system comprises a brake shoe configured to selectively apply the rotation braking force against an inner surface of the shaft portion.

Example 20 - The surgical instrument of Example 19, wherein the rotation braking system comprises a plurality of biasing members configured to bias the brake shoe into contact with the inner surface of the shaft portion.

CLAIMS

WHAT IS CLAIMED IS:

1. A surgical instrument, comprising:

a housing;

a shaft assembly extending distally from the housing, wherein the shaft assembly comprises:

a shaft portion defining a longitudinal axis; and

an end effector extending distally from the shaft portion, wherein the end effector and the shaft portion are axially rotatable relative to the housing about the longitudinal axis, and wherein the end effector comprises:

a first jaw; and

a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration; and

a rotation locking mechanism configured to prevent an axial rotation of the end effector and the shaft portion relative to the housing in the closed configuration, wherein the rotation locking mechanism is configured to permit the axial rotation of the end effector and the shaft portion relative to the housing in the open configuration.

2. The surgical instrument of Claim 1, wherein the rotation locking mechanism comprises a closure member movable from a first position to a second position to transition the end effector to the closed configuration and the rotation locking mechanism to a locked configuration.

3. The surgical instrument of Claim 2, wherein the closure member is movable from the second position to the first position to transition the end effector to the open configuration and the rotation locking mechanism to an unlocked configuration.

4. The surgical instrument of Claim 3, wherein the shaft portion comprises a first plurality of teeth, and wherein the closure member comprises a second plurality of teeth configured to lockingly engage the first plurality of teeth in the locked configuration.

5. The surgical instrument of Claim 4, wherein the second plurality of teeth are configured to disengage from the first plurality of teeth as the closure member is moved from the second position to the first position.

6. The surgical instrument of Claim 5, wherein the second position is distal to the first position.

7. The surgical instrument of Claim 6, wherein the first jaw comprises a staple cartridge.

8. The surgical instrument of Claim 7, wherein the second jaw comprises an anvil movable by the closure member to capture tissue between the staple cartridge and the anvil in the closed configuration.

9. A surgical instrument, comprising:

a housing;

a shaft assembly extending distally from the housing, wherein the shaft assembly comprises:

a shaft portion defining a longitudinal axis; and

an end effector extending distally from the shaft portion, wherein the end effector and the shaft portion are axially rotatable relative to the housing about the longitudinal axis, and wherein the end effector comprises:

a first jaw; and

a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration; and

a rotation locking mechanism configured to resist an axial rotation of the end effector and the shaft portion relative to the housing in the closed configuration up to a predetermined torque, wherein the rotation locking mechanism is configured to permit the axial rotation of the end effector and the shaft portion relative to the housing in the open configuration.

10. The surgical instrument of Claim 9, wherein the rotation locking mechanism comprises a closure member movable from a first position to a second position to transition the end effector to the closed configuration and the rotation locking mechanism to a locked configuration.

11. The surgical instrument of Claim 10, wherein the closure member is movable from the second position to the first position to transition the end effector to the open configuration and the rotation locking mechanism to an unlocked configuration.

12. The surgical instrument of Claim 11, wherein the second position is distal to the first position.

13. The surgical instrument of Claim 12, wherein the shaft portion comprises a first plurality of teeth, and wherein the rotation locking mechanism comprises:

an engagement member comprising a second plurality of teeth; and

a biasing member comprising:

a first end attached to the closure member; and

a second end attached to the engagement member, wherein the biasing member is configured to bias the second plurality of teeth into a meshing engagement with the first plurality of teeth.

14. The surgical instrument of Claim 13, wherein the second plurality of teeth are configured to disengage from the first plurality of teeth as the closure member is moved from the second position to the first position.

15. The surgical instrument of Claim 14, wherein the first jaw comprises a staple cartridge.

16. The surgical instrument of Claim 15, wherein the second jaw comprises an anvil movable by the closure member to capture tissue between the staple cartridge and the anvil in the closed configuration.

17. A surgical instrument, comprising:

a housing;

a shaft assembly extending distally from the housing, wherein the shaft assembly comprises:

a shaft portion defining a longitudinal axis; and

an end effector extending distally from the shaft portion, wherein the shaft portion and the end effector are axially rotatable relative to the housing about the longitudinal axis, and wherein the end effector comprises:

a first jaw; and

a second jaw movable relative to the first jaw to transition the end effector between an open configuration and a closed configuration; and

a rotation braking system configured to selectively apply a rotation braking force against the shaft portion.

18. The surgical instrument of Claim 17, wherein the rotation braking system is configured to apply the rotation braking force against the shaft portion in the closed configuration.

19. The surgical instrument of Claim 18, wherein the rotation braking system comprises a brake shoe configured to selectively apply the rotation braking force against an inner surface of the shaft portion.

20. The surgical instrument of Claim 19, wherein the rotation braking system comprises a plurality of biasing members configured to bias the brake shoe into contact with the inner surface of the shaft portion.

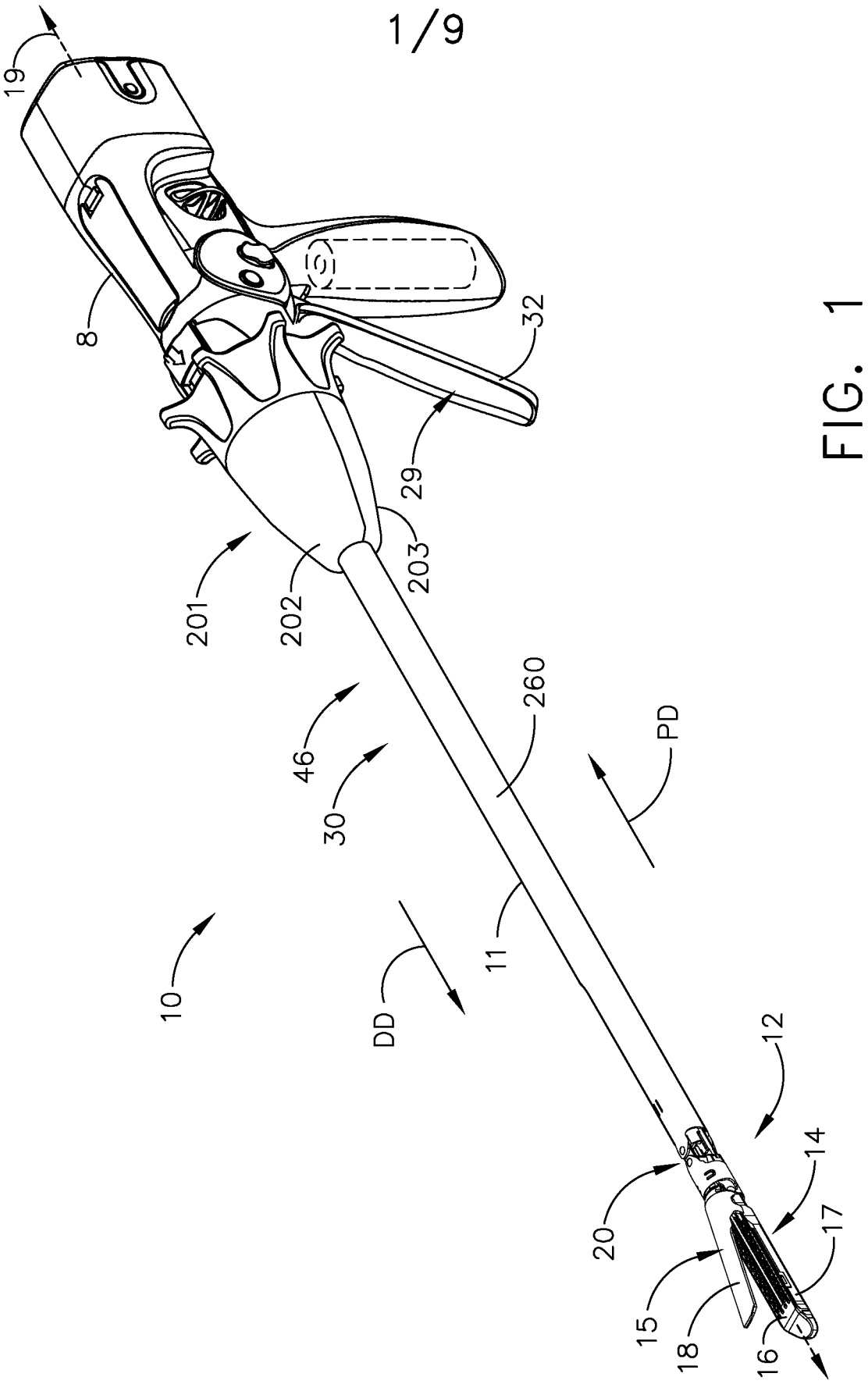

FIG. 1

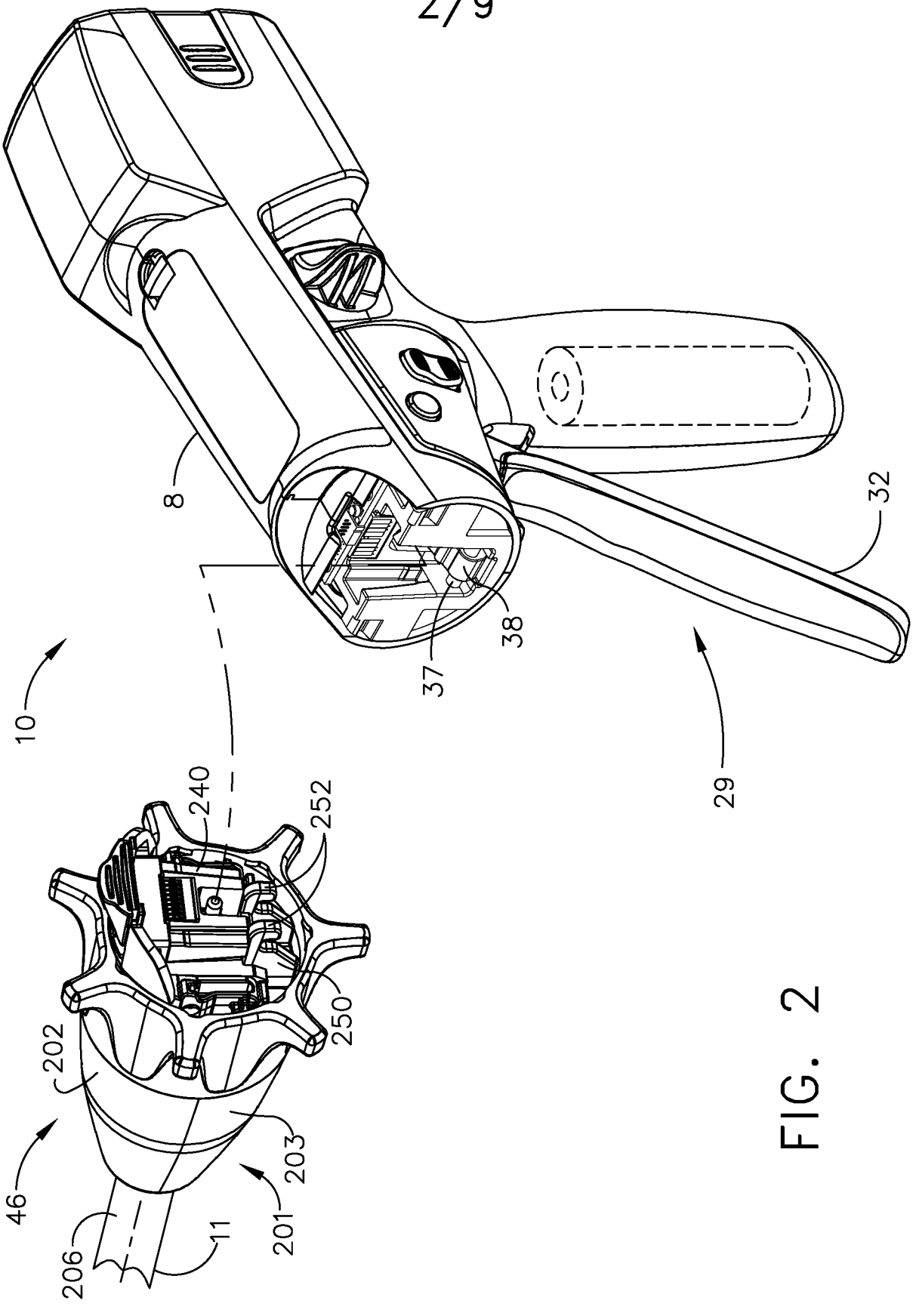

FIG. 2

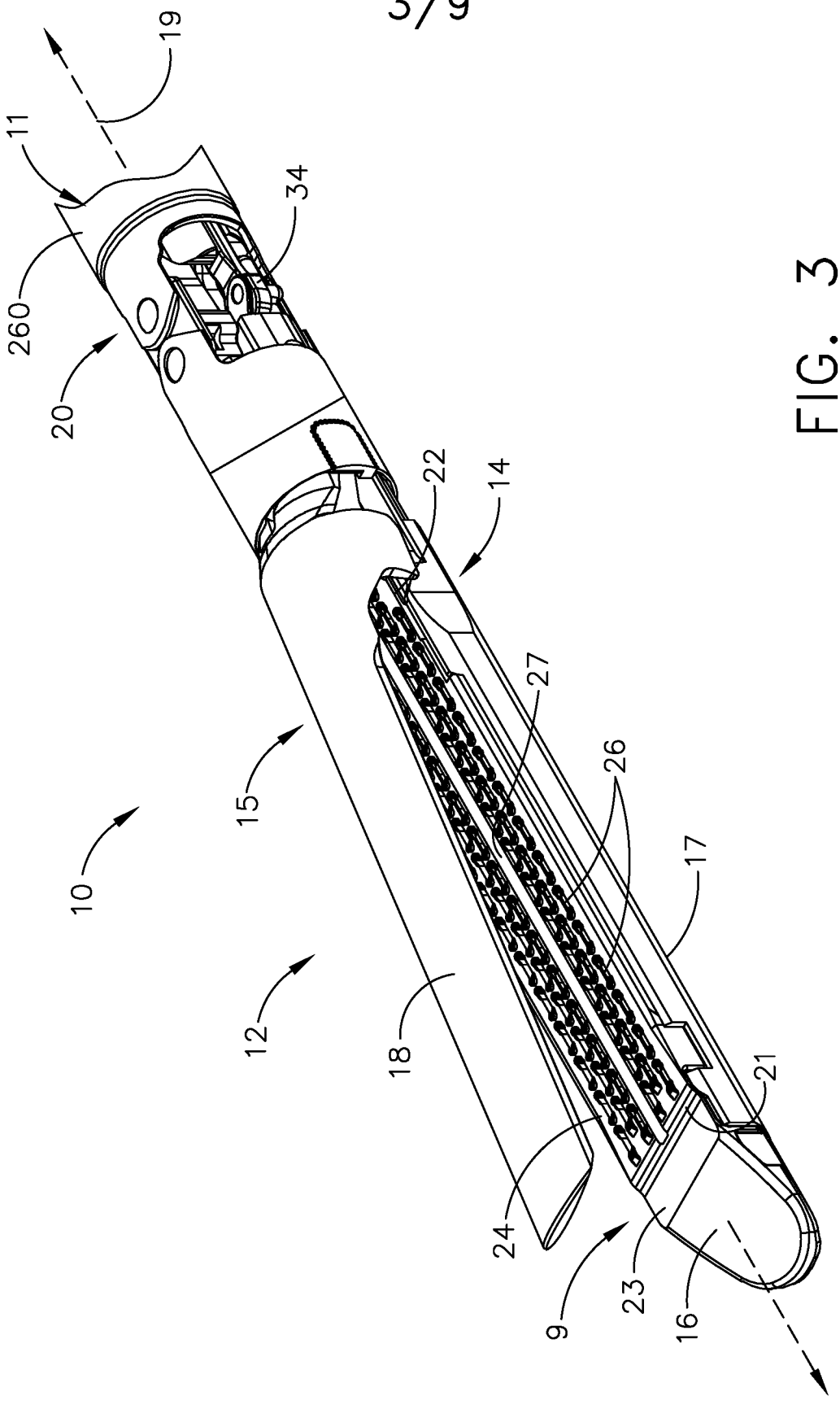

FIG. 3

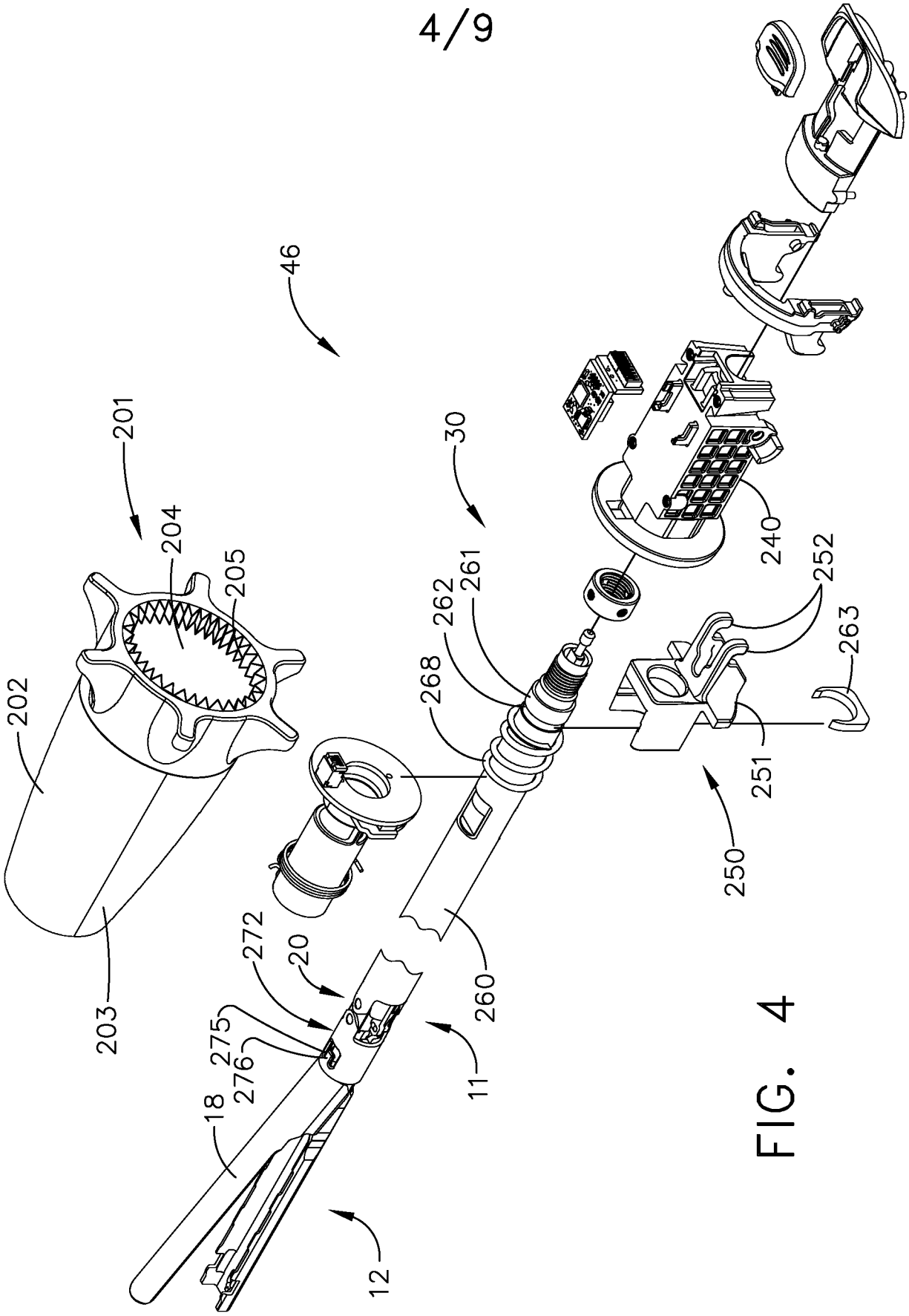
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FIG. 4

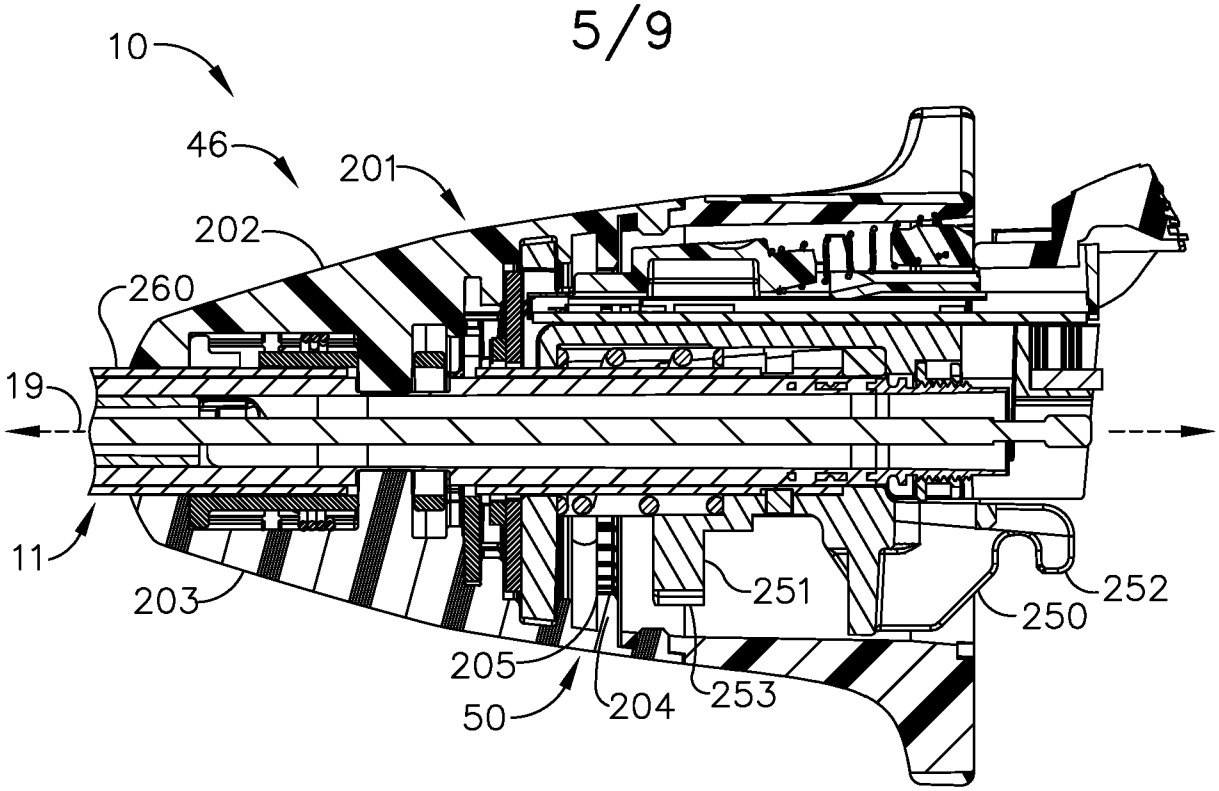
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FIG. 5

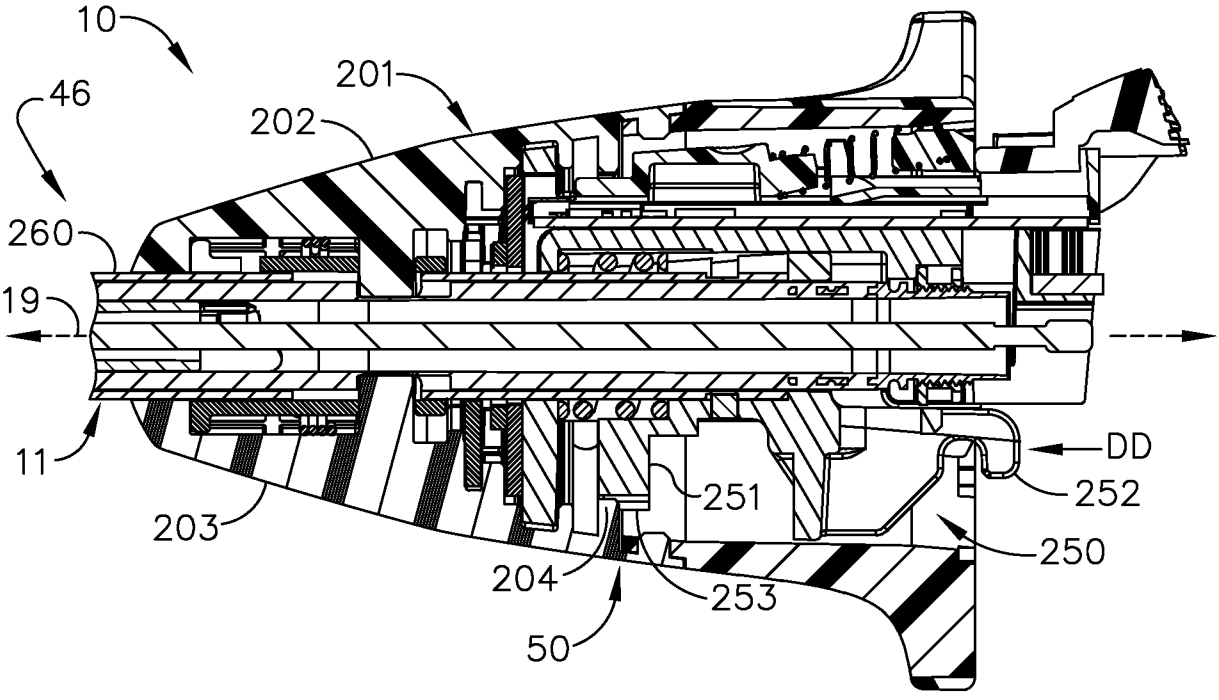
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FIG. 6

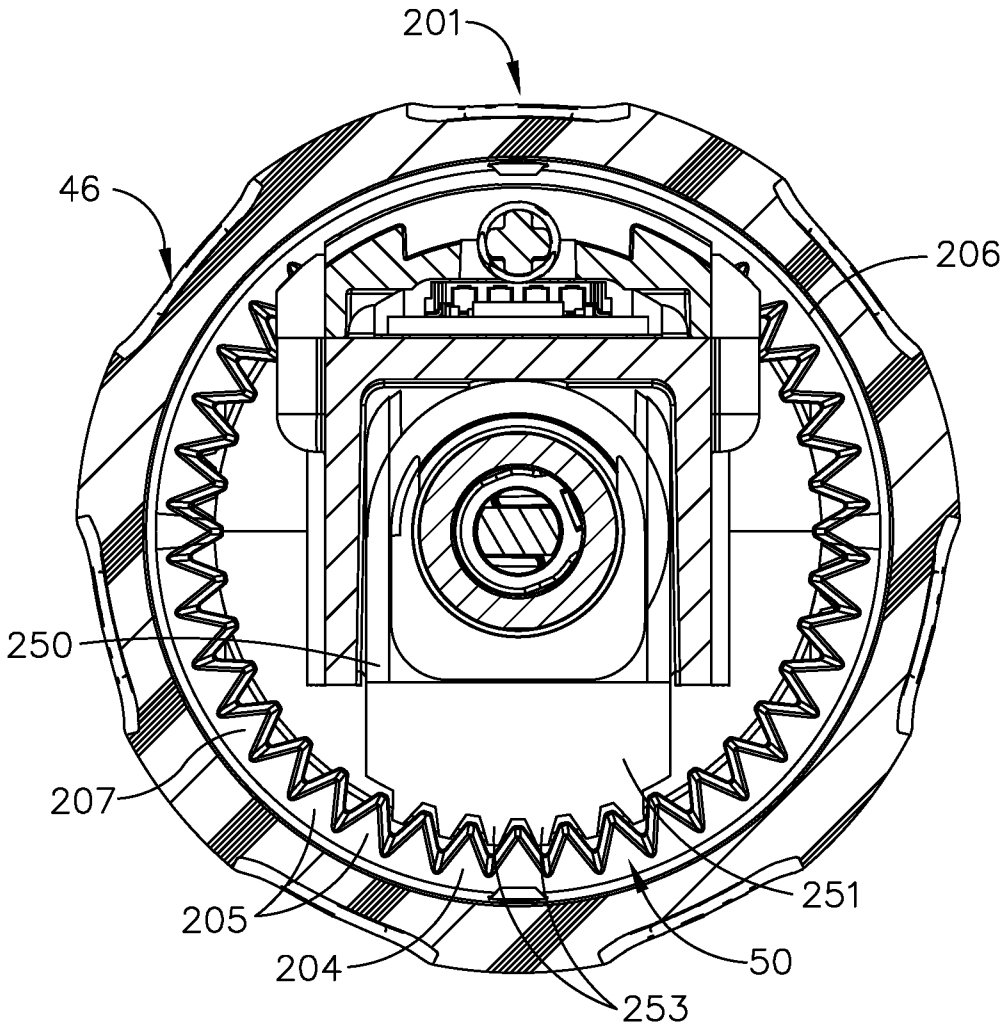

FIG. 7

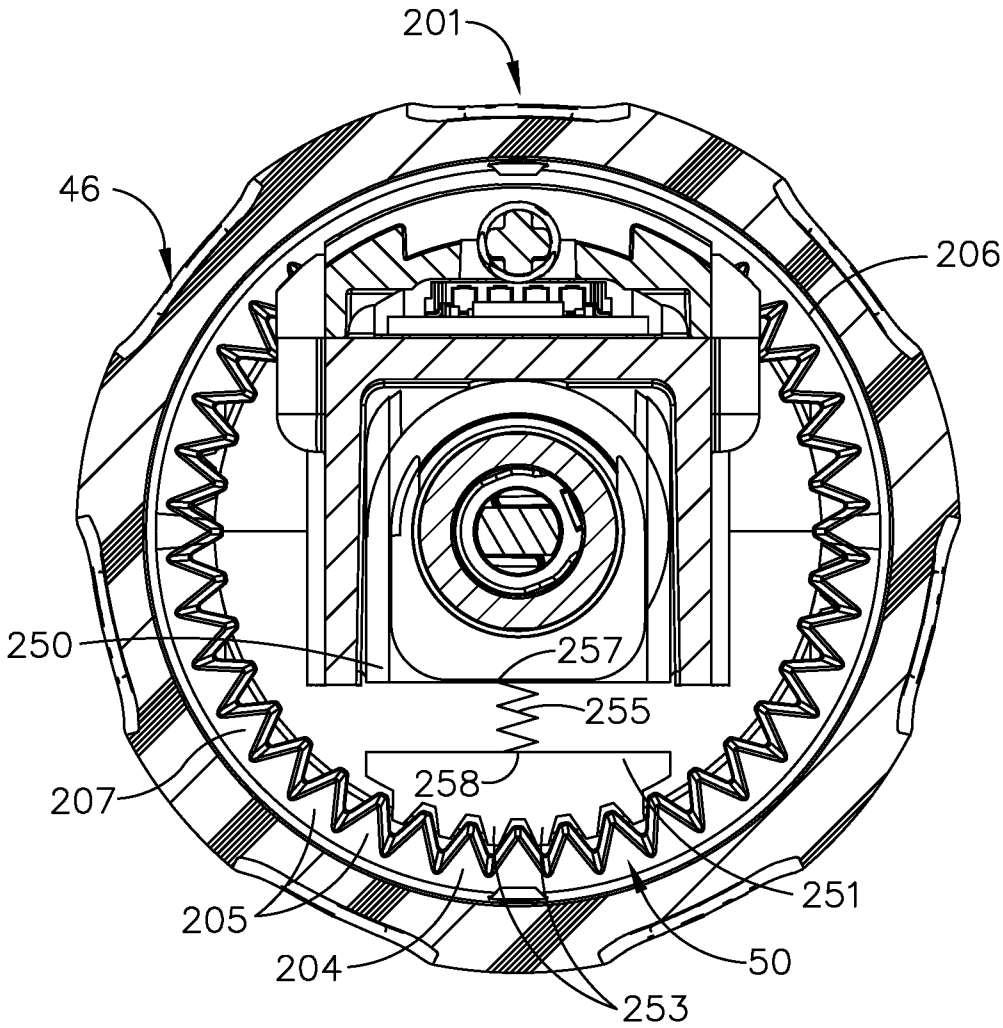

FIG. 8

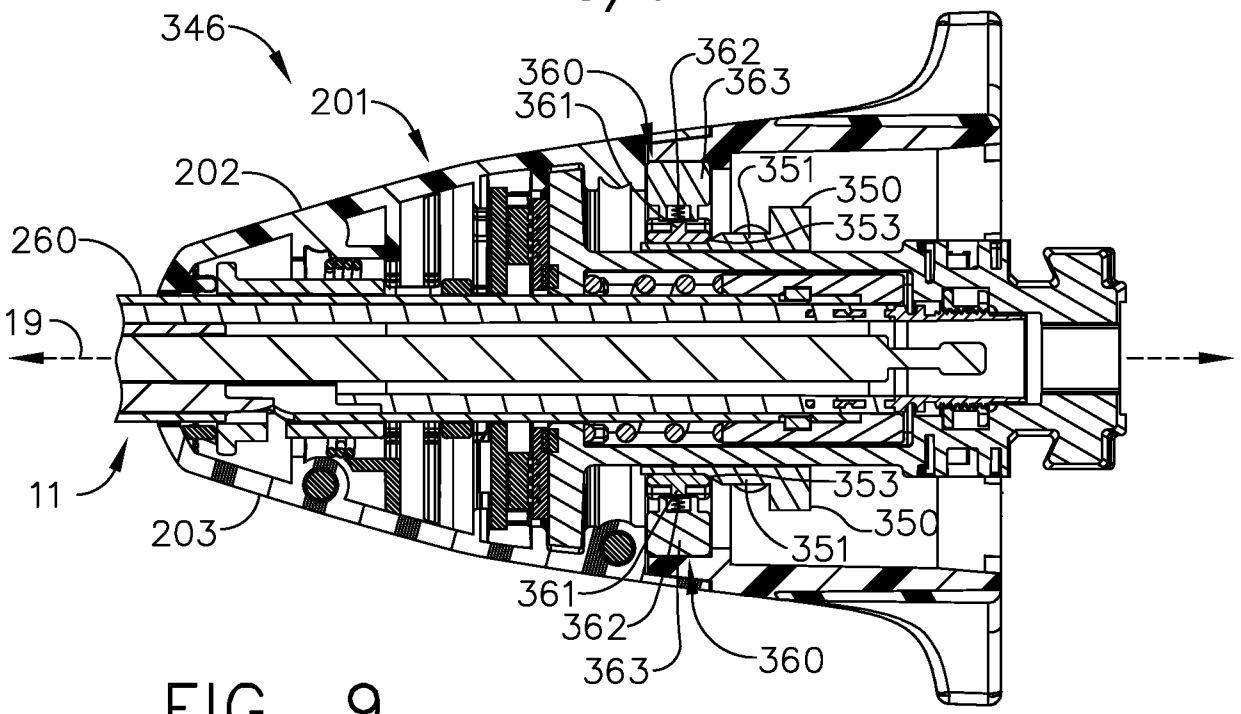
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FIG. 9

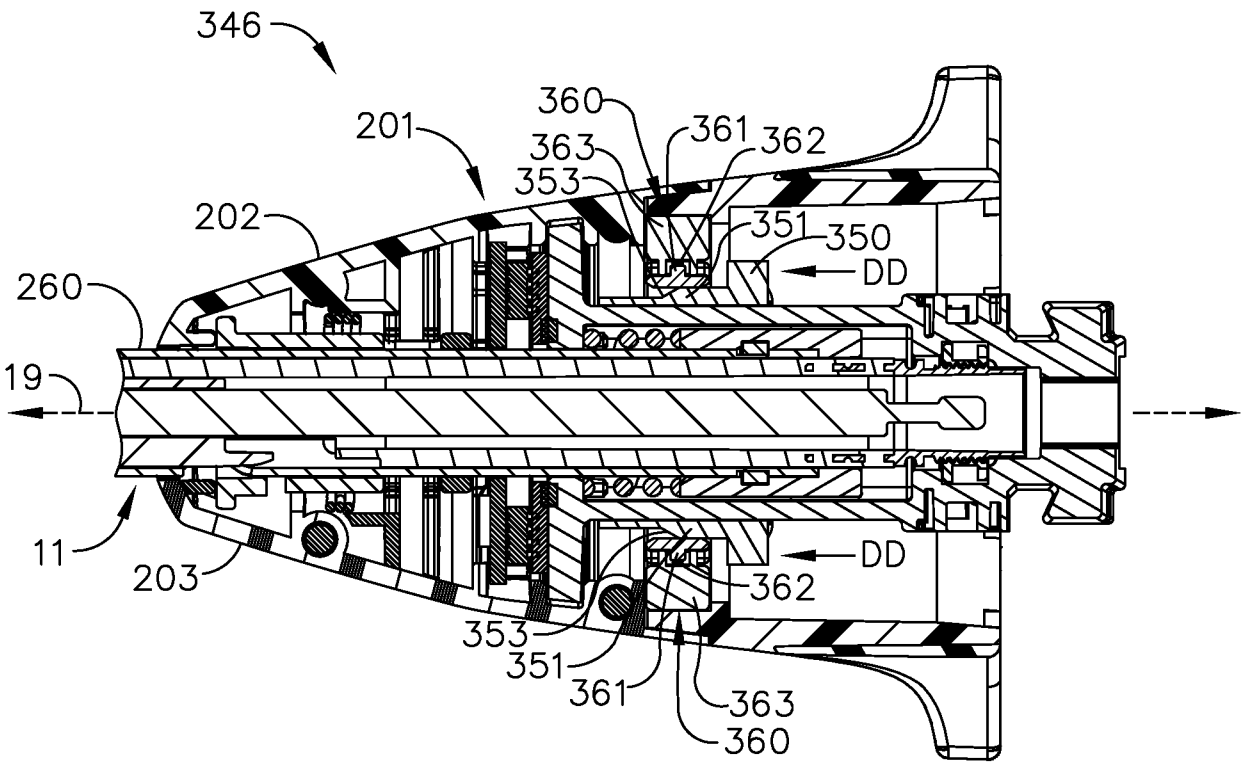
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FIG. 10

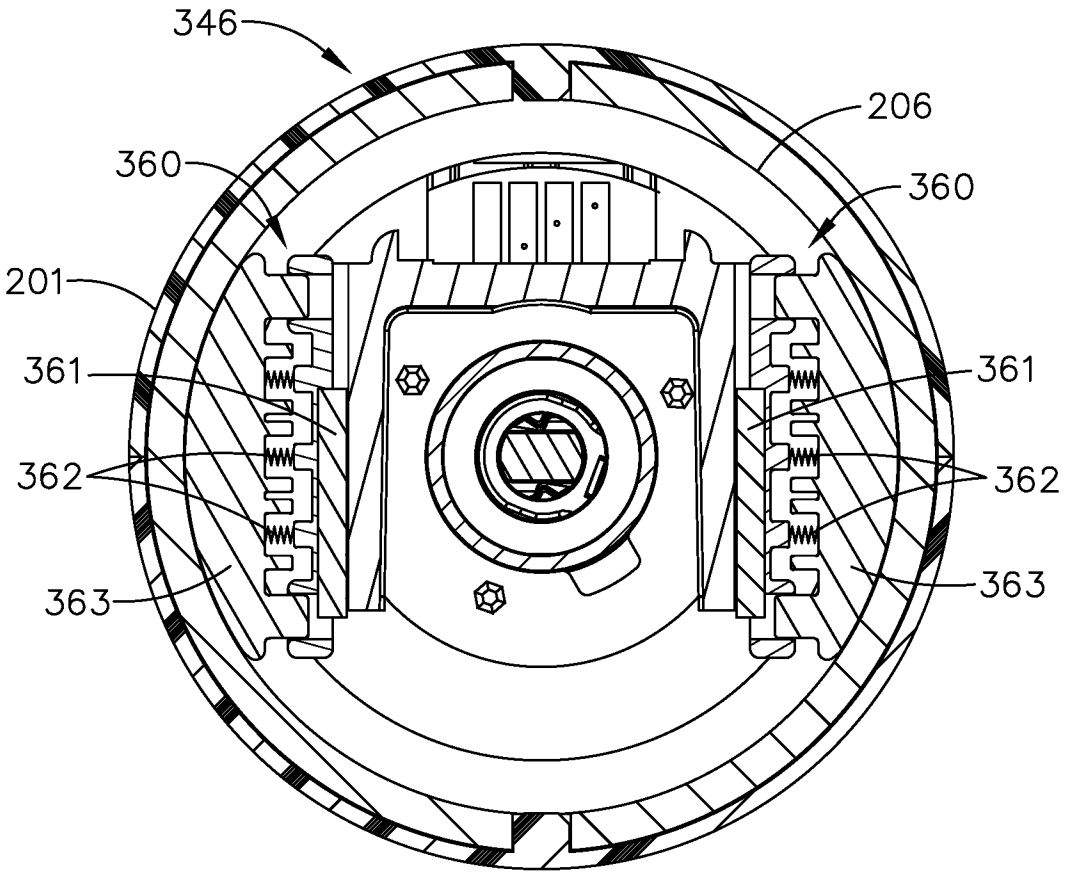

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/057646

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/072
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 21 2015 000296 U1 (TOUCHSTONE INT MEDICAL SCIENCE CO LTD [CN]) 4 September 2017 (2017-09-04)	1-12, 17-20
A	paragraph [0011] - paragraph [0016] paragraph [0027] - paragraph [0049]; figures	13-16

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A	paragraph [0025] - paragraph [0029]; figures	15,16

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A	column 3, line 20 - column 6, line 37; figures	13-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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

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

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

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2019	04/02/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Croatto, Loredana

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/057646

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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X A	US 2010/193568 A1 (SCHEIB CHARLES J [US] ET AL) 5 August 2010 (2010-08-05) paragraph [0092] - paragraph [0097]; figures 16-21	1,9, 17-20 2-8, 10-16

X A	US 5 732 871 A (CLARK GEORGE A [US] ET AL) 31 March 1998 (1998-03-31) column 9, line 18 - line 59; figures 1, 6, 15, 30, 31	1,9, 17-20 2-8, 10-16

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2018/057646

Patent document cited in search report	Publication date	Patent family member(s)	Publication date

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