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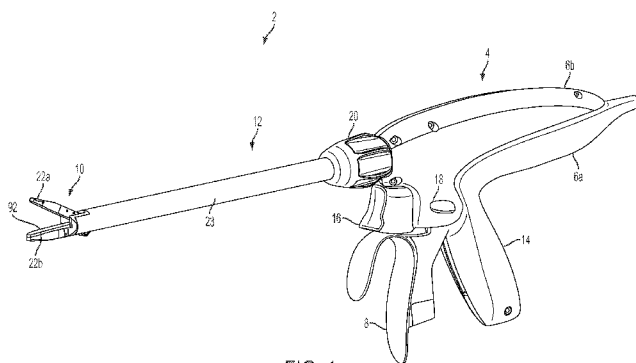
(54) **Title:** DEVICE STATUS FEEDBACK FOR BIPOLAR TISSUE SPACER

FIG. 1

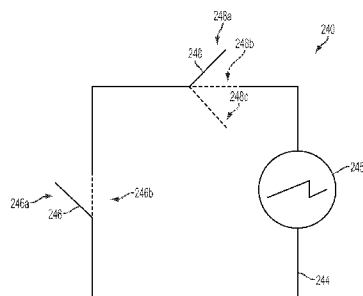


FIG. 10

(57) **Abstract:** A surgical instrument includes an end effector and a feedback system. The end effector includes a first jaw and a second jaw, wherein at least one of the first jaw and the second jaw is movable relative to the other one of the first jaw and the second jaw to transition the end effector during a closure stroke between an open configuration, a first approximated configuration, and a second approximated configuration. The feedback system includes an indicator, the indicator transitionable between a first indicator position, a second indicator position, and a third indicator position, wherein the indicator is in the first indicator position when the end effect is in the open configuration, wherein the indicator is in the second indicator position when the end effector is in the first approximated configuration, and wherein the indicator is in the third indicator position when the end effector is in the second approximated configuration.



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SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
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the earlier application (Rule 4.17(iii))*

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TITLE

DEVICE STATUS FEEDBACK FOR BIPOLAR TISSUE SPACER

BACKGROUND

The present invention relates to surgical instruments and, in various circumstances, to surgical sealing and transecting instruments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0001] The features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of instances of the invention taken in conjunction with the accompanying drawings, wherein:

[0002] FIG. 1 illustrates a perspective view of a surgical instrument comprising a handle and an end effector assembly;

[0003] FIG. 2 illustrates a perspective view of the surgical instrument of FIG. 1;

[0004] FIG. 3 illustrates a partial side view of the surgical instrument of FIG. 1;

[0005] FIG. 4 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0006] FIG. 5 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0007] FIG. 5A illustrates a feedback system including an indicator circuit for use with the surgical instrument of FIG 1;

[0008] FIG. 5B illustrates a feedback system for use with the surgical instrument of FIG 1;

[0009] FIG. 6 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0010] FIG. 7 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0011] FIG. 8 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0012] FIG. 9 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0013] FIG. 10 illustrates a feedback system including an indicator circuit for use with the surgical instrument of FIG 1;

[0014] FIG. 11 illustrates a partial side view of a handle assembly of the surgical instrument of FIG 1 with a removed housing shroud;

[0015] FIG. 12 illustrates a side view of an end effector assembly and a partial shaft assembly of the surgical instrument of FIG 1 including an indicator visible through an indicator window;

[0016] FIG. 13 illustrates a feedback system for use with the surgical instrument of FIG 1;

[0017] FIG. 14 illustrates an indicator of a feedback system of the surgical instrument of FIG. 1 in a plurality of indicator positions relative to an indicator window; and

[0018] FIG. 15 illustrates an indicator of a feedback system of the surgical instrument of FIG. 1 in a plurality of indicator positions relative to an indicator window.

DETAILED DESCRIPTION

[0019] Certain exemplary embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices and methods disclosed herein. One or more examples of these embodiments are illustrated in the accompanying drawings. Those of ordinary skill in the art will understand that the devices and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary embodiments and that the scope of the various embodiments of the present invention is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment may be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present invention.

[0020] 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.

[0021] The terms "proximal" and "distal" are used herein with reference to a clinician manipulating the handle portion of the surgical instrument. The term "proximal" referring to the portion closest to the clinician and the term "distal" referring 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.

[0022] Various exemplary devices and methods are provided for performing laparoscopic and minimally invasive surgical procedures. However, the person of ordinary skill in the art 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, those of ordinary skill in the art 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 elongated shaft of a surgical instrument can be advanced.

[0023] Turning to the Drawings wherein like numerals denote like components throughout the several views, FIG. 1 depicts one form of an electrosurgical instrument 2. The electrosurgical instrument 2 comprises a handle assembly 4, a shaft assembly 12 coupled to a distal end of the handle assembly 4, and an end effector 10 coupled to the distal end of the shaft assembly 12. The handle assembly 4 is configured as a pistol grip and comprises left and right handle housing shrouds 6a, 6b, a closure trigger 8, a pistol-grip handle 14, a firing trigger 16, an energy button 18, and a rotatable shaft knob 20. An electrical cable may enter the handle assembly 4 at a proximal end.

[0024] In some circumstances, the end effector 10 can be coupled to the distal end of the shaft assembly 12. The end effector 10 may include a first jaw 22a and a second jaw 22b. The first jaw 22a is pivotably coupled to the second jaw 22b. The first jaw 22a is pivotally moveable with respect to the second jaw 22b to grasp tissue therebetween. In some circumstances, the second jaw 22b is fixed. In other circumstances, the first jaw 22a and the second jaw 22b are pivotally movable. The end effector 10 may include at least one electrode 92. The electrode 92 is configured to deliver energy. Energy delivered by the electrode 92 may comprise, for example, radiofrequency (RF) energy, sub-therapeutic RF energy, ultrasonic energy, and/or other suitable forms of energy. In some circumstances, a cutting member (not shown) is receivable within a longitudinal slot defined by the first jaw 22a and/or the second jaw 22b. The cutting member can be configured to cut tissue grasped between the first jaw 22a and the second jaw 22b. In some circumstances, the cutting member may include an electrode for delivering energy, such as, for example, RF and/or ultrasonic energy.

[0025] In certain instances, an energy button 18 is configured to deliver energy to the at least one electrode 92 coupled to the end effector 10 from a power source. In certain instances, when the energy button 18 is depressed, a circuit is completed allowing delivery of energy to the electrode 92. In some embodiments, the power source is a generator. In certain instances, the generator is external to the surgical instrument 2 which is separably coupled to the generator. In other instances, the generator is integrated with the surgical instrument 2. In certain instances, feedback systems described by the present disclosure comprise indicators which are housed within the generator and can be separably coupled to the surgical instrument 2 in the instances where the generator is separably coupled to the surgical instrument 2, for example. In certain instances, the power source may be suitable for therapeutic tissue treatment, tissue cauterization/sealing, as well as sub-therapeutic treatment and measurement.

[0026] In certain instances, the surgical instrument 2 may include a closure drive assembly which may comprise an outer sheath 23, for example. In certain instances, the closure trigger 8 can be operatively coupled to at least one of the jaws 22a, 22b through the closure drive assembly such that actuation of the closure trigger 8 in a closure stroke may transition the jaws 22a, 22b between a plurality of configurations including an open configuration and an approximated configuration, for example. In certain instances, the surgical instrument 2 may include a firing drive assembly. In certain instances, the firing trigger 16 may be operatively coupled to the cutting member of the end effector 10 through the firing drive assembly such that actuation of the firing trigger 16 in a firing stroke may cause the cutting member to be advanced relative to the end effector 10 to cut tissue captured between the jaws 22a, 22b, for example.

[0027] FIG. 2 illustrates a side perspective view of the electrosurgical instrument 2 illustrated in FIG. 1. FIG. 2 illustrates the right handle housing 6b. The energy button 18 extends through the handle assembly 4 and is accessible on both sides of the handle assembly 4. The closure trigger 8, the firing trigger 16, and the energy button 18 may comprise an ergonomic design. In some circumstances, the handle assembly 4 is thinner near the energy button 18 to allow ease of access to the energy button 18 by a clinician. In some circumstances, the energy button 18 is disposed on either the left handle housing 6a or the right handle housing 6b. FIG. 3 illustrates a side view of the electrosurgical instrument 2 and the right handle housing 6b. Various electrosurgical instruments suitable for use with the present disclosure are described in U.S. Patent Application Nos. 14/075,839 and 14/075,863. U.S. Patent Application No. 14/075,839, entitled ELECTROSURGICAL DEVICES, and filed November 8, 2013, is hereby incorporated by reference herein in its entirety. Furthermore, U.S. Patent Application No. 14/075,863, entitled ELECTROSURGICAL DEVICES, and filed November 8, 2013, is hereby incorporated by reference herein in its entirety.

[0028] FIG. 4 illustrates one embodiment of the surgical instrument 2 of FIG. 1 with the left handle housing 6a removed. The handle assembly 4 comprises a plurality of components for actuating the surgical instrument 2, such as, for example, mechanisms for affecting closure of the jaws 22a, 22b of the end effector 10, deploying the cutting member within the end effector 10, and/or delivering energy to the one or more electrodes 92 coupled to the end effector 10. In certain instances, a closure trigger 8 may be operably coupled to a closure drive assembly which can be configured to transition the jaws 22a, 22b between an open configuration and an approximated

configuration. In certain instances, the closure trigger 8 is connected to a closure actuator located within the handle assembly 4. In certain instances, the closure actuator comprises a toggle arm 24 which may be coupled to the closure trigger 8 at a first pivot 25 and to a yoke 26 at a second pivot 27. In certain instances, the closure actuator may comprise any suitable actuator for coupling the closure trigger 8 to a jaw actuator of the shaft assembly. For example, in some embodiments, the closure actuator comprises an L-shaped lever arm. In certain instances, when the closure trigger 8 is actuated towards the pistol grip handle 14, the toggle arm 24 may drive movement of the yoke 26 in a first direction along a longitudinal axis L-L. Longitudinal movement of the yoke 26 in the first direction may drive a closure drive, such as, for example, the outer sheath 23, to transition the jaws 22a, 22b from the open configuration to the approximated configuration, for example. Furthermore, the longitudinal movement of the yoke 26 in a second direction, opposite the first direction, may drive the closure drive to transition the jaws 22a, 22b from the approximated configuration to the open configuration, for example.

[0029] In certain instances, a firing trigger 16 is configured to deploy the cutting member within the end effector 10. The firing trigger 16 can be operatively coupled to firing drive assembly including, for example, a compound gear 42, as illustrated in FIG. 4. The compound gear 42 may interface with a rack 44, for example. The rack 44 can be coupled to a firing drive which may extend through the outer sheath 23 and may transmit axial motions to the cutting member of the end effector 10. In certain instances, when the firing trigger 16 is actuated, the compound gear 42 rotates and moves the rack 44 distally. The distal movement of the rack 44 may cause distal movement of the

firing drive and deployment of the cutting member within the end effector 10. The cutting member can be deployed from a proximal end of the end effector 10 to a distal end of the end effector 10. In certain instances, the firing trigger 16 comprises a high pivot to provide a linear feel during actuation of the firing trigger 16. The linear feel provides increased control and comfort to a clinician actuating the firing trigger 16.

[0030] In certain instances, the compound gear 42 can be operably coupled to a motor (not shown). Rotational motions generated by the motor may cause the rack 44 to be advanced distally, and in turn cause the cutting member to be deployed from the proximal end of the end effector 10 to the distal end of the end effector 10, for example. In certain instances, the motor can be powered by a power source such as, for example, a battery (not shown). In certain instances, the firing trigger 16 may comprise a switch (not shown), for example, which can be operably coupled to a circuit, for example, such that movement of the firing trigger 16 from a first position to a second position may cause the switch to close the circuit which may activate the motor to deploy the cutting member, for example.

[0031] Referring to FIGS. 4 and 5, in some instances, the surgical instrument 2 may comprise a locking mechanism which may be configured to engage the firing drive assembly to interfere with, resist, and/or prevent deployment of the cutting member of the end effector 10. In certain instances, the locking mechanism may include a locking member 38. In certain instances, the locking member 38 can be transitioned between a locked configuration and an unlocked configuration; in the locked configuration, the locking member 38 can be configured to engage a rack unlock block 40 of the firing drive assembly to interfere with, resist, and/or prevent deployment of the cutting

member of the end effector 10. In certain instances, as illustrated in FIG. 5, a lock spring 64 may be coupled to the locking member 38 to apply a biasing force against the locking member 38. The biasing force may bias the locking member 38 to maintain a locking engagement with the firing drive assembly.

[0032] In certain instances, the closure drive assembly is movable to release the firing drive assembly by causing the locking member 38 to transition from locking engagement with the rack unlock block 40, as illustrated in FIG. 5, to the unlocked configuration, as illustrated in FIG. 7, for example. In certain instances, the closure drive assembly may comprise an unlocking member 41 which may be movable to raise the locking member 38 from locking engagement with the rack unlock block 40, for example. In other words, actuation of the trigger 8 may transition the jaw 22a, 22b to the approximated configuration and may release the locking mechanism of the firing drive assembly by causing the unlocking member 41 to motivate the locking member 38 out of locking engagement with the rack unlock block 40, for example. In certain instances, when the closure trigger 8 is released and the yoke 26 returns to a rest position, the lock spring 64 may bias the locking member 38 back into a locking engagement with the rack unlock block 40, for example.

[0033] In certain instances, the locking mechanism of the surgical instrument 2 may be employed as a safety mechanism which may prevent deployment of the cutting member of the end effector 10 while the jaws 22a, 22b are in the open configuration and/or while the jaws 22a, 22b are not sufficiently transitioned to the closed configuration. In use, a clinician may orient the end effector 10 to position the jaws 22a, 22b around a desired tissue to seal and cut the desired tissue. Furthermore, the

clinician may actuate the closure trigger 8 to transition the jaws 22a, 22b from the open configuration toward the approximated configuration to clamp the desired tissue, for example. In certain instances, however, the surgical instrument 2 may not be appropriate for safely treating the clamped tissue. For example, the clamped tissue may comprise a thickness that is too large to be safely treated with the surgical instrument 2. In such instances, the locking mechanism may be employed to prevent deployment of the cutting member of the end effector 10 to cut the clamped tissue if the clinician actuates the firing trigger 16 to deploy the cutting member to cut the clamped tissue. In other words, the thickness of the clamped tissue may not permit sufficient closure of the jaws 22a, 22b around the clamped tissue for the jaws 22a, 22b to reach the approximated configuration. Accordingly, the clinician may not be able to sufficiently actuate the closure trigger 8 to complete a closure stroke. In turn, the unlocking member 41 may not be sufficiently motivated to release the locking member 38 out of locking engagement with the rack unlock block 40.

[0034] In certain instances, the yoke 26 can be coupled to an unlocking member 41. In certain instances, when the yoke 26 is moved in response to the actuation of the closure trigger 8, the locking member 41 lifts the locking member 38 vertically away from the rack unlock block 40. In certain instances, when the locking member 38 has been lifted a sufficient distance, the rack 44 is allowed to move and the firing trigger 16 is actuatable to deploy the cutting member within the end effector 10. In certain instances, the firing trigger 16 is unlocked when the jaws 22a, 22b are sufficiently closed such that the cutting member cannot skip out of a slot formed in the end effector 10. For example, in some instances, the locking member 38 is released when the

closure trigger 8 is rotated about 30 degrees. In other instances, the locking member 38 may be released at a lower or higher degree of rotation of the closure trigger 8. In certain instances, the firing trigger 16 is unlocked when the clamped tissue between the jaws 22a, 22b is sufficiently compressed to enable the cutting member to fully transect the clamped tissue. In certain instances, the firing trigger 16 is unlocked when the clamped tissue between the jaws 22a, 22b is sufficiently compressed to a thickness that is less than or equal, or at least substantially equal, to the height of the cutting surface of the cutting member of the end effector 10, for example.

[0035] The reader will appreciate that it may be desirable to provide a clinician utilizing the surgical instrument 2 with feedback at various stages during operation of the surgical instrument 2. In certain instances, the surgical instrument 2 may comprise one or more mechanical feedback systems. In certain instances, the surgical instrument 2 may comprise one or more electrical feedback systems. In certain instances, the surgical instrument 2 may comprise combinations of mechanical feedback systems and electrical feedback systems. In certain instances, some of the feedback systems described herein may include one or more indicators. In certain instances, the indicators may comprise, for example, visual indicators such as display screens, backlights, and/or LEDs, for example. In certain instances, the indicators may comprise audio indicators such as speakers and/or buzzers, for example. In certain instances, the indicators may comprise tactile indicators such as haptic actuators, for example. In certain instances, the indicators may comprise combinations of visual indicators, audio indicators, and/or tactile indicators, for example.

[0036] In certain instances, one or more of the feedback systems of the surgical instrument 2 may be configured to alert a clinician actuating the closure trigger 8 if a tissue bite clamped by the end effector 10 comprises a thickness that is too large for proper treatment via the surgical instrument 2. In certain instances, one or more of the feedback systems of the surgical instrument 2 may be configured to alert a clinician actuating the firing trigger 16 if the firing drive assembly is locked by the locking mechanism of the surgical instrument 2. For example, the one or more of the feedback systems of the surgical instrument 2 may be configured to alert the clinician actuating the firing trigger 16 if the locking member 38 is in locking engagement with the rack unlock block 40. In certain instances, one or more of the feedback systems of the surgical instrument 2 may be configured to alert a clinician actuating the closure trigger 8 when the firing drive assembly becomes unlocked. In other words, one or more of the feedback systems of the surgical instrument 2 may be configured to alert a clinician actuating the closure trigger 8 when the jaws 22a, 22b are sufficiently closed such that the rack unlock block 40 is released from locking engagement with locking member 38.

[0037] Referring to FIGS. 5-7, the surgical instrument 2 may comprise an electrical feedback system 202 (FIG. 5A). In certain instances, the system 202 may include an indicator circuit 204 which may comprise an indicator 205. In certain instances, the circuit 204 may include a plurality of switches such as, for example, normally open, normally closed, and/or other switch types. In certain instances, the circuit 204 may include a switch 206 which may be associated with the firing trigger 16, for example. In certain instances, as illustrated in FIG. 5A, the switch 206 can be transitioned between an inactive or open configuration or position 206a and an active or closed configuration

or position 206b. In certain instances, the switch 206 can be coupled to the firing trigger 16 such that actuation of the firing trigger 16 between an unactuated position and a first actuated position during the firing stroke may cause the switch 206 to move from the inactive configuration 206a to the active configuration 206b. In certain instances, the actuation of the firing trigger 16 from the unactuated position to the first actuated position may be a slight actuation that may not cause movement of the cutting member of the end effector 10 or may cause a slight movement of the cutting member of the end effector 10 that may not cause the cutting member to be sufficiently advanced to cut tissue clamped between the jaws 22a, 22b.

[0038] Referring again to FIGS. 5-7, in certain instances, the circuit 204 may include a switch 208 which may be associated with the locking member 38, for example. In certain instances, as illustrated in FIG. 5A, the switch 208 can be transitioned between an inactive or open configuration or position 208a and an active or closed configuration or position 208b.

[0039] As described above, the locking member 38 can be transitioned between the locked position, wherein the locking member 38 is in locking engagement with the firing drive assembly, and the unlocked position, wherein firing drive assembly is released from locking engagement with the locking member 38. In certain instances, the switch 208 can be coupled to the locking member 38 such that the switch 208 remains in the active configuration 208b while the locking member 38 is in the locked configuration. Furthermore, the switch 208 may be transitioned from the active configuration 208b to the inactive configuration 208a when the locking member 38 is transitioned from the locked configuration to the unlocked configuration, for example.

[0040] Referring primarily to FIG. 5A, in certain instances, the indicator circuit 204 is closed and the indicator 205 is activated when the switch 206 and the switch 208 are both in the active configuration, for example. In certain instances, the indicator circuit 204 is open and the indicator 205 is inactive if one of the switch 206 and the switch 208 is in the inactive configuration, for example. In certain instances, the indicator circuit 204 is open and the indicator 205 is inactive if both of the switches 206 and 208 are in the inactive configuration, for example.

[0041] In certain instances, when the locking member 38 is in the locked configuration and the firing trigger 16 is in the first actuated position, the indicator circuit 204 is closed and the indicator 205 is activated. For example, a clinician may actuate the closure trigger 8 to clamp tissue comprising a thickness that is too large for proper treatment via the surgical instrument 2. In such instances, the locking member 38 may remain in the locked configuration because the unlocking member 41 has not been sufficiently moved by the closure trigger 8 to separate the locking member 38 from locking engagement with the firing drive assembly, as described above. In result, the switch 208 may remain in the active configuration 208b. In such instance, if the clinician attempts to actuate the firing trigger 16 from the unactuated position to the first actuated position, as described above, the switch 206 may also be transitioned to the active configuration 206b which may cause the indicator circuit 204 to be closed and the indicator 205 to be activated to alert the clinician that the cutting member cannot be advanced to cut tissue captured by the end effector 10 because the firing drive assembly is locked, for example. In other words, the indicator 205 may alert the clinician that the jaws 22a, 22b are too far apart and that the cutting member cannot be advanced. In response, the clinician may

release the captured tissue and may attempt to capture a more suitable tissue target, for example.

[0042] The reader will appreciate that if the captured tissue is not too large for proper treatment with the surgical instrument 2, the closure trigger 8 may be sufficiently actuated to allow the unlocking member 41 to sufficiently motivate the locking member 38 to the unlocked configuration to release the rack unlock block 40 and free the firing drive assembly. The transitioning of the locking member 38 to the unlocked configuration causes the switch 208 to be transitioned to the inactive configuration 208a. In such instance, if the clinician attempts to actuate the firing trigger 16 from the unactuated position to the first actuated position, as described above, the switch 206 may be transitioned to the active configuration 206b but since the switch 208 is in the inactive configuration 208a, the indicator circuit 204 will not be closed and the indicator 205 will not be activated; and since the firing drive assembly is free from locking engagement with the locking member 38, the clinician may continue actuating the firing trigger 16 to advance the cutting member of the end effector 10 to cut the tissue captured between the jaws 22a, 22b, for example. In other words, the indicator 205 is not activated since the jaws 22a, 22b are sufficiently closed around captured tissue and, accordingly, the firing trigger 16 can be fully actuated in a complete firing stroke to advance the cutting member of the end effector 10 to cut the captured tissue.

[0043] In certain instances, as illustrated in FIG. 5B, the indicator 205, the switch 206, and the switch 208 can be operably coupled to a microcontroller 220 ("controller"), for example. In certain instances, the controller 220 may include a microprocessor 222 ("processor") and one or more memory units 224 operationally coupled to the processor

222, for example. A power source such as, for example, a battery 226 can be configured to supply power to the controller 220 and/or the indicator 205, for example. In certain instances, the memory 224 may include program instructions that can be executed from the memory 224 to cause the processor 220 to transmit activation signals to the indicator 205 in response to simultaneous active signals received from the switches 206 and 208, for example.

[0044] The controller 220 may be implemented using integrated and/or discrete hardware elements, software elements, and/or a combination of both. Examples of integrated hardware elements may include processors, microprocessors, microcontrollers, integrated circuits, application specific integrated circuits (ASIC), programmable logic devices (PLD), digital signal processors (DSP), field programmable gate arrays (FPGA), logic gates, registers, semiconductor devices, chips, microchips, chip sets, microcontrollers, system-on-chip (SoC), and/or system-in-package (SIP). Examples of discrete hardware elements may include circuits and/or circuit elements such as logic gates, field effect transistors, bipolar transistors, resistors, capacitors, inductors, and/or relays. In certain instances, the controller 220 may include a hybrid circuit comprising discrete and integrated circuit elements or components on one or more substrates, for example.

[0045] In certain instances, the microcontroller 220 may be an LM 4F230H5QR, available from Texas Instruments, for example. In certain instances, the Texas Instruments LM4F230H5QR is an ARM Cortex-M4F Processor Core comprising on-chip memory of 256 KB single-cycle flash memory, or other non-volatile memory, up to 40 MHz, a prefetch buffer to improve performance above 40 MHz, a 32 KB single-cycle

serial random access memory (SRAM), internal read-only memory (ROM) loaded with StellarisWare® software, 2KB electrically erasable programmable read-only memory (EEPROM), one or more pulse width modulation (PWM) modules, one or more quadrature encoder inputs (QEI) analog, one or more 12-bit Analog-to-Digital Converters (ADC) with 12 analog input channels, among other features that are readily available. Other microcontrollers may be readily substituted for use with the present disclosure. Accordingly, the present disclosure should not be limited in this context.

[0046] Referring to FIGS. 8 and 9, in certain instances, the surgical instrument 2 may comprise one or more mechanical feedback systems such as, for example, a mechanical feedback system 212. In certain instances, the mechanical feedback system 212 may replace the electrical feedback system 202, for example. In certain instances, the mechanical feedback system 212 can be employed to provide feedback to a clinician using the surgical instrument 2 as to the whether the firing drive assembly is locked, for example.

[0047] As illustrated in FIG. 8, the mechanical feedback system 212 may include an indicator window 214 positioned on an outer wall of the handle housing 4, for example. In addition, the mechanical feedback system 212 may include a locked indicator 216 which indicates that the firing drive assembly is locked, for example, and an unlocked indicator 218 which indicates that the firing drive assembly is unlocked, for example. In certain instances, as illustrated in FIG. 8, the indicators 216 and 218 can be operably coupled to the locking member 38. For example, as illustrated in FIG. 8, the indicators 216 and 218 can be pivotally coupled to the locking member 38 via a pivot member 220. In certain instances, the indicators 216 and 218 can be operably movable with the

locking member 38 and can be aligned with the indicator window 214 such that the locked indicator 216 is visible from the indicator window 214, as illustrated FIG. 8, while the locking member 38 is in the locked configuration, and the unlocked indicator 218 is visible from the indicator window 214, as illustrated in FIG. 9, while the locking member 38 is in the unlocked configuration, for example.

[0048] In some instances, the jaws 22a, 22b are configured to maintain a minimal spacing therebetween to prevent damage to components of the surgical instrument 2 and/or the tissue section. In some instances, full actuation of the closure trigger 8 corresponds to a rotation of about 30 degrees. When the closure trigger 8 is fully rotated against the pistol grip handle 14, a closure trigger lock 46 is engaged to maintain the jaws 22a, 22b in a closed position. Once the trigger lock 46 has been engaged, the clinician may release the closure trigger 8 and the trigger lock 46 maintains the closure trigger 8 in a closed position.

[0049] In certain instances, the trigger lock 46 may maintain the closure trigger 8 in a less than fully retracted position to prevent damage to components of the surgical instrument 2 due to over application of force to the jaws 22a, 22b. The trigger lock 46 may maintain the closure trigger 8 in a sufficiently rotated position to release the locking member 38 from the rack unlock block 40. For example, in the some instances, the trigger lock 46 maintains the closure trigger 8 at a rotation of about 28 degrees. With the closure trigger 8 in a locked position, the clinician may actuate the firing trigger 16 to deploy the cutting member within the end effector 10. In some instances, the clinician may actuate the energy button 18 to deliver energy to a tissue section grasped between the jaws 22a, 22b prior to or simultaneously with, deployment of the cutting member.

[0050] Referring to FIGS. 10 and 11, the surgical instrument 2 may include closure feedback systems that are associated with the closure trigger 8 such as, for example, an electrical feedback system 240 and/or a mechanical feedback system 242. As described above, the closure trigger 8 is actuatable between an initial unactuated position and an actuated locked position to close the jaws 22a, 22b around tissue, for example. In certain instances, the closure feedback systems 240 and/or 242 may be configured to warn or alert a clinician actuating the trigger 8 in the event the captured tissue comprises a thickness that cannot be properly treated utilizing the surgical instrument 2. In certain instances, the closure feedback systems 240 and/or 242 may be configured to warn or alert a clinician actuating the trigger 8 in the event the tissue captured between the jaws 22a, 22b cannot be safely compressed to a thickness that is less than or equal, or at least substantially equal, to the height of the cutting surface of the cutting member of the end effector 10, for example. In certain instances, the closure feedback systems 240 and/or 242 may be configured to warn or alert a clinician if the actuation force exerted against the trigger 8 by the clinician exceeds a safe threshold, for example. In certain instances, the closure feedback systems 240 and/or 242 may be configured to warn or alert a clinician actuating the trigger 8 in the event the tissue captured between the jaws 22a, 22b prevents approximation for the end effector 10 during a closure stroke from a first approximated configuration, for example, to a second approximated configuration, for example. In certain instances, the first approximated configuration corresponds to a tissue thickness that is not safely treatable by the surgical instrument 2; and the second approximated configuration corresponds to a tissue thickness that is safely treatable by the surgical instrument 2.

[0051] Referring to FIG. 10, the electrical feedback system 240 may include an indicator circuit 244. In certain instances, the indicator circuit 244 may comprise an indicator 245. In certain instances, the circuit 244 may include a plurality of switches such as, for example, normally open, normally closed, and/or other switch types. In certain instances, the circuit 244 may include a switch 246 which may be associated with the closure trigger 8, for example. In certain instances, the switch 246 can be transitioned between an inactive or open configuration or position 246a and an active or closed configuration or position 246b, as illustrated in FIG. 10. In certain instances, the switch 246 can be coupled to the closure trigger 8 such that actuation of the closure trigger 8 between the initial unactuated position and the actuated locked position during the closure stroke may cause the switch 246 to move from the inactive configuration 246a to the active configuration 246b, for example.

[0052] Further to the above, as illustrated in FIG. 10, the circuit 244 may comprise a switch 248. In certain instances, the switch 248 can be transitioned between a first inactive or open configuration or position 248a, an active or closed configuration or position 248b, and a second inactive or open configuration or position 248c during the closure stroke, for example. In certain instances, the switch 248 can be associated with one of the jaws 22a, 22b, for example. In certain instances, the switch 248 can be coupled to the jaw 22a, for example, such that motion of the jaw 22a during the closure stroke from an open unactuated or initial position to a first actuated position may cause the switch 248 to be transitioned from the first inactive configuration 248a, for example, to the active configuration 248b, for example; and motion of the jaw 22a during the closure stroke beyond the first actuated position to a second actuated position, for

example, may cause the switch 248 to be transitioned from the active configuration 248b, for example, to the second inactive configuration 248c, for example. In certain instances, the circuit 244 can be closed and the indicator 245 can be activated when the switches 246 and 248 are in the closed configurations 246b and 248b, respectively.

[0053] In use, a clinician may position the jaws 22a, 22b around tissue and may actuate the closure trigger 8 through a closure stroke to actuate the jaws 22a, 22b to clamp the tissue, for example. In certain instances, the first actuated position of the jaw 22a can be associated with a first tissue thickness, for example; and the second actuated position of the jaw 22a can be associated with a second tissue thickness, for example. In certain instances, the first tissue thickness is too large for proper treatment with the surgical instrument 2. In certain instances, the second tissue thickness is suitable for treatment with the surgical instrument 2. In certain instances, if the tissue clamped between the jaws 22a, 22b comprises the first tissue thickness, the jaw 22a may remain in the first actuated position and may not be able to transition beyond the first actuated position to the second actuated position, as the clinician continues to actuate the trigger 8, due to the large thickness of the tissue clamped between the jaws 22a, 22b. Accordingly, the switch 248 may remain in the active configuration 248b, for example. If the clinician continues actuating the closure trigger 8 through the remainder of the actuation stroke, the closure trigger 8 may ultimately reach the actuated locked position; at such instance, the switch 246 may reach the active configuration 246b and since the switch 248 is also in the active configuration 248b, the circuit 244 will become closed and the indicator 245 activated to alert the clinician that the captured tissue

comprises a thickness that is too large for proper treatment with the surgical instrument 2.

[0054] The reader will appreciate that if the tissue clamped between the jaws 22a, 22b comprises a thickness suitable for treatment via the instrument 2 such as, for example, the second tissue thickness, the jaw 22a may continue to move past the first actuated position and toward the second actuated position as the clinician continues to actuate the trigger 8 through the closure stroke. Accordingly, the switch 248 may move past the active configuration 248b to the inactive configuration 248c. If the clinician continues actuating the closure trigger 8 through the remainder of the actuation stroke, the closure trigger 8 may ultimately reach the actuated locked position; at such instance, the switch 246 may reach the active configuration 246b. But since the switch 248 is in the inactive configuration 248c, the circuit 244 will remain open and the indicator 245 will remain inactive when the switch 246 reaches the closed configuration 246b. In other words, since the tissue clamped between the jaws 22a, 22b comprises a thickness that is not too large for treatment with the surgical instrument 2, the indicator 245 may remain inactive.

[0055] In certain instances, the switch 248 can be associated with the closure drive assembly at a position proximal to the jaw 22a and can be operable in a similar manner as described above. In certain instances, the switch 248 can be associated with the jaw 22b and can be operable in a similar manner as described above. In certain instances, the circuit 244 may comprise a third switch (not shown) which can be associated with the jaw 22b such that the circuit 244 is closed and the indicator 245 is activated when

the third switch and the switches 246 and 248 are all in the active configuration, for example.

[0056] Referring to FIG. 11, in certain instances, the mechanical feedback system 242 may replace the electrical feedback system 240, for example, to provide feedback to a clinician actuating the trigger 8 in the event the tissue clamped between the jaws 22a, 22b comprises a thickness that cannot be properly treated with the surgical instrument 2. As illustrated in FIG. 11, the mechanical feedback system 242 may include an indicator window 264 positioned on an outer wall of the handle housing 4, for example. In certain instances, as illustrated in FIG. 12, the indicator window 264 can be positioned on the outer sheath 23 of the shaft assembly 12, for example.

[0057] In any event, the mechanical feedback system 242 may include an indicator 266. In certain instances, as illustrated in FIGS. 14 and 15, the indicator 266 can be movable between a first indicator position 280, a second indicator position 282, and a third indicator position 284, for example. In certain instances, as illustrated in FIG. 15, the indicator 266 is not visible through the indicator window 264 while in the first indicator position 280 and while in the third indicator position 284. However, in certain instances, the indicator 266 is visible through the indicator window 264 while in the second indicator position 282, for example. In certain instances, the indicator 266 is movable between a plurality of indicator positions that may be defined by color coded sections depicted on the outer sheath 23, for example.

[0058] In certain instances, as illustrated in FIG. 11, the indicator 266 can be movably coupled to the closure drive assembly via an indicator arm 268, for example. In certain instances, the indicator 266 can be pivotally coupled to the closure drive assembly of

the surgical instrument 2 such that motion of the closure drive assembly between a first closure position corresponding to the unactuated open position of the jaw 22a, a second closure position corresponding to the first actuated position of the jaw 22a, and a third closure position corresponding to the second actuated position of the jaw 22a may cause the indicator 266 to move between the first indicator position, the second indicator position, and the third indicator position, respectively, for example.

[0059] In use, a clinician may position the jaws 22a, 22b around tissue and may actuate the closure trigger 8 through a closure stroke to actuate the jaws 22a, 22b to clamp the tissue, for example. As the clinician actuates the trigger 8, the closure drive assembly may be transitioned from the first closure position to the second closure position which may cause the jaw 22a to be transitioned from the initial unactuated position to the first actuated position, and may cause the indicator 266 to be transitioned from the first indicator position 280 to the second indicator position 282. As described above, the indicator 266 may be visible through the indicator window 264 in the second indicator position 282. Also described above, if the tissue clamped between the jaws 22a, 22b comprises the first tissue thickness, the jaw 22a may remain in the first actuated position and may not be able to transition to the second actuated position, as the clinician continues to actuate the trigger 8, due to the large thickness of the tissue clamped between the jaws 22a, 22b. Accordingly, the indicator 266 may remain in the second indicator position 282 and may remain visible through the indicator window 264 to provide the clinician with feedback that the captured tissue cannot be properly treated with surgical instrument 2, for example.

[0060] The reader will appreciate that if the tissue clamped between the jaws 22a, 22b comprises a thickness suitable for treatment with the instrument 2 such as, for example, the second tissue thickness, the closure drive assembly may continue to move past the second closure position to the third closure position, for example, and the jaw 22a may continue to move past the first actuated position to the second actuated position, for example, as the clinician continues to actuate the trigger 8 through the closure stroke. In result, the indicator 266 may be moved past the second indicator position 282 toward the third indicator position 284, for example, and away from indicator window 264.

[0061] In certain instances, referring to FIG. 13, the surgical instrument 2 may include one or more feedback systems such as, for example, a feedback system 270. In certain instances, as illustrated in FIG. 13, the feedback system 270 may include the controller 220 which may include the processor 222 and the memory 224, for example. In certain instances, the feedback system 270 can be powered by a power source such as, for example, the battery 226. In certain instances, the feedback system 270 may comprise one or more indicators such as, for example, the indicator 205. In certain instances, the feedback system 270 may comprise one or more load cells such as, for example, strain gauges 272 and 274.

[0062] Strain gauges suitable for use in the present invention include (a) feedback electroactive polymer elements whose impedance or resistance varies as a function of the amount of strain in the device and (b) conventional strain gauges in which the resistance of the device varies as a function of the amount of strain in the device, thus allowing the amount of strain to be readily quantified and monitored. Such strain gauges

are commercially from a number of different sources, including National Instruments Co., Austin, Tex., and include piezoresistive strain gauges (for which resistance varies nonlinearly with strain) and bonded metallic strain gauges (for which resistance typically varies linearly with strain). The later strain gauges consist of very fine wire or metallic foil that is arranged in a grid pattern. The grid is bonded to a thin backing or carrier, which may be directly attached to the substrate being monitored for strain.

Consequently, the strain experienced by the substrate is transferred directly to the strain gauge, which responds with a change in electrical resistance. Commercially available strain gauges typically have nominal resistance values within the range of 30 to 3000 Ω , with 120 Ω , 350 Ω and 1000 Ω devices being especially common.

[0063] In certain instances, the strain gauge 272 is operable to monitor closure actuation forces applied by a clinician to the surgical instrument 2 through the closure trigger 8, for example. In certain instances, the strain gauge 272 can be placed on various locations of the surgical instrument 2 that are associated with the closure stroke. In certain instances, the strain gauge 272 can be placed on the closure drive, for example. In certain instances, the strain gauge 272 can be placed on the closure trigger 8, for example. In certain instances, the strain gauge 272 can be placed on toggle arm 24, for example.

[0064] In certain instances, the strain gauge 274 is operable to monitor firing actuation forces applied by a clinician to the surgical instrument 2 through the firing trigger 16, for example. In certain instances, the strain gauge 274 can be placed on various locations of the surgical instrument 2 that are associated with the firing stroke. In certain

instances, the strain gauge 274 can be placed on the firing drive, for example. In certain instances, the strain gauge 274 can be placed on the firing trigger 16, for example.

[0065] In certain instances, the memory 224 may include program instructions that can be executed from the memory 224 to cause the processor 220 to monitor strain measurements transmitted from the strain gauge 272 and/or the strain gauge 274 to the processor 222. In certain instances, the strain measurements of the strain gauge 272 and/or the strain gauge 274 can be transmitted to the processor 222 through an analogue to digital converter, for example. In certain instances, the memory 224 may include program instructions that can be executed from the memory 224 to cause the processor 220 to detect an increase in the monitored closure actuation forces beyond a predetermined threshold and to transmit an activation signal to the indicator 205 in response to the detection of such an increase. In certain instances, the memory 224 may include program instructions that can be executed from the memory 224 to cause the processor 220 to detect an increase in the monitored firing actuation forces beyond a predetermined threshold and to transmit an activation signal to the indicator 205 in response to the detection of such increase.

[0066] The reader will appreciate one or more of the switches described by the present disclosure may comprise mechanical switches, electro-mechanical switches, and/or solid state switches. In certain instances, one or more of the switches of the present disclosure may comprise open, inactive, and/or non-conductive positions, states, and/or configurations. In certain instances, one or more of the switches of the present disclosure may comprise closed, active, and/or conductive positions, states and/or configurations. In certain instances, one or more of the switches of the present

disclosure can be transitioned from the open, inactive, and/or non-conductive positions, states, and/or configurations to the closed, active, and/or conductive positions, states and/or configurations to close and/or activate one or more circuits associated with such switches, for example.

[0067] 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, the device can be reconditioned for reuse after at least one use. Reconditioning can include any combination of the steps of disassembly of the device, followed by cleaning or replacement of particular pieces, and subsequent reassembly. In particular, the device can be disassembled, and any number of the particular pieces or parts of the device can be selectively replaced or removed in any combination. Upon cleaning and/or replacement of particular parts, the device can be reassembled for subsequent use either at a reconditioning facility, or by a surgical team immediately prior to a surgical procedure. 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.

[0068] Preferably, the invention described herein will be processed before surgery. First, a new or used instrument is obtained and if necessary cleaned. The instrument can 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 are then placed in a field of radiation that can penetrate the container, such as gamma radiation, x-rays, or high-energy electrons. The radiation kills bacteria on the

instrument and in the container. The sterilized instrument can then be stored in the sterile container. The sealed container keeps the instrument sterile until it is opened in the medical facility.

[0069] 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 does 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.

[0070] 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. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

CLAIMS

WHAT IS CLAIMED IS:

1. A surgical instrument, comprising:
 - a shaft;
 - an end effector extending distally from the shaft, the end effector comprising:
 - a first jaw;
 - a second jaw, wherein at least one of the first jaw and the second jaw is movable relative to the other one of the first jaw and the second jaw to transition the end effector between an open configuration and an approximated configuration;
 - an electrode operable to seal tissue captured between the first jaw and the second jaw in the approximated configuration; and
 - a cutting member movable to cut the tissue captured between the first jaw and the second jaw in the approximated configuration;
 - a housing extending proximally from the shaft, the housing comprising:
 - a closure trigger actuatable in a closure stroke to transition the end effector from the open configuration to the approximated configuration, the closure trigger movable between an initial unactuated position and an actuated position during the closure stroke; and

a firing trigger actuatable in a firing stroke to advance the cutting member to cut the tissue captured between the first jaw and the second jaw in the approximated configuration; and

a feedback system comprising an indicator circuit, the indicator circuit comprising:

a first switch transitionable between a first switch inactive configuration and a first switch active configuration, the first switch associated with the closure trigger, wherein the actuation of the closure trigger from the initial unactuated position to the actuated position transitions the first switch from the first switch active configuration to the first switch inactive configuration;

a second switch transitionable between an second switch inactive configuration and a second switch active configuration, the second switch associated with the firing trigger, wherein actuation of the firing trigger transitions the second switch from the second switch inactive configuration to the second switch active configuration; and

an indicator activated when the first switch is in the first switch active configuration and when the second switch is in the second switch active configuration.

2. The surgical instrument of Claim 1, further comprising a locking member movable between a locked position and an unlocked position.

3. The surgical instrument of Claim 2, wherein the locking member, in the locked position, is configured to resist advancement of the cutting member to cut the tissue captured between the first jaw and the second jaw in the approximated configuration.
4. The surgical instrument of Claim 3, wherein the first switch is in the first switch active configuration when the locking member is in the locked position.
5. The surgical instrument of Claim 4, wherein the first switch is in the first switch inactive configuration when the locking member is in the unlocked position.
6. The surgical instrument of Claim 1, wherein the firing trigger is actuatable during the firing stroke to a first actuated position and to a second actuated position beyond the first actuated position.
7. The surgical instrument of Claim 6, wherein the second switch is in the second switch active configuration when the firing trigger is in the first actuated position.
8. The surgical instrument of Claim 7, wherein the cutting member comprises a cutting surface, and wherein the cutting surface is in contact with the tissue when the firing trigger is in the second actuated position.

9. A surgical instrument, comprising:

an end effector, the end effector transitionable between an open configuration, a first approximated configuration, and a second approximated configuration;

a closure drive assembly movable in a closure stroke to transition the end effector from the open configuration to the first approximated configuration and further to the second approximated configuration;

a cutting member;

a firing drive assembly;

a firing trigger operably coupled to the firing drive assembly, the firing trigger actuatable in a firing stroke between an initial unactuated position, a first actuated position, and a second actuated position, wherein the firing trigger is movable from the first actuated position to the second actuated position to motivate the firing assembly to advance the cutting member to engage tissue captured by the end effector in the second approximated configuration; and

a feedback system comprising an indicator circuit, the indicator circuit comprising:

a first switch transitionable between a first switch open position and a first switch closed position, wherein the first switch is in the first switch closed position when the end effector is in the first approximated configuration, and wherein the first switch is in the first switch open position when the end effector is in the second approximated configuration;

a second switch transitionable between a second switch open position and a second switch closed position, wherein the second switch is in the second switch open configuration when the firing trigger is in the initial unactuated position, and wherein the second switch is in the second switch closed position when the firing trigger is in the first actuated position; and

an indicator activated when the first switch is in the first switch closed position and when the second switch is in the second switch closed position.

10. The surgical instrument of Claim 9, further comprising a locking member movable between a locked position and an unlocked position.

11. The surgical instrument of Claim 10, wherein the locking member is in the locked position when the end effector is in the first approximated configuration.

12. The surgical instrument of Claim 11, wherein the locking member is in the unlocked position when the end effector is in the second approximated configuration.

13. The surgical instrument of Claim 12, wherein the locking member is configured to engage the firing drive assembly in the locked configuration.

14. The surgical instrument of Claim 13, wherein the locking member is configured to release the firing drive assembly in the unlocked configuration.

15. The surgical instrument of Claim 14, wherein the first switch is coupled to the locking member, wherein movement of the locking member from the locked position to the unlocked position transitions the first switch from the first switch closed configuration to the first switch open configuration.

16. A surgical instrument, comprising:

an end effector, comprising:

a first jaw; and

a second jaw, wherein at least one of the first jaw and the second jaw is movable relative to the other one of the first jaw and the second jaw to transition the end effector during a closure stroke between an open configuration, a first approximated configuration, and a second approximated configuration; and

a feedback system comprising an indicator, the indicator transitionable between a first indicator position, a second indicator position, and a third indicator position, wherein the indicator is in the first indicator position when the end effect is in the open configuration, wherein the indicator is in the second indicator position when the end effector is in the first approximated configuration, and wherein the indicator is in the third indicator position when the end effector is in the second approximated configuration.

17. The surgical instrument of Claim 16, wherein the feedback system comprises an indicator window positioned on the shaft.

18. The surgical instrument of Claim 16, wherein the feedback system comprises an indicator window, and wherein the indicator is visible through the indicator window when the indicator is in the second indicator position.

19. A surgical instrument, comprising:

a shaft;

a handle extending proximally from the shaft, the handle comprising a closure trigger actuatable in a closure stroke between an initial unactuated position and a locked actuated position;

an end effector extending distally from the shaft, the end effector operably coupled to the closure trigger, wherein the end effector comprises:

a first jaw; and

a second jaw, wherein at least one of the first jaw and the second jaw is movable relative to the other one of the first jaw and the second jaw to transition the end effector during the closure stroke between an open configuration, a first approximated configuration, and a second approximated configuration; and

a feedback system including an indicator circuit, the indicator circuit comprising:

a first switch transitionable between a first open position, an intermediate closed position, and a second open position, wherein the first switch is in the first open position when the end effector is in the open configuration, wherein the first switch is in the intermediate closed position when the end effector is in the first approximated configuration, and wherein the first switch is in the second open position when the end effect is in the second approximated configuration;

a second switch transitionable between an open position and a closed position, wherein the second switch is in the open position when the closure trigger is in the initial unactuated position, and wherein the second switch is in the closed position when the closure trigger is in the locked actuated position; and

an indicator, the indicator activated when the first switch is in the intermediate closed position and when the second switch is in the closed position.

20. The surgical instrument of Claim 19, wherein the first switch is movably coupled to the first jaw.

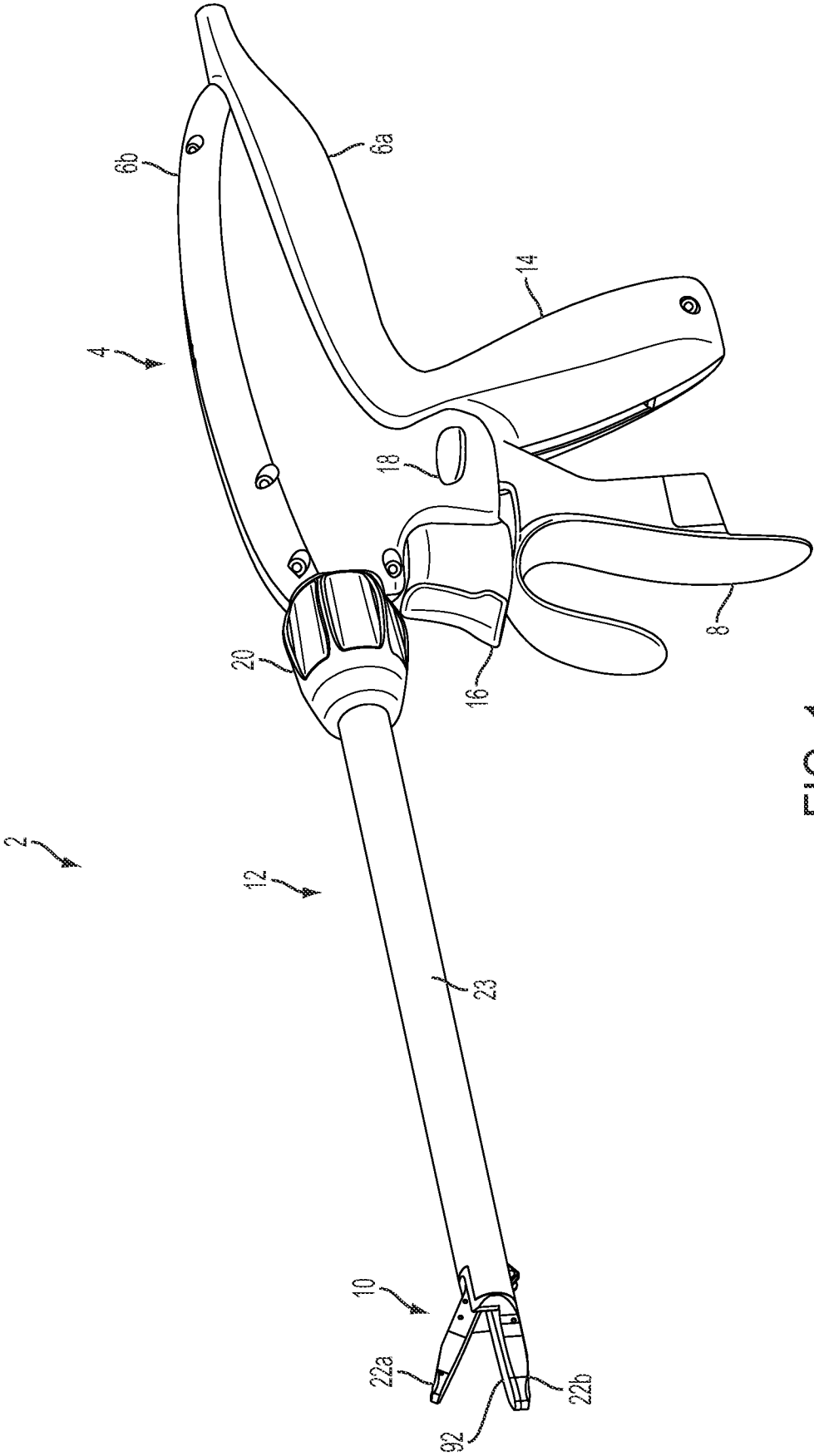
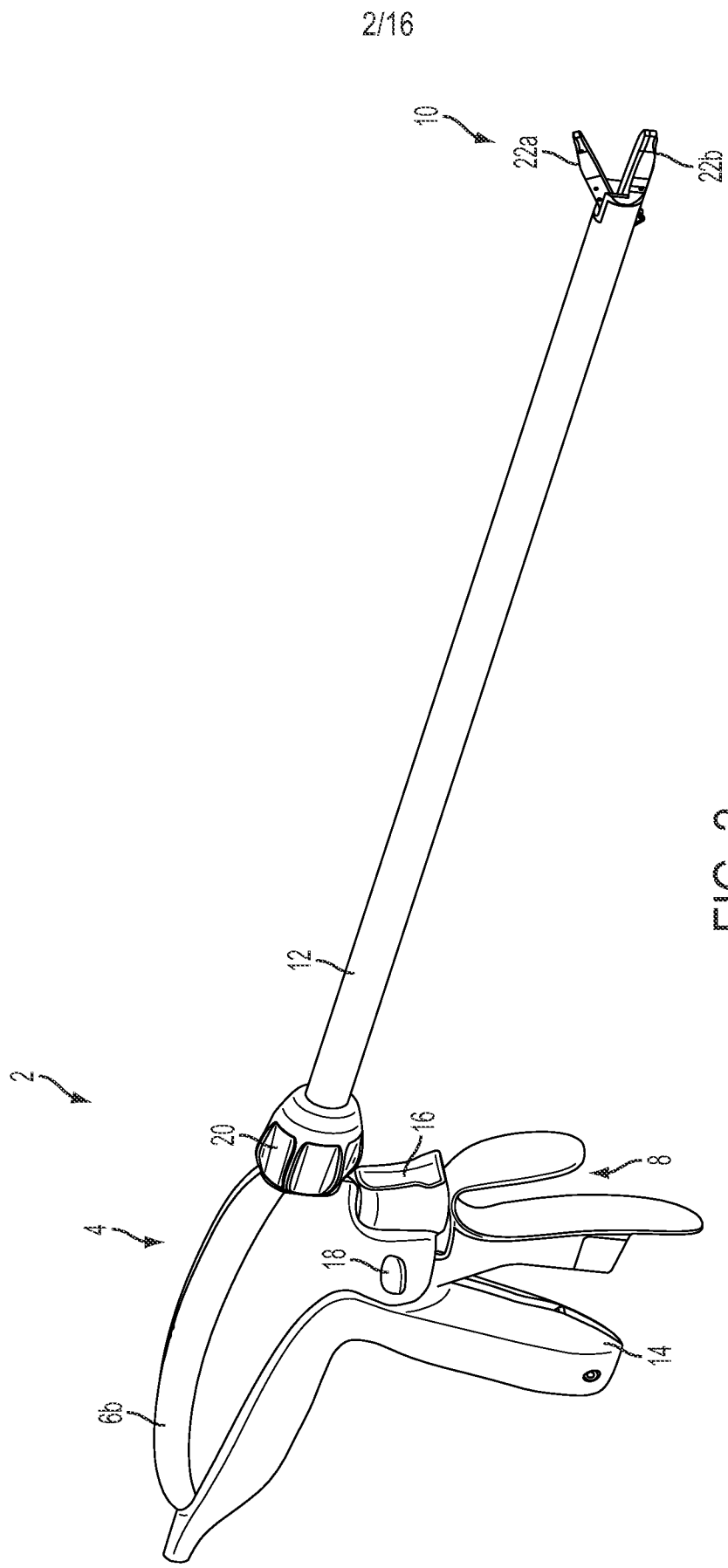


FIG. 1



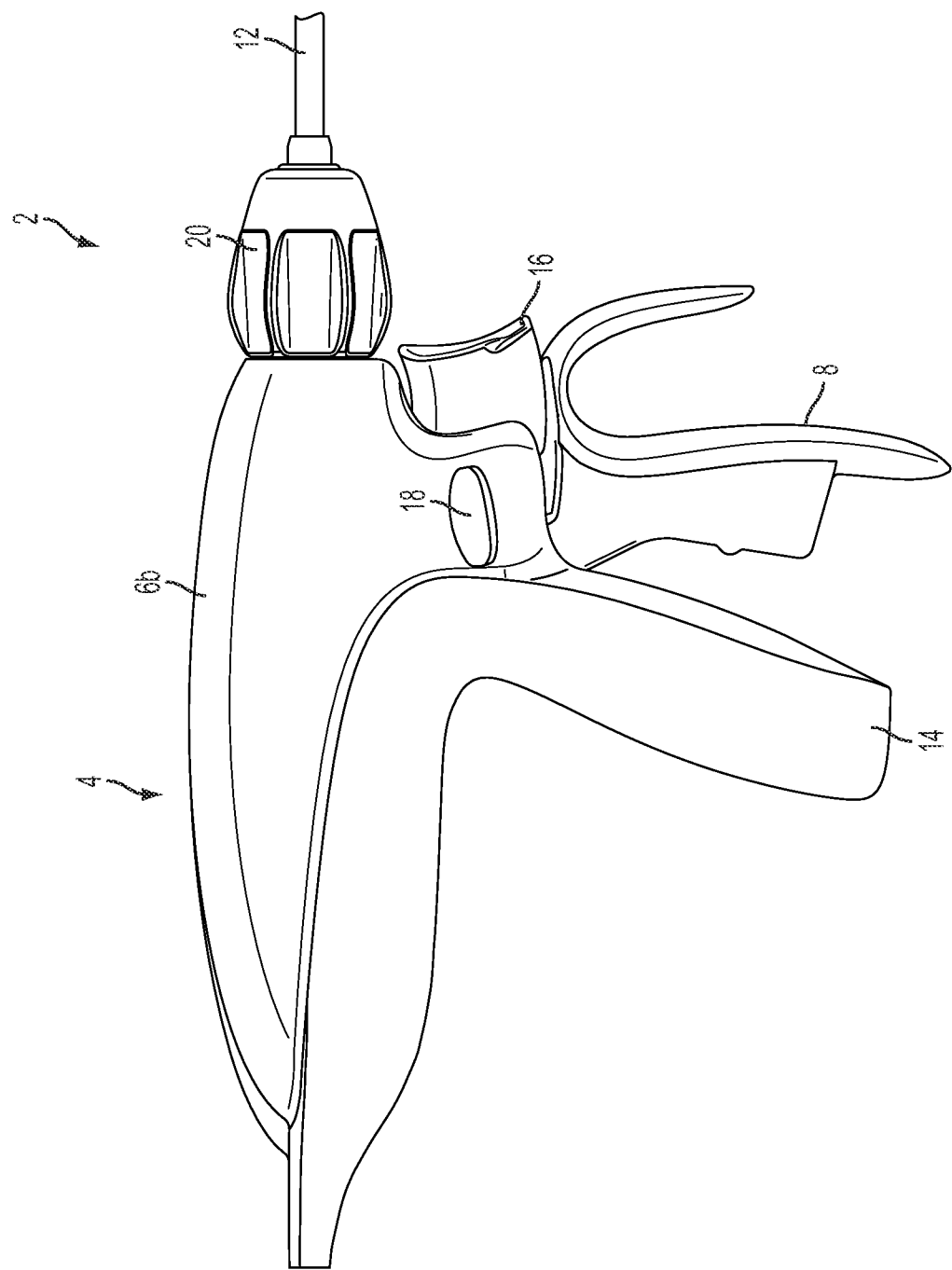


FIG. 3

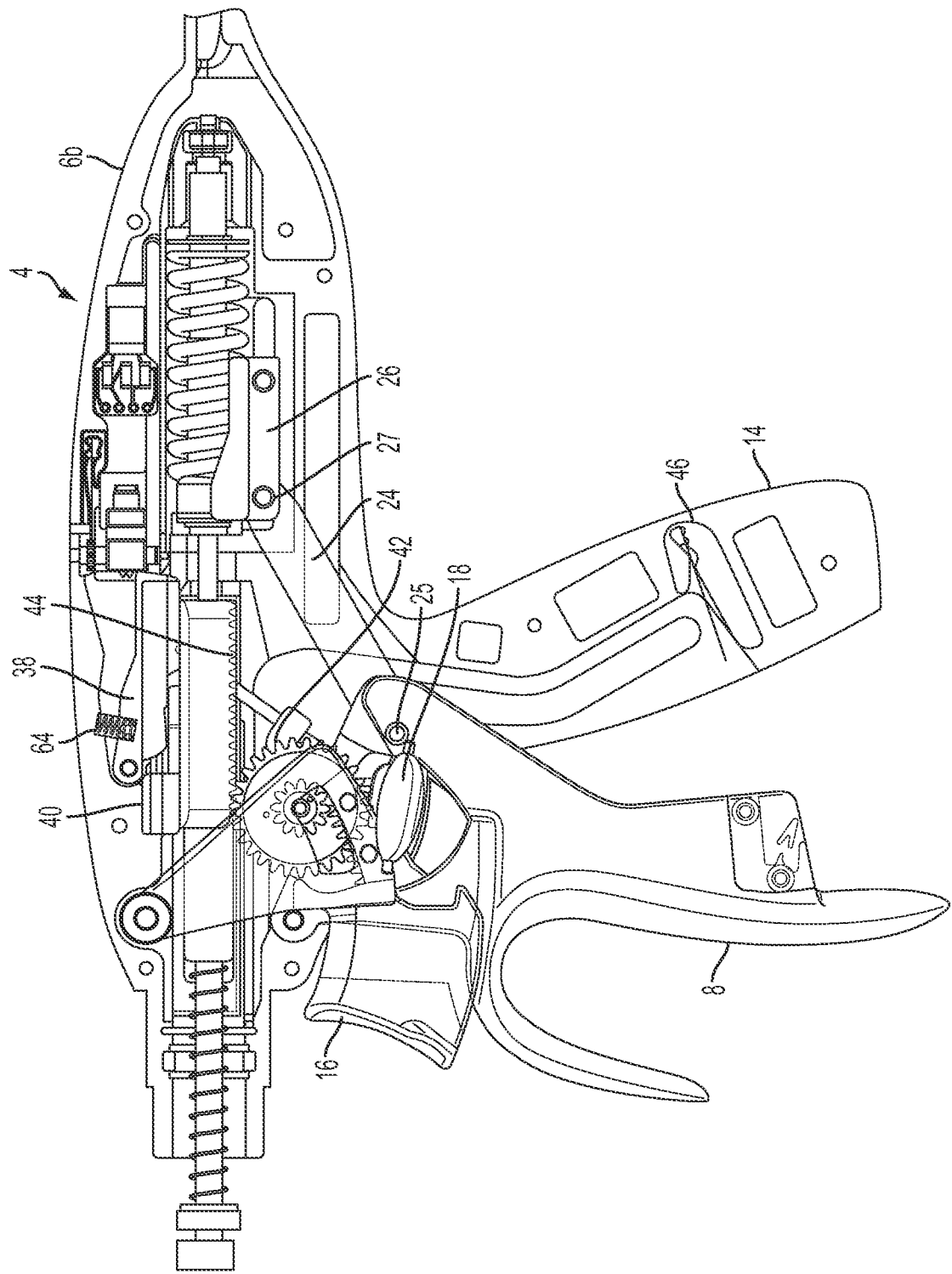


FIG. 4

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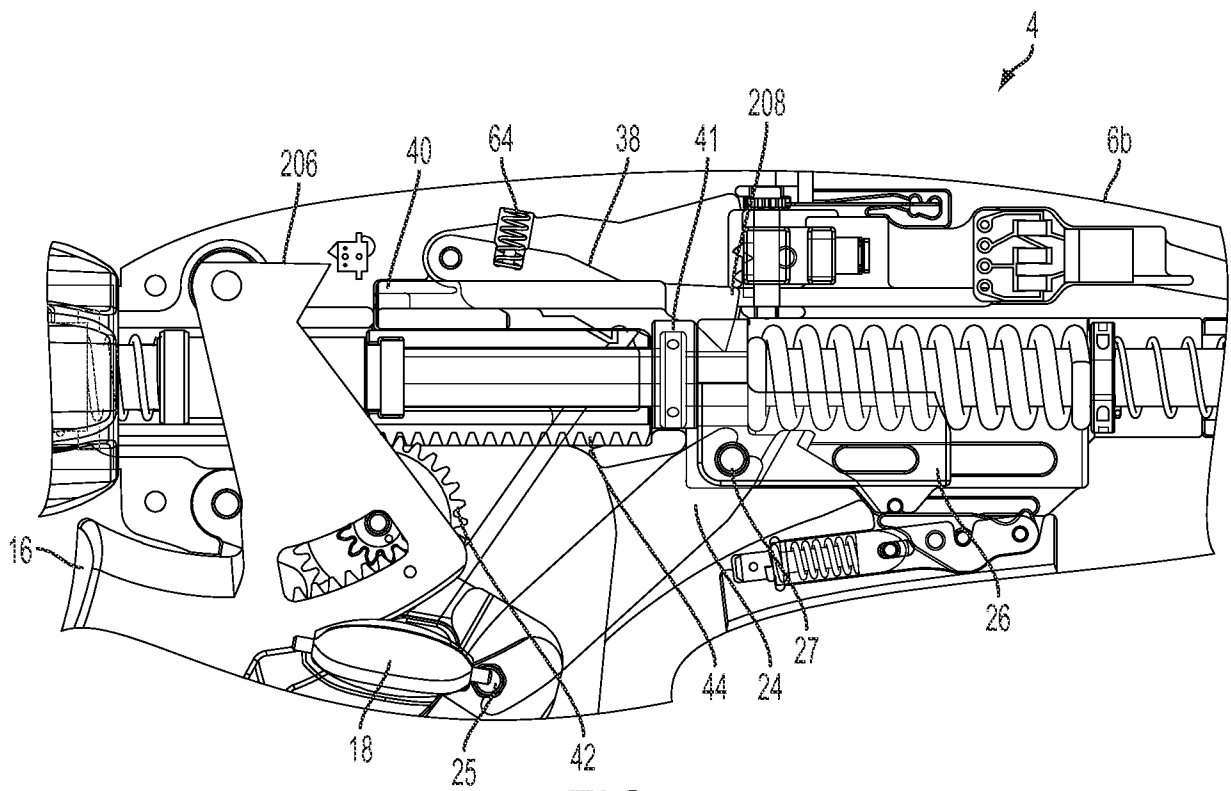


FIG. 5

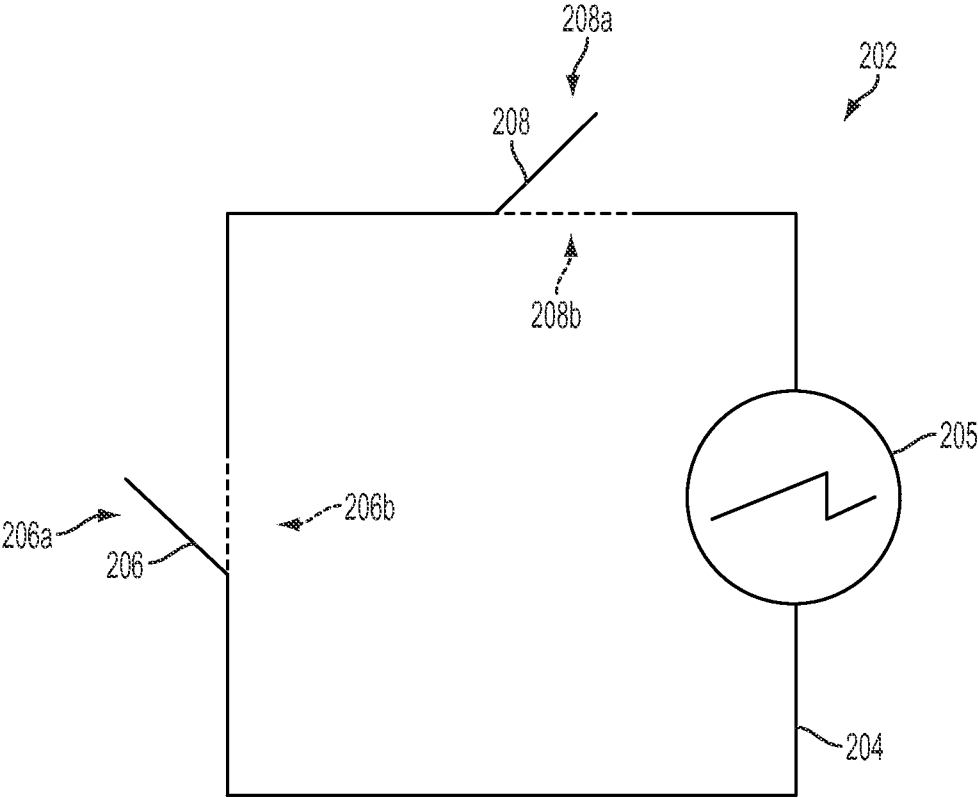


FIG. 5A

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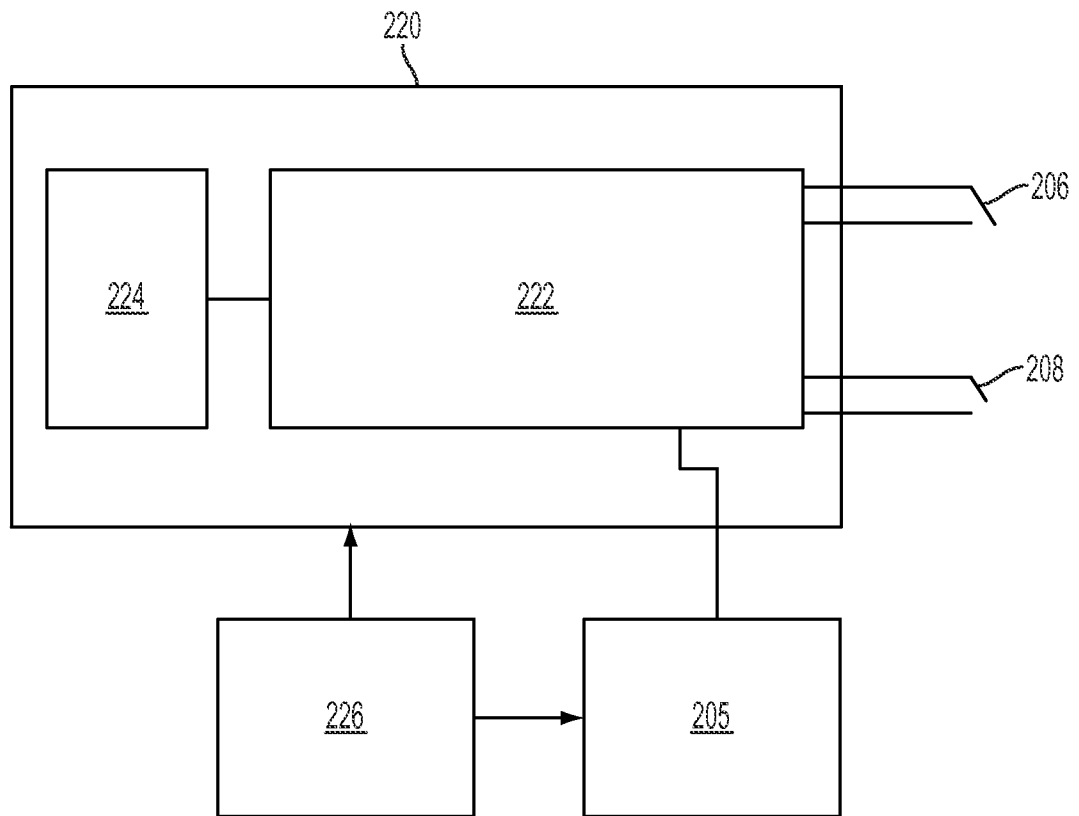


FIG. 5B

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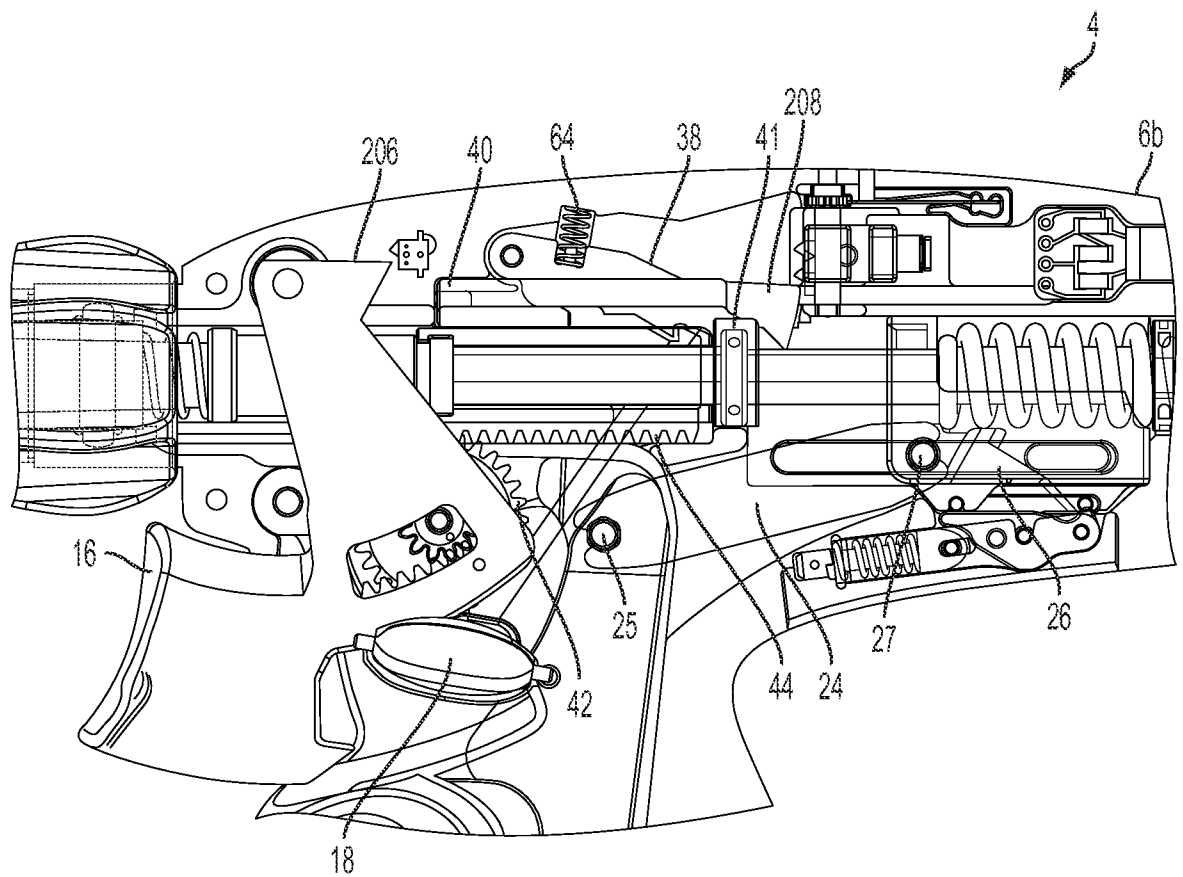


FIG. 6

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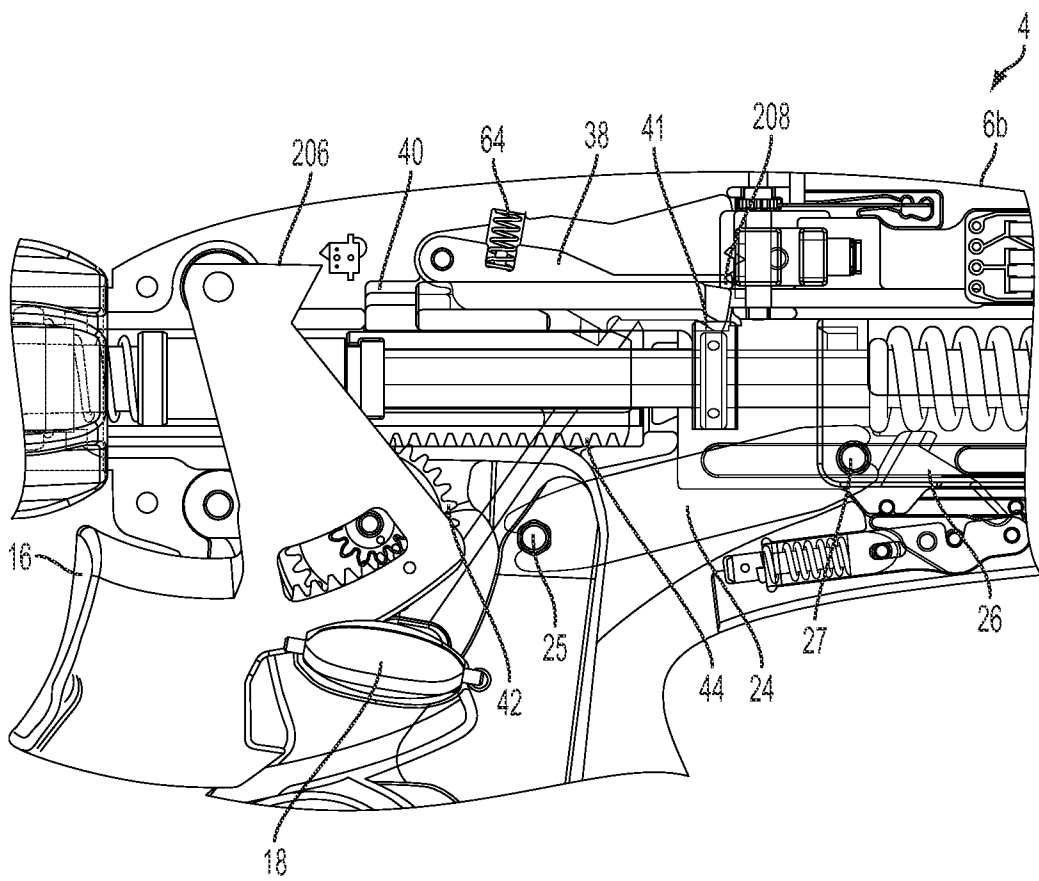


FIG. 7

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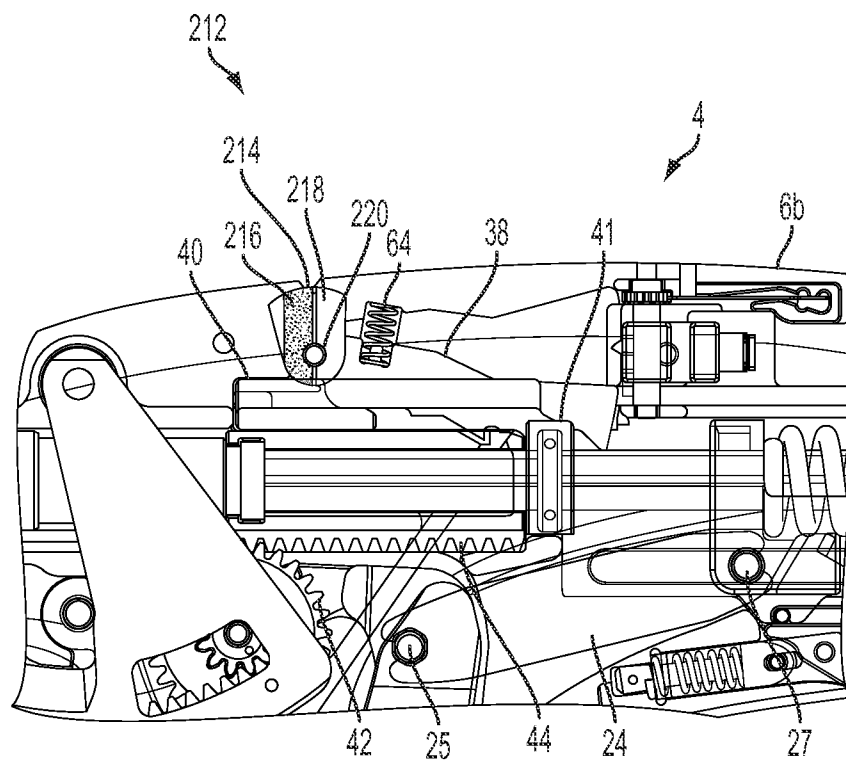


FIG. 8

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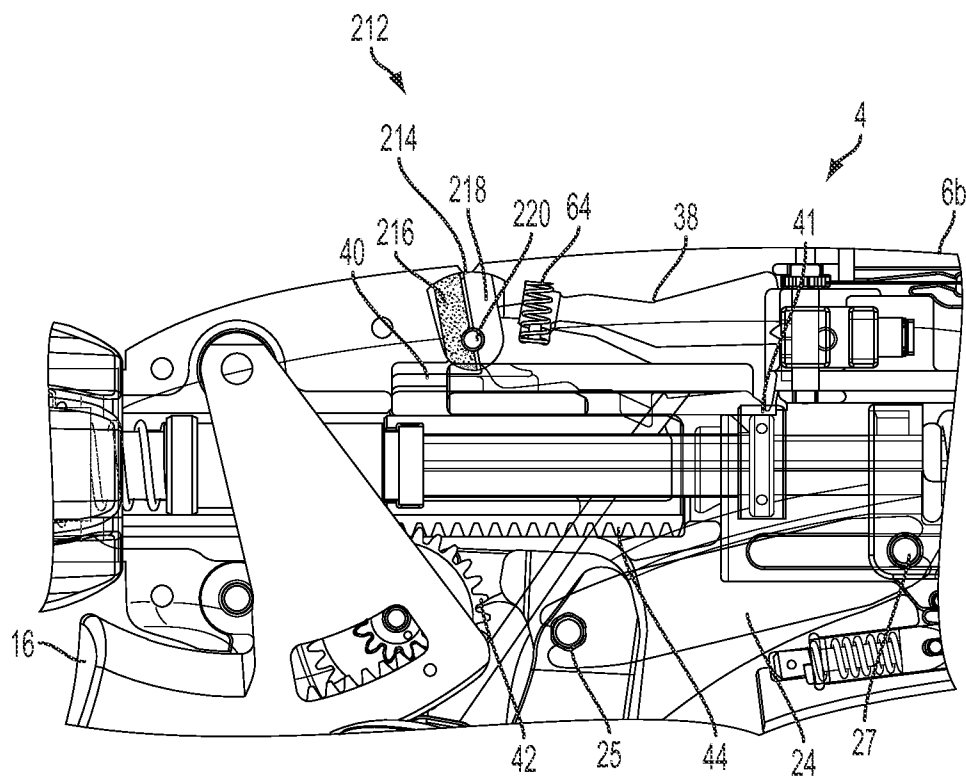


FIG. 9

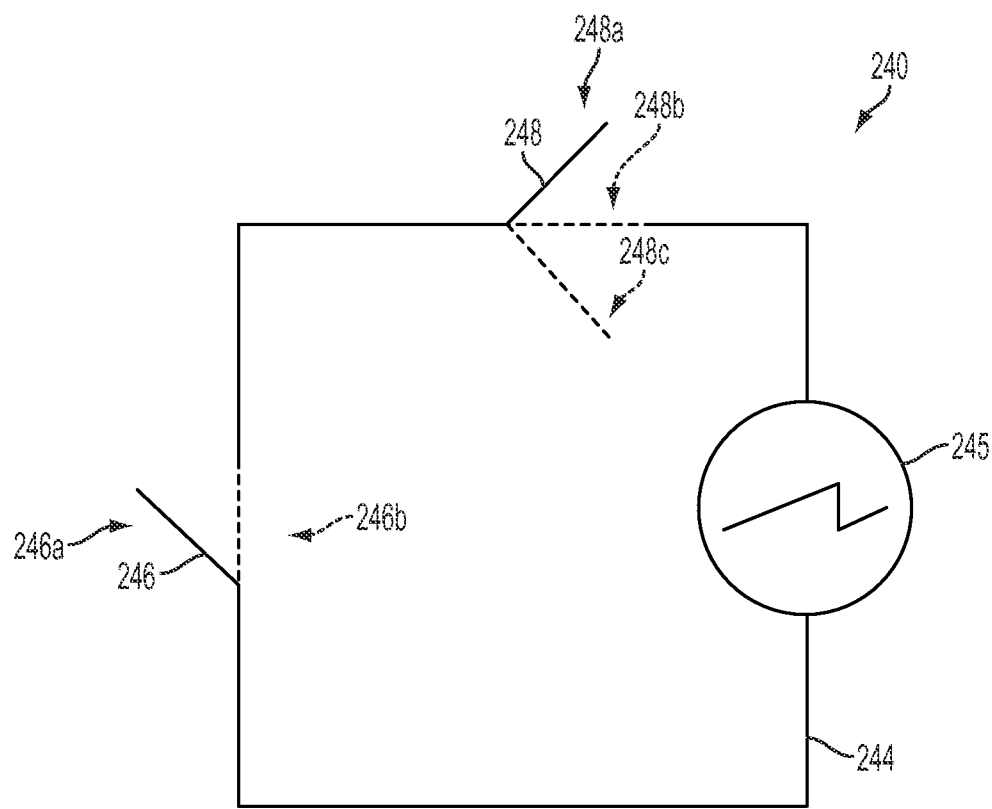


FIG. 10

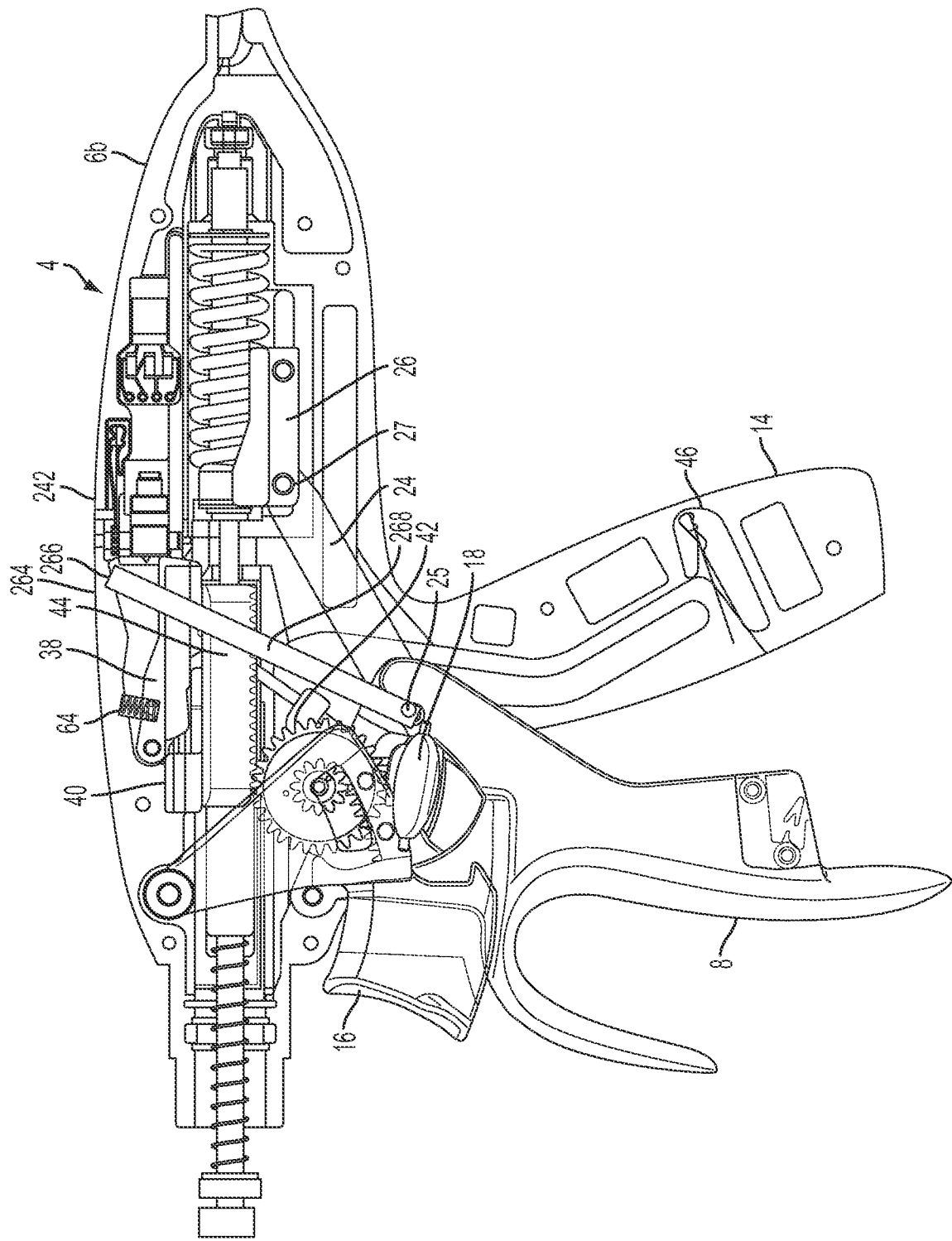
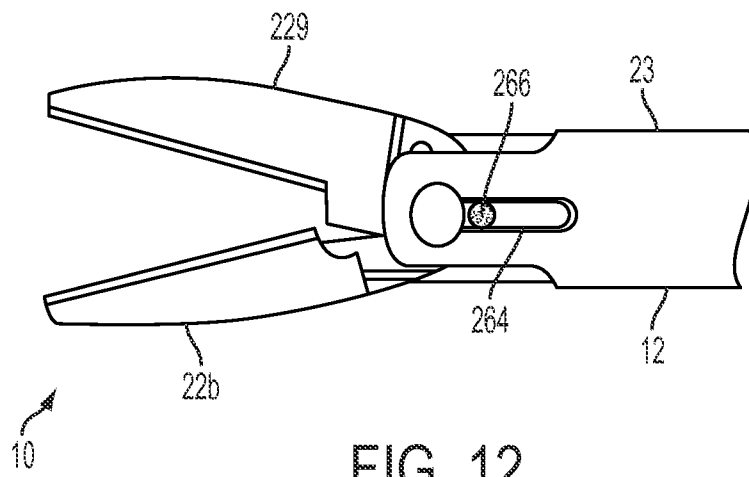


FIG. 11

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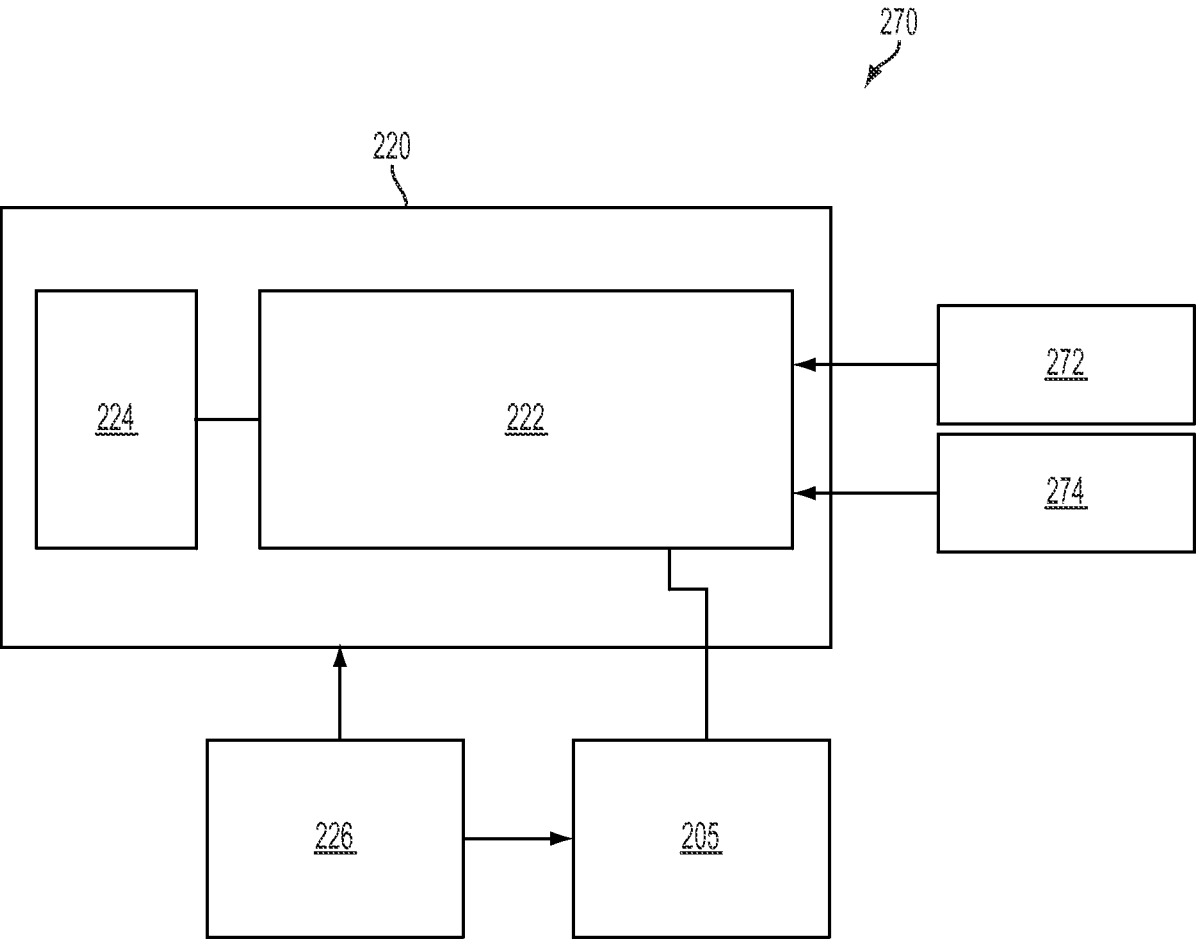


FIG. 13

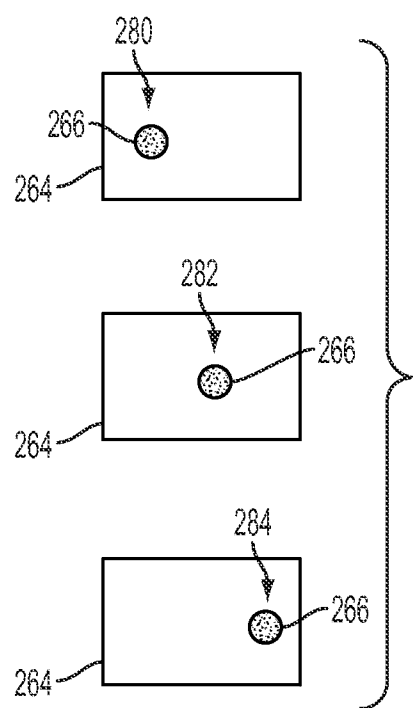


FIG. 14

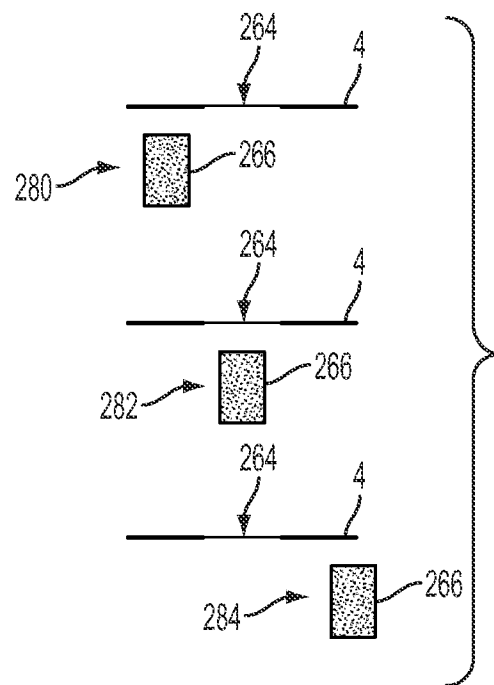


FIG. 15

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/025893

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B18/14 A61B17/295
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	US 2012/012636 A1 (BECKMAN ANDREW T [US] ET AL) 19 January 2012 (2012-01-19) paragraph [0110] paragraphs [0141] - [0156]; figures 11A-17 paragraphs [0204] - [0213]; figures 29-35 -----	1-20
X	US 2013/296843 A1 (BOUDREAUX CHAD P [US] ET AL) 7 November 2013 (2013-11-07) paragraphs [0065] - [0066] paragraphs [0077] - [0088]; figures 6-13D paragraphs [0103] - [0110]; figures 19-26 -----	1-20
X	US 2007/106297 A1 (DUMBAULD PATRICK L [US] ET AL) 10 May 2007 (2007-05-10) paragraphs [0130] - [0146]; figures 5A-14 paragraphs [0176] - [0182]; figures 18-22C ----- -/-	1-8



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

14 July 2015

Date of mailing of the international search report

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PCT/US2015/025893

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 529 681 A1 (TYCO HEALTHCARE [US]) 5 December 2012 (2012-12-05) paragraphs [0083] - [0097]; figures 13A-16B paragraphs [0103] - [0105] -----	1-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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