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(54) **SYSTEM FOR SUTURE TRIMMING**
SYSTEM ZUM NÄHFADEN ABSCHNEIDEN
SYSTÈME DE COUPE DE SUTURE

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Description

FIELD OF THE PRESENT DISCLOSURE

[0001] The present disclosure relates generally to devices and methods for use in trimming suture material. In particular, techniques are disclosed for suture trimming that may be used to close a puncture or opening associated with a percutaneous surgery.

BACKGROUND

[0002] Techniques have been developed to allow an increasing number and variety of procedures to be performed percutaneously as minimally invasive alternatives to conventional "open" surgeries. Such techniques provide the benefits of reducing postoperative pain, decreasing hospital stays and periods of disability, and lowering costs for both hospitals and patients. Generally, these procedures utilize one or more elongated instruments that are introduced through a patient's skin for use in carrying out the procedure, which may include clinical treatments such as percutaneous coronary intervention. As an illustration, the physician may gain vascular access through introducer and introducer sheath to deliver diagnostic or therapeutic device(s) into vessel percutaneously without cutting down the skin and subcutaneous tissue in a percutaneous coronary intervention. Correspondingly, it is desirable to attempt repair the access site or otherwise provide support for the surrounding tissue during the postoperative healing process.

[0003] Notably, closing the openings formed to carry out the percutaneous procedure with sutures may reduce recovery time, minimize the risk of infection or provide other benefits. In clinical practices, manual compression and vascular closure devices are standard procedures to achieve hemostasis after interventions. The principle of manual compression is to apply external compression force upon an adjacent area upstream of the access site for a certain period of time to reduce blood flow and control bleeding. However, this is time-consuming, inconvenient, and uncomfortable for the patient. Although other methods of closing wounds have been developed, including the use of staples and clips, suturing remains a beneficial technique that provides advantages over these alternatives. Specifically, suture-based technologies have been developed to improve efficiency and safety of hemostasis. Such suture-based closure devices allow the physician to place, anchor suture(s) around a vessel opening percutaneously, and close the access site after the procedure by forming sliding knot(s) that may be cinched to draw the opening closed. After the knots are delivered and hemostasis is achieved, the excess length of sutures should be trimmed and removed appropriately. As will be described in the materials below, the systems and methods of this disclosure satisfy these and other needs.

[0004] US 2013/072949 A1 describes a suture locking

device including a suture locking assembly, a suture cutting member, and an actuator assembly. The actuator assembly includes a first actuator operable longitudinally to lock the suture with the suture locking assembly, and a second actuator operable laterally to concurrently cut the suture with the suture cutting member and disconnect the suture locking assembly from the suture locking device. US 2004/097865 A1 describes a suture trimmer having a shaft with a groove formed in the side thereof, a cutting member movably disposed within the shaft, and a suture retainer slidably disposed within the shaft. The suture trimmer may be used to position knots formed within a suture loop prior to trimming the free end(s) of the suture loop, and to deliver an agent near the location where the suture is severed.

SUMMARY

[0005] This disclosure includes a device for trimming suture material as defined in the appended claims. The device includes an elongated shaft, an elongated tubular cutter disposed over the shaft, an elongated tubular barrel disposed over the cutter and a suture loader at a distal end of the shaft configured to engage suture material. A first actuator is configured to cause relative motion between the shaft and the barrel and a second actuator is configured to cause relative motion between the cutter and both of the barrel and the shaft.

[0006] In one embodiment, the suture loader comprises a head at the distal end of the shaft and a longitudinal groove formed in the head and sized to receive the suture material. The suture loader may have a gap in the shaft proximal to the head. The suture loader may also have a hook extending into the gap and aligned with an edge of the groove.

[0007] In one embodiment, the device may include an opening at the distal end of the barrel that is configured to allow suture material to extend from the suture loader when the shaft and the barrel are in a closed position.

[0008] In one embodiment, a distal portion of the shaft may have a surface formed by a change in shaft diameter against which the cutter contacts when the cutter is moved distally with respect to the shaft.

[0009] In one embodiment, a distal portion of the shaft may have a knot advancing surface.

[0010] In the claimed invention, the first actuator is a slider such that motion of the slider in a distal direction corresponds to a relative change in position between the shaft and the barrel to expose a distal end of the shaft having the suture loader. The first actuator may require disengagement through motion in a different direction before allowing the motion in the distal direction.

[0011] In one embodiment, the first actuator may be a depressible button such that inward pressure on the button corresponds to a relative change in position between the shaft and the barrel to expose a distal end of the shaft having the suture loader. The inward pressure may be translated to a longitudinal motion by cooperating ramps

coupled to the first actuator.

[0012] In one embodiment, the second actuator may be a lever such that motion of an end of the lever corresponds to a distal motion of the cutter. Proximal motion of the end of the lever may correspond to a distal motion of the cutter.

[0013] In one embodiment, a proximal end of the shaft may be coupled to and be moveable with respect to the barrel by the first actuator and a proximal end of the cutter may be coupled to and be moveable with respect to the barrel by the second actuator.

[0014] In one embodiment, a proximal portion of the barrel may be coupled to and be moveable with respect to the shaft by the first actuator and a proximal end of the cutter may be coupled to and be moveable with respect to the shaft by the second actuator.

[0015] This disclosure also includes a method for trimming excess suture material after knot tying, which does not form part of the claimed invention. The method may involve providing suture trimming device having an elongated shaft, an elongated tubular cutter disposed over the shaft, and an elongated tubular barrel disposed over the cutter, opening a suture loader by causing relative motion between the barrel and the shaft using a first actuator, engaging excess suture material extending from a preformed knot with the suture loader, closing the suture loader around the excess suture material as a result of relative motion between the barrel and the shaft and operating a second actuator to cause the cutter to advance distally to sever the engaged excess suture material.

[0016] Engaging the excess suture material may longitudinally stabilize the suture material.

[0017] A surface of a distal end of the shaft may be advanced against the preformed knot. The preformed knot may be cinched against the surface. Alternatively or in addition, advancing the surface of the distal end of the shaft may position the preformed knot at a desired location.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Further features and advantages will become apparent from the following and more particular description of the preferred embodiments of the disclosure, as illustrated in the accompanying drawings, and in which like referenced characters generally refer to the same parts or elements throughout the views, and in which:

FIG. 1 depicts a schematic view of an embodiment of a suture trimming device.

FIG. 2 schematically depicts an exploded view of an embodiment of a suture trimming device.

FIG. 3 schematically depicts an embodiment of a distal end of a suture trimming device with an open suture loader.

FIGs. 4 and 5 schematically depict opposing views of an embodiment of a distal end of a suture trimming device with a closed suture loader.

FIG. 6 schematically depicts an embodiment of a distal end of a suture trimming device with a closed suture loader after cutting excess suture material.

FIGs. 7-9 schematically depict operations involving an embodiment of a first actuator of a suture trimming device.

FIGs. 10 and 11 schematically depict operations involving another embodiment of a first actuator of a suture trimming device.

FIG. 12 depicts a schematic view of another embodiment of a suture trimming device.

DETAILED DESCRIPTION

[0019] At the outset, it is to be understood that this disclosure is not limited to particularly exemplified materials, architectures, routines, methods or structures as such may vary. Thus, although a number of such options, similar or equivalent to those described herein, can be used in the practice or embodiments of this disclosure, the preferred materials and methods are described herein.

[0020] It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments of this disclosure only and is not intended to be limiting.

[0021] The detailed description set forth below in connection with the appended drawings is intended as a description of exemplary embodiments of the present disclosure and is not intended to represent the only exemplary embodiments in which the present disclosure can be practiced. The term "exemplary" used throughout this description means "serving as an example, instance, or illustration," and should not necessarily be construed as preferred or advantageous over other exemplary embodiments. The detailed description includes specific details for the purpose of providing a thorough understanding of the exemplary embodiments of the specification. It will be apparent to those skilled in the art that the exemplary embodiments of the specification may be practiced without these specific details. In some instances, well known structures and devices are shown in block diagram form in order to avoid obscuring the novelty of the exemplary embodiments presented herein.

[0022] For purposes of convenience and clarity only, directional terms, such as top, bottom, left, right, up, down, over, above, below, beneath, rear, back, and front, may be used with respect to the accompanying drawings. These and similar directional terms should not be construed to limit the scope of the disclosure in any manner.

[0023] Unless defined otherwise, all technical and sci-

entific terms used herein have the same meaning as commonly understood by one having ordinary skill in the art to which the disclosure pertains. It should be appreciated that the techniques of this disclosure may be applied in conjunction with any procedure involving the placing of a suture knot within the interior of a patient's body.

[0024] Finally, as used in this specification and the appended claims, the singular forms "a," "an" and "the" include plural referents unless the content clearly dictates otherwise.

[0025] Referring to FIG. 1, a suture trimming device 10 according to one embodiment is shown, partially in section, that is adapted to remove the excess suture material from knotted tissue percutaneously. Functionality associated with suture trimming device 10 includes loading suture material into the device and cutting the excess free at a desired location adjacent the formed knot. As illustrated, suture trimmer 10 includes handle 12 to facilitate manipulation by a physician and elongated suture cutting assembly 14. Associated with handle 12 are first actuator 16 and second actuator 18 that may be used to selectively move components of suture cutting assembly 14 when performing the suture loading and trimming operations.

[0026] Further details of suture trimming device 10 are shown in the exploded view of FIG. 2. Suture cutting assembly 14 includes shaft 20, cutter 22, and barrel 24 coaxially disposed within each other. In this embodiment, shaft 20 when positioned within barrel 24 forms an annular, coaxial lumen through which cutter 22 may travel. As will be described below, shaft 20 may be selectively moved with respect to barrel 24 during a suture loading operation under control of first actuator 16, while cutter 22 may be selectively moved with respect to shaft 20 and barrel 24 during a suture cutting operation under control of second actuator 18. The distal ends of shaft 20 and barrel 24 cooperate to form a suture loader, that may be opened and closed by relative motion between shaft 20 and barrel 24. A proximal end of shaft 20 may be coupled to first actuator 16, such that shaft 20 is biased in a proximal direction by first spring member 26. A proximal end of cutter 22 may be coupled to second actuator 18 by link 32, such that cutter 22 is biased in a proximal direction by second spring member 28. Shaft 20 and cutter 22 may be independently slidable within barrel 24 in this embodiment, although other embodiments may involve a static shaft, with a moveable barrel and cutter as exemplified by FIG. 12, discussed below. The proximal end of shaft 20 may be coupled to first actuator 16 by link 30, while the proximal end of cutter 22 may be coupled to second actuator 18 by link 32. Handle 12 may be formed from opposing housing portions 34 and 36 and secured together by screws 38.

[0027] To help illustrate operations involving the loading of suture into suture trimming device 10, FIGs. 3-5 show detail views of the distal end of suture cutting assembly 14 and the selective positioning of shaft 20 in relation to barrel 24 as may be controlled through first

actuator 16. In FIG. 3, shaft 20 is in a more distal position relative to barrel 24 as controlled by first actuator 16 (not shown in this view) as will be discussed below. In this distal position, the end of shaft 20 protrudes from barrel 24, forming an open suture loader that includes head 40 of shaft 20, with a longitudinally oriented groove 42 sized to accept the suture. Proximal to the head 40 is gap 44, such that hook 46, aligned with one edge of groove 42, is configured to capture suture 48 as indicated. For example, gap 44 may be positioned over suture 48 to allow it to be engaged by hook 46 with the distally extending portion of suture 48 able to be disposed within groove 42. In this open position of the suture loader, at least a portion of gap 44 is exposed beyond the distal end of barrel 24. As indicated, cutter 22 remains in a relatively proximal position during the suture loading operation. Other suitable mechanisms may be employed to load suture material into a distal portion of shaft 20 as desired.

[0028] Next, FIG. 4 shows the distal end of suture cutting assembly 14 including the suture loader from the opposite side, with the distal end of shaft 20 in a more proximal position relative to barrel 24, corresponding to the suture loader being in a closed position. As may be seen, when shaft 20 is in this position, the suture loader is effectively closed around suture 48. Specifically, at least a portion of head 40 has been pulled within the distal end of barrel 24. Suture 48 lies within groove 42, allowing head 40 to fit within barrel 24. As such, the closed position is characterized by the distal end of barrel 24 extending past gap 44. The proximal extension of suture 48 travels from gap 44 out opening 50 formed in barrel 24, which may be configured as a longitudinal slot and may be sized appropriately, such as by having dimensions to accommodate the two strands of suture 48. Tension may then be applied to the proximal end of suture 48 in order to bring knot 52 into proximity of the surface of head 40. Groove 42 may be sized to resist entry of knot 52 so that the physician may readily determine when knot 52 abuts head 40. Moreover, since knot 52 may be too large to fit within groove 42, the distal end of head 40 may form a knot advancing surface. As will be appreciated, this may be used by the physician to aid in placing the knot at a desired location and/or when cinching the suture material to tighten the knot. For example, groove 42 may serve to limit suture movement and stabilize interaction between suture 48 and device 10 as it is being advanced over the suture 48 following the loading operation. Optionally, to help ensure stability while device 10 is in contact with knot 52, the distal surface of head 40 may be recessed radially inward to receive the knot 52, forming a concave surface indicated by the dashed line. Thus, knot 52 may be steadied by device 10 as it is being advanced to a desired location or being tightened as indicated above. Correspondingly, the knot advancing surface may be used to perform one or more aspects associated with suturing, including completing a preformed knot, positioning a preformed knot and/or tightening a preformed knot.

[0029] Further, FIG. 5 shows the distal end of suture cutting assembly 14 with the suture loader still in the closed position from the original side depicted in FIG. 3. To aid visualization of the cooperation between the various components of suture trimming device 10, barrel 24 is depicted as being transparent in these figures, but in practice may be formed from any suitable biocompatible material including metals or polymers. Accordingly, in the view of FIG. 5, which as with FIG. 4 depicts shaft 20 in a proximal position relative to barrel 24, it may be seen that knot 52 has been drawn into contact with head 40, so that the proximally extending portion of suture 48 lies within groove 42, is engaged by hook 46 and travels through gap 44 out opening 50 (not visible in this view) of barrel 24.

[0030] With shaft 20 in its proximal position relative to barrel 24 causing the suture loader to be in the closed position, suture 48 may be cut by advancing cutter 22 distally with respect to shaft 20 and barrel 24, for example, by appropriate manipulation of second actuator 18 (not shown in this view) as discussed below. Cutter 22 is depicted in FIG. 6 in its distal position and suture 48 has been trimmed. As will be appreciated, the coaxial relationship of cutter 22 within barrel 24 and disposed over shaft 20 ensures that cutter 22 engages suture 48 where it travels from groove 42 into gap 44. The distal end of cutter 22 may have a beveled, sharpened edge in order to more easily sever the suture material. As desired, head 40 may have a surface such as flange 54 against which the sharpened edge of cutter 22 mates to facilitate the trimming of suture 48. Flange 54 may be formed by a change in diameter of shaft 20 or other suitable means. Thus, when knot 52 abuts head 40 at the opening of groove 42, a consistent length of suture material extends through groove 42 to gap 44 where cutter 22 engages it, ensuring the trimming operation leaves sufficient material. The amount of suture material left during the trimming operation may be established by the size of head 40 chosen and therefore the length of groove 42.

[0031] Turning now to FIGs. 7-9, additional details regarding first actuator 16 and second actuator 18 are illustrated. In particular, the sequence of FIGs. 7-9 show operations involving movement of first actuator 16 in a first direction perpendicular to the longitudinal axis of handle 12 to release locking member 56, followed by a distal movement in a second direction, parallel with the longitudinal axis. For example, FIG. 7 shows first actuator 16 in its nominal, proximal position, corresponding to the related closed suture loader position with shaft 20 in a proximal position with respect to barrel 24 (not shown in this view). As noted above, the proximal end of shaft 20 is coupled to first actuator 16 by link 30 and is biased in the proximal direction by spring member 26. Locking member 56 may be made from a resilient material and nominally may engage recess 58 (not visible in this view, but shown in FIG. 9) formed in at least one of the housings of handle 12, such as portion 34 or 36. Correspondingly,

an application of force to actuator 16 in an inward, perpendicular direction as indicated by the arrow in FIG. 8 deflects and disengages locking member 56. Then, first actuator 16 may be slid distally by applying force in the longitudinal direction indicated by the arrow in FIG. 9, compressing spring member 26 and driving shaft 20 distally through translation of link 30. At the distal range of travel for first actuator 16, shaft 20 may be in a distal position with respect to barrel 24, corresponding to the open suture loader position depicted in FIG. 3. After suture 48 has been loaded through groove 42, gap 44 and engaged by hook 46 as described above, first actuator 16 may be returned to the position shown in FIG. 7 by removing the distally oriented force, thereby allowing spring member 26 to expand from its compressed state, pushing link 30 and correspondingly shaft 20 back to the proximal position associated with a closed suture loader. Alternatively or in addition, the physician may manually apply a proximal sliding force to first actuator 16 to achieve the same result. Due to the resilient nature of locking member 56, it re-engages recess 58, to retain shaft 20 in the closed position.

[0032] Correspondingly, once suture 48 has been loaded and first actuator 16 returned to its locked, proximal position, second actuator 18 may be manipulated to effect the cutting operation. In this embodiment, second actuator 18 is configured as a lever, pivoting around axle 60. As such, applying a proximally-oriented force to second actuator 18 drives link 32 distally, compressing spring member 28. Since the proximal end of cutter 22 is coupled by link 32, it is advanced relative to shaft 20 and barrel 24 as described above. Since locking member 56 retains shaft 20 in its more proximal position, the sharpened distal edge of cutter 22 is driven against flange 54 to sever the suture material caught between these elements. Removal of the proximally-oriented force from second actuator 18 allows compressed spring member 28 to expand, withdrawing cutter 22 to its nominal, proximal position after the cutting operation is performed. Alternatively or in addition, the physician may manually apply a distal force to second actuator 18 to achieve the same result.

[0033] It should be appreciated that the specific mechanisms described above with respect to first actuator 16 and second actuator 18 are intended as examples only and that any suitable means of causing relative motion of shaft 20 and/or cutter 22 with respect to barrel 24 may be employed. To help illustrate, an alternative embodiment is depicted in FIGs. 10 and 11 that features first actuator 70 configured as a depressible button as compared to the sliding mechanism of first actuator 16. In these illustrations, similar elements having similar functions to those described above have been given the same reference numbers. For example, the components associated with second actuator 18 are generally similar and may perform the operations as described above. Further, shaft 20 may be biased proximally by spring member 26 in a similar manner to the above embodiment. The prox-

imal end of shaft 20 is coupled to first actuator 70 by link 72 as shown. First actuator 70 and link 72 cooperate through opposing ramps to translate a force applied perpendicularly to handle 12 into a longitudinal translation of shaft 20. For example, in the nominal closed position, spring member 26 biases shaft 20 proximally in a similar manner to that described above, with first actuator 70 in a first, non-depressed position. By applying an inward force as indicated by the arrow, first actuator 70 may be depressed into the second position shown in FIG. 11. The inclined faces of the ramps of link 72 and first actuator 70 slide with respect to each other, translating the inward, perpendicular motion of first actuator 70 into a distal motion of link 72, which in turn compresses spring member 26 and drives shaft 20 distally, opening the suture loader. After loading the suture material as described above, the inward force applied to first actuator 70 may be withdrawn, so that expansion of spring member 26 pushes link 72, along with shaft 20, proximally and closes the suture loader. Interaction of the ramped surfaces of first actuator 70 and link 72 cause first actuator to assume its initial, non-depressed position. Second actuator 18 may then be manipulated to advance cutter 22 and trim the captured suture material.

[0034] The techniques of this disclosure may also be extended to other suture trimmer configurations. For example, the embodiments discussed above involve a static barrel, with shaft and cutter elements that move in relation. However, with suitable modifications, the suture trimmer device may have a shaft that remains static and barrel and cutter elements that move. To help illustrate, FIG. 12 depicts an embodiment of suture trimming device 80 exemplifying these characteristics. Suture trimming device 80 also has an elongated suture cutting assembly with a shaft 82 coaxially disposed within a tubular cutter 84 and an outer barrel 86. These elements are similar to the above embodiment particularly with regard to the suture loader aspects of the distal end shaft 82, which may be configured to capture and engage suture material, as well as the distal end of cutter 84, which may be configured to trim suture material, both as described above. However, in this embodiment, shaft 82 remains fixed, while barrel 86 may be moved proximally to expose the distal end of shaft 82 and open the suture loader or moved distally to close the suture loader so that excess suture material may be trimmed. Cutter 84 is able to slide over shaft 82 independently of barrel 86. As illustrated, suture trimmer 80 includes handle 88 with first actuator 90 and second actuator 92 that may be used to selectively move barrel 86 and cutter 84, respectively. A proximal portion of barrel 86 may be coupled to first actuator 90 by link 94, such that barrel 86 is biased in a distal direction by first spring member 96. Further, a proximal end of cutter 84 may be coupled to second actuator 92 by link 98, such that cutter 84 is biased in a proximal direction by second spring member 100.

[0035] Suture trimming device 80 may be used in a similar manner to the other embodiments of this disclo-

sure to remove excess suture material. As discussed, barrel 86 is biased in a distal direction to place the suture loader in a closed position. Accordingly, the physician may employ first actuator 90 to expose the distal end of shaft 82 to open the suture loader when loading the suture material. By sliding first actuator 90 proximally, link 94 pulls barrel 86 proximally, so that the distal end of shaft 82 protrudes. Once the suture material is captured, using the shaft head elements including a groove, a gap and a hook as described above, first actuator 90 may then be released (and/or manually returned to its more distal position) to extend barrel 86 over the captured suture material, closing the suture loader. Second actuator 92 is configured similarly to actuator 18 and performs a similar function. The physician applies a proximal force to the end of second actuator 92, causing it to pivot and drive cutter 84 distally, compressing second spring member 98 and severing the excess suture material engaged by the suture loader. As with the other embodiments, the first and/or second actuator may rely on different mechanics to achieve the desired relative motion between shaft 82, cutter 84 and barrel 86.

[0036] Described herein are certain exemplary embodiments. However, one skilled in the art that pertains to the present embodiments will understand that the principles of this disclosure can be extended easily with appropriate modifications as provided for within the scope of the appended claims that define the claimed invention.

Claims

1. A surgical device for trimming suture material comprising an elongated shaft (20), an elongated tubular cutter (22) disposed over the elongated shaft (20), the elongated tubular cutter (22) having a circumferential cutting edge, an elongated tubular barrel (24) disposed over the elongated tubular cutter (22), the elongated tubular barrel (24) having a proximal end and a distal end, a suture loader formed at a distal end of the elongated shaft configured to engage suture material (48), a first actuator (16) configured to cause relative distal translational motion of the elongated shaft (20) with respect to the elongated tubular barrel (24) and a second actuator (18) configured to cause relative translational motion between the elongated tubular cutter (22) and both of the elongated tubular barrel (24) and the elongated shaft (20), wherein , that.
the first actuator (16) comprises a slider configured to move from a locked position, longitudinally along a range of travel in a distal direction after disengaging a locking member by motion of the locking member in a direction perpendicular to the distal direction, and to move longitudinally along the range of travel in a proximal direction back to the locked position, the first actuator (16) being further configured such that:

i) motion of the slider in the distal direction to a distal end of the range of travel causes the elongated shaft (20) to move from a proximal position to a distal position such that the suture loader is exposed beyond the distal end of the elongated tubular barrel (24) to open the suture loader for loading a suture, and

ii) motion of the slider in the proximal direction to a proximal end of the range of travel until engaging the locking member causes the elongated shaft (20) to return from the distal position to the proximal position to close the suture loader and secure the suture within the suture loader for cutting by the elongated tubular cutter (22),

the proximal end of the elongated shaft (20) being coupled to the first actuator (16) by a link (30) and being biased in the proximal direction by a spring member (26).

2. The surgical device of claim 1, wherein the suture loader comprises a head (40) at the distal end of the elongated shaft (20) and a longitudinal groove (42) formed in the head (40) and sized to receive the suture material (48).
3. The surgical device of claim 2, wherein the suture loader further comprises a gap (44) in the elongated shaft (20) proximal to the head.
4. The surgical device of claim 3, wherein the suture loader further comprises a hook extending into the gap and aligned with an edge of the groove.
5. The surgical device of claim 1, further comprising an opening at the distal end of the elongated tubular barrel (24) that is configured to allow suture material (48) to extend from the suture loader when the elongated shaft (20) and the elongated tubular barrel (24) are in a closed position wherein the elongated shaft (20) is in a proximal position with respect to the elongated tubular barrel (24).
6. The surgical device of claim 1, wherein the cutter (22) contacts a flange (54) on a proximal surface of a head (40) of a distal portion of the elongated shaft (20) when the elongated tubular cutter (22) is moved distally with respect to the elongated shaft (20).
7. The surgical device of claim 1, wherein a distal portion of the elongated shaft (20) has a knot advancing surface.
8. The surgical device of claim 1, wherein the first actuator (16) comprises a depressible button such that inward pressure on the button corresponds to a relative change in position between the elongated shaft (20) and the elongated tubular barrel (24) to expose

a distal end of the shaft (20) having the suture loader.

9. The surgical device of claim 8, wherein the inward pressure is translated to a longitudinal motion by cooperating ramps coupled to the first actuator (16).
10. The surgical device of claim 1, wherein the second actuator (18) comprises a lever such that motion of an end of the lever corresponds to a distal motion of the elongated tubular cutter (22).
11. The surgical device of claim 1, wherein a proximal end of the elongated shaft (20) is coupled to and is moveable with respect to the elongated tubular barrel (24) by the first actuator (16) and a proximal end of the elongated tubular cutter (22) is coupled to and is moveable with respect to the elongated tubular barrel (24) by the second actuator (18).
12. The surgical device of claim 1, wherein a proximal end of the elongated tubular barrel (24) is coupled to and is moveable with respect to the elongated shaft (20) by the first actuator (16) and a proximal end of the elongated tubular cutter (22) is coupled to and is moveable with respect to the elongated shaft (20) by the second actuator (18).

Patentansprüche

1. Eine chirurgische Vorrichtung zum Trimmen von Nahtmaterial, beinhaltend einen länglichen Schaft (20), einen länglichen röhrenförmigen Schneider (22), der über dem länglichen Schaft (20) angeordnet ist, wobei der längliche röhrenförmige Schneider (22) eine Umfangsschneidekante aufweist, einen länglichen röhrenförmigen Zylinder (24), der über dem länglichen röhrenförmigen Schneider (22) angeordnet ist, wobei der längliche röhrenförmige Zylinder (24) ein proximales Ende und ein distales Ende aufweist, einen Nahtlader, der an einem distalen Ende des länglichen Schafts gebildet ist und konfiguriert ist, um in ein Nahtmaterial (48) einzugreifen, einen ersten Aktor (16), der konfiguriert ist, um eine relative distale Translationsbewegung des länglichen Schafts (20) mit Bezug auf den länglichen röhrenförmigen Zylinder (24) zu bewirken, und einen zweiten Aktor (18), der konfiguriert ist, um eine relative Translationsbewegung zwischen dem länglichen röhrenförmigen Schneider (22) und sowohl dem länglichen röhrenförmigen Zylinder (24) als auch dem länglichen Schaft (20) zu bewirken, wobei der erste Aktor (16) ein Gleitstück beinhaltet, das konfiguriert ist, um sich von einer verriegelten Position längs entlang einem Fortbewegungsbereich in eine distale Richtung zu bewegen, nachdem ein Verriegelungselement durch eine Bewegung des Verriegelungselements in eine Richtung senkrecht zu

der distalen Richtung gelöst wurde, und sich längs entlang dem Fortbewegungsbereich in eine proximale Richtung zurück zu der verriegelten Position zu bewegen, wobei der erste Aktor (16) ferner so konfiguriert ist, dass:

- i) eine Bewegung des Gleitstücks in die distale Richtung zu einem distalen Ende des Fortbewegungsbereichs bewirkt, dass sich der längliche Schaft (20) von einer proximalen Position in eine distale Position bewegt, sodass der Nahtlader über das distale Ende des länglichen röhrenförmigen Zylinders (24) hinaus freigelegt ist, um den Nahtlader zum Laden einer Naht zu öffnen, und
- ii) eine Bewegung des Gleitstücks in die proximale Richtung zu einem proximalen Ende des Fortbewegungsbereichs bis zum Eingreifen in das Verriegelungselement bewirkt, dass der längliche Schaft (20) von der distalen Position in die proximale Position zurückkehrt, um den Nahtlader zu schließen und die Naht innerhalb des Nahtladers zum Schneiden durch den länglichen röhrenförmigen Schneider (22) zu sichern,

wobei das proximale Ende des länglichen Schafts (20) durch ein Verbindungsglied (30) mit dem ersten Aktor (16) gekoppelt ist und durch ein Federelement (26) in die proximale Richtung vorgespannt ist.

2. Chirurgische Vorrichtung gemäß Anspruch 1, wobei der Nahtlader einen Kopf (40) an dem distalen Ende des länglichen Schafts (20) und eine Längsrille (42), die in dem Kopf (40) gebildet ist und bemessen ist, um das Nahtmaterial (48) aufzunehmen, beinhaltet.
3. Chirurgische Vorrichtung gemäß Anspruch 2, wobei der Nahtlader ferner einen Spalt (44) in dem länglichen Schaft (20) proximal zu dem Kopf beinhaltet.
4. Chirurgische Vorrichtung gemäß Anspruch 3, wobei der Nahtlader ferner einen Haken beinhaltet, der sich in den Spalt erstreckt und nach einer Kante der Rille ausgerichtet ist.
5. Chirurgische Vorrichtung gemäß Anspruch 1, die ferner eine Öffnung an dem distalen Ende des länglichen röhrenförmigen Zylinders (24) beinhaltet, der konfiguriert ist, um Nahtmaterial (48) zu erlauben, sich von dem Nahtlader zu erstrecken, wenn sich der längliche Schaft (20) und der längliche röhrenförmige Zylinder (24) in einer geschlossenen Position befinden, wobei sich der längliche Schaft (20) mit Bezug auf den länglichen röhrenförmigen Zylinder (24) in einer proximalen Position befindet.
6. Chirurgische Vorrichtung gemäß Anspruch 1, wobei

der Schneider (22) einen Flansch (54) auf einer proximalen Oberfläche eines Kopfs (40) eines distalen Abschnitts des länglichen Schafts (20) kontaktiert, wenn der längliche röhrenförmige Schneider (22) mit Bezug auf den länglichen Schaft (20) distal bewegt wird.

7. Chirurgische Vorrichtung gemäß Anspruch 1, wobei ein distaler Abschnitt des länglichen Schafts (20) eine Knoten voranbringende Oberfläche aufweist.
8. Chirurgische Vorrichtung gemäß Anspruch 1, wobei der erste Aktor (16) einen niederdrückbaren Knopf beinhaltet, sodass ein Druck nach innen auf den Knopf einer relativen Änderung der Position zwischen dem länglichen Schaft (20) und dem länglichen röhrenförmigen Zylinder (24) entspricht, um ein distales Ende des Schafts (20), das den Nahtlader aufweist, freizulegen.
9. Chirurgische Vorrichtung gemäß Anspruch 8, wobei der Druck nach innen durch kooperierende Rampen, die mit dem ersten Aktor (16) gekoppelt sind, in eine Längsbewegung übersetzt wird.
10. Chirurgische Vorrichtung gemäß Anspruch 1, wobei der zweite Aktor (18) einen Hebel beinhaltet, sodass eine Bewegung eines Endes des Hebels einer distalen Bewegung des länglichen röhrenförmigen Schneiders (22) entspricht.
11. Chirurgische Vorrichtung gemäß Anspruch 1, wobei ein proximales Ende des länglichen Schafts (20) durch den ersten Aktor (16) mit dem länglichen röhrenförmigen Zylinder (24) gekoppelt ist und mit Bezug auf diese bewegbar ist und ein proximales Ende des länglichen röhrenförmigen Schneiders (22) durch den zweiten Aktor (18) mit dem länglichen röhrenförmigen Zylinder (24) gekoppelt ist und mit Bezug auf diesen bewegbar ist.
12. Chirurgische Vorrichtung gemäß Anspruch 1, wobei ein proximales Ende des länglichen röhrenförmigen Zylinders (24) durch den ersten Aktor (16) mit dem länglichen Schaft (20) gekoppelt ist und mit Bezug auf diesen bewegbar ist und ein proximales Ende des länglichen röhrenförmigen Schneiders (22) durch den zweiten Aktor (18) mit dem länglichen Schaft (2) gekoppelt ist und mit Bezug auf diesen bewegbar ist.

Revendications

1. Un dispositif chirurgical destiné à découper un matériau formant fil de suture comprenant une tige (20) allongée, un élément de coupe (22) tubulaire allongé disposé par-dessus la tige (20) allongée, l'élément

de coupe (22) tubulaire allongé ayant un bord coupant circonférentiel, un cylindre (24) tubulaire allongé disposé par-dessus l'élément de coupe (22) tubulaire allongé, le cylindre (24) tubulaire allongé ayant une extrémité proximale et une extrémité distale, un élément de chargement de fil de suture formé au niveau d'une extrémité distale de la tige allongée configuré pour entrer en prise avec le matériau formant fil de suture (48), un premier actionneur (16) configuré pour provoquer un mouvement translationnel distal relatif de la tige (20) allongée par rapport au cylindre (24) tubulaire allongé et un deuxième actionneur (18) configuré pour provoquer un mouvement translationnel relatif entre l'élément de coupe (22) tubulaire allongé et à la fois le cylindre (24) tubulaire allongé et la tige (20) allongée, dans lequel le premier actionneur (16) comprend un élément coulissant configuré pour se déplacer depuis une position verrouillée, longitudinalement le long d'une étendue de progression dans une direction distale après qu'il soit sorti de prise d'avec un organe de verrouillage par le mouvement de l'organe de verrouillage dans une direction perpendiculaire à la direction distale, et pour se déplacer longitudinalement le long de l'étendue de progression dans une direction proximale pour son retour à la position verrouillée, le premier actionneur (16) étant en outre configuré de telle sorte :

- i) que le mouvement de l'élément coulissant dans la direction distale jusqu'à une extrémité distale de l'étendue de progression provoque le déplacement de la tige (20) allongée depuis une position proximale jusqu'à une position distale de telle sorte que l'élément de chargement de fil de suture est exposé au-delà de l'extrémité distale du cylindre (24) tubulaire allongé afin d'ouvrir l'élément de chargement de fil de suture pour le chargement d'un fil de suture, et
- ii) que le mouvement de l'élément coulissant dans la direction proximale jusqu'à une extrémité proximale de l'étendue de progression jusqu'à ce qu'il entre en prise avec l'organe de verrouillage provoque le retour de la tige (20) allongée depuis la position distale jusqu'à la position proximale afin de fermer l'élément de chargement de fil de suture et de maintenir solidement en place le fil de suture à l'intérieur de l'élément de chargement de fil de suture pour qu'il soit coupé par l'élément de coupe (22) tubulaire allongé,

l'extrémité proximale de la tige (20) allongée étant couplée au premier actionneur (16) par un élément de liaison (30) et étant sollicitée dans la direction proximale par un organe formant ressort (26).

2. Le dispositif chirurgical de la revendication 1, dans

lequel l'élément de chargement de fil de suture comprend une tête (40) au niveau de l'extrémité distale de la tige (20) allongée et une rainure (42) longitudinale formée dans la tête (40) et dimensionnée pour recevoir le matériau formant fil de suture (48).

3. Le dispositif chirurgical de la revendication 2, dans lequel l'élément de chargement de fil de suture comprend en outre un espace vide (44) dans la tige (20) allongée proximal à la tête.
4. Le dispositif chirurgical de la revendication 3, dans lequel l'élément de chargement de fil de suture comprend en outre un crochet s'étendant jusque dans l'espace vide et aligné avec un bord de la rainure.
5. Le dispositif chirurgical de la revendication 1, comprenant en outre une ouverture au niveau de l'extrémité distale du cylindre (24) tubulaire allongé qui est configurée pour permettre au matériau formant fil de suture (48) de s'étendre depuis l'élément de chargement de fil de suture lorsque la tige (20) allongée et le cylindre (24) tubulaire allongé sont dans une position fermée dans laquelle la tige (20) allongée est dans une position proximale par rapport au cylindre (24) tubulaire allongé.
6. Le dispositif chirurgical de la revendication 1, dans lequel l'élément de coupe (22) entre en contact avec un épaulement (54) sur une surface proximale d'une tête (40) d'une portion distale de la tige (20) allongée lorsque l'élément de coupe (22) tubulaire allongé est déplacé distalement par rapport à la tige (20) allongée.
7. Le dispositif chirurgical de la revendication 1, dans lequel une portion distale de la tige (20) allongée a une surface d'avancée de noeud.
8. Le dispositif chirurgical de la revendication 1, dans lequel le premier actionneur (16) comprend un bouton pouvant être enfoncé de telle sorte qu'une pression vers l'intérieur sur le bouton correspond à un changement relatif de position entre la tige (20) allongée et le cylindre (24) tubulaire allongé afin d'exposer une extrémité distale de la tige (20) ayant l'élément de chargement de fil de suture.
9. Le dispositif chirurgical de la revendication 8, dans lequel la pression vers l'intérieur est translatée en un mouvement longitudinal par des rampes coopératives couplées au premier actionneur (16).
10. Le dispositif chirurgical de la revendication 1, dans lequel le deuxième actionneur (18) comprend un levier de telle sorte que le mouvement d'une extrémité du levier correspond à un mouvement distal de l'élément de coupe (22) tubulaire allongé.

11. Le dispositif chirurgical de la revendication 1, dans lequel une extrémité proximale de la tige (20) allongée est couplée au cylindre (24) tubulaire allongé et est déplaçable par rapport à celui-ci par le premier actionneur (16) et une extrémité proximale de l'élément de coupe (22) tubulaire allongé est couplée au cylindre (24) tubulaire allongé et est déplaçable par rapport à celui-ci par le deuxième actionneur (18). 5
12. Le dispositif chirurgical de la revendication 1, dans lequel une extrémité proximale du cylindre (24) tubulaire allongé est couplée à la tige (20) allongée et est déplaçable par rapport à celle-ci par le premier actionneur (16) et une extrémité proximale de l'élément de coupe (22) tubulaire allongé est couplée à la tige (20) allongée et est déplaçable par rapport à celle-ci par le deuxième actionneur (18). 10 15

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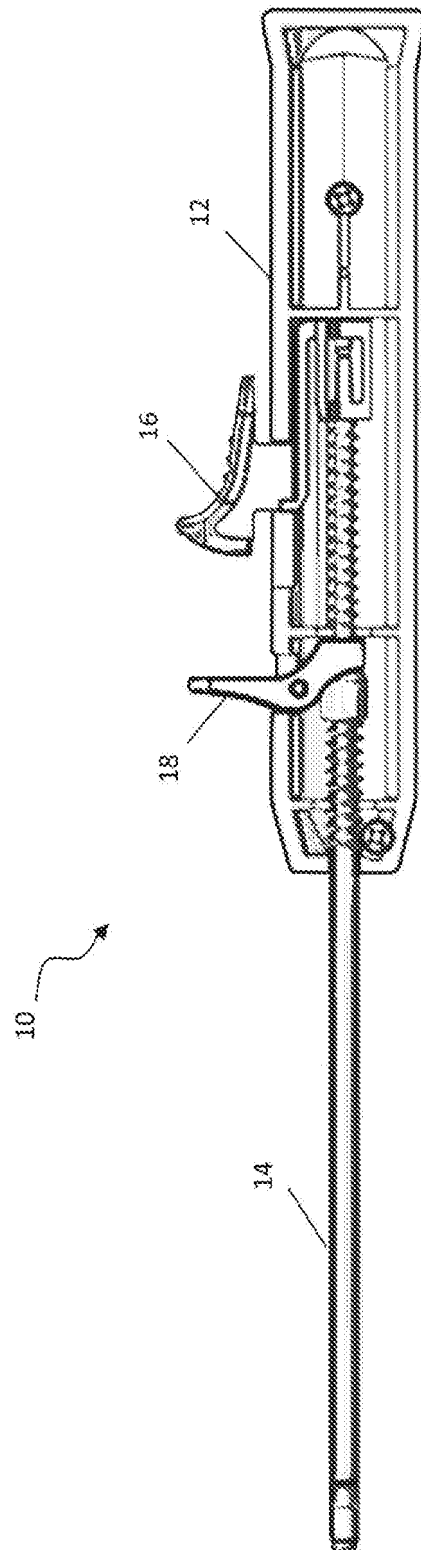


FIG. 1

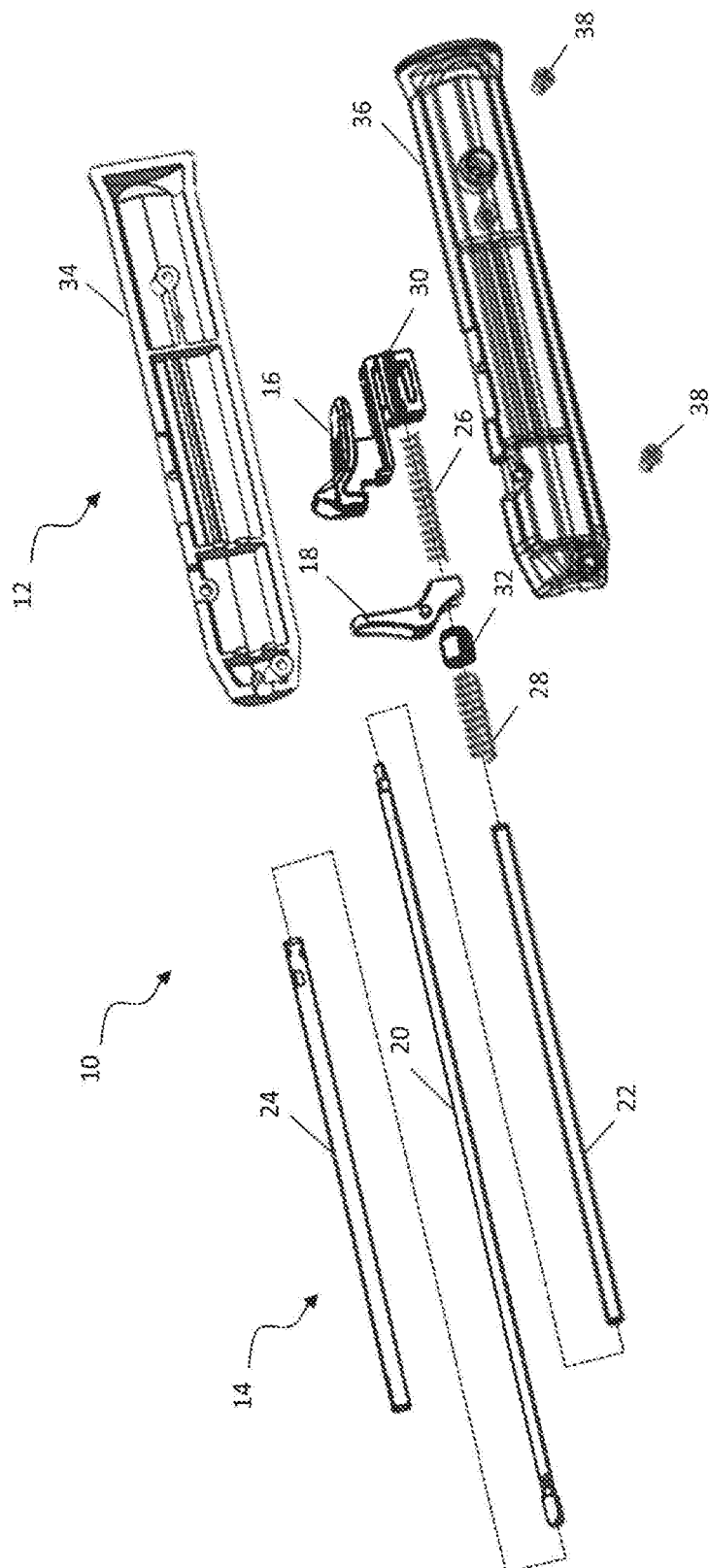


FIG. 2

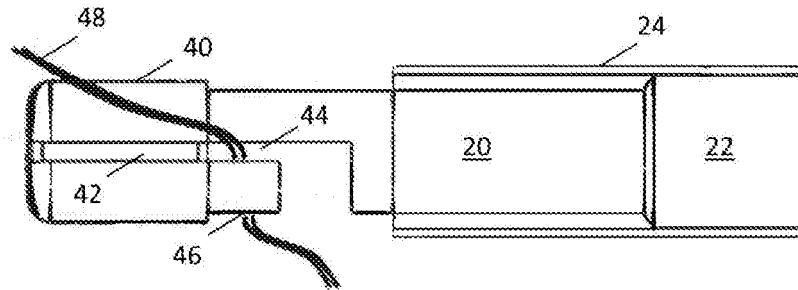


FIG. 3

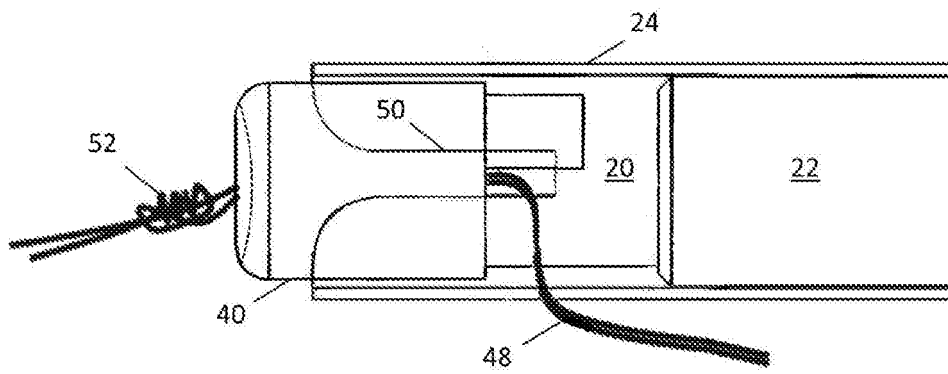


FIG. 4

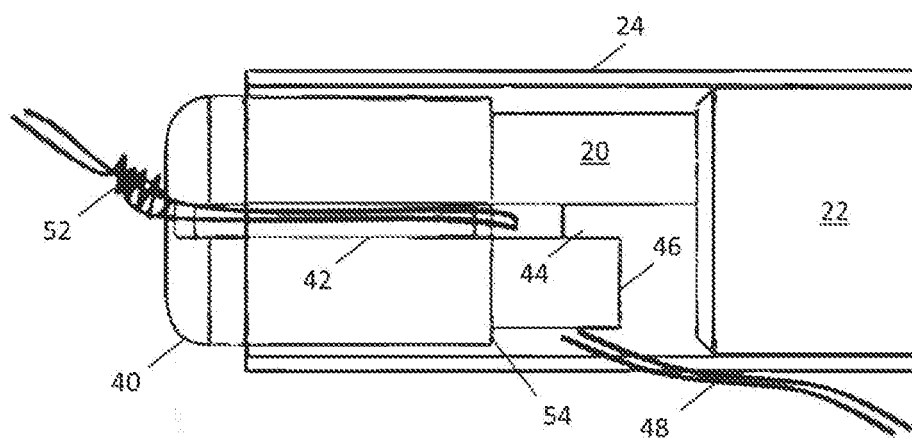


FIG. 5

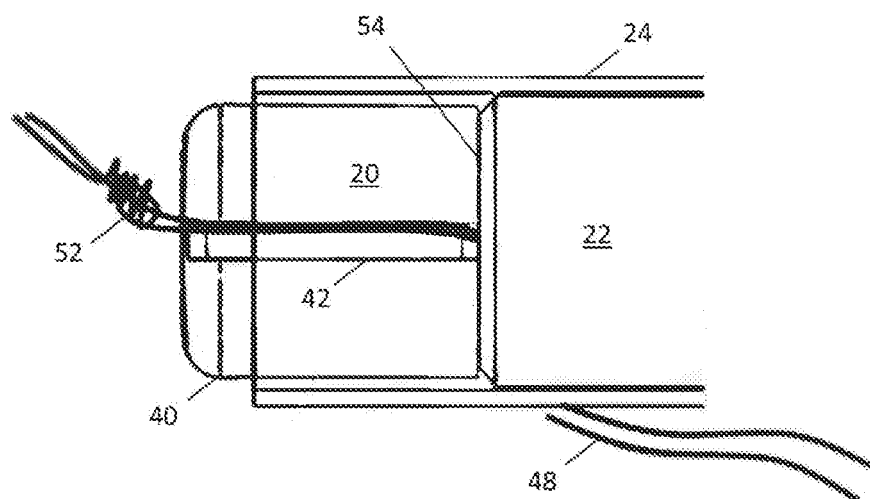


FIG. 6

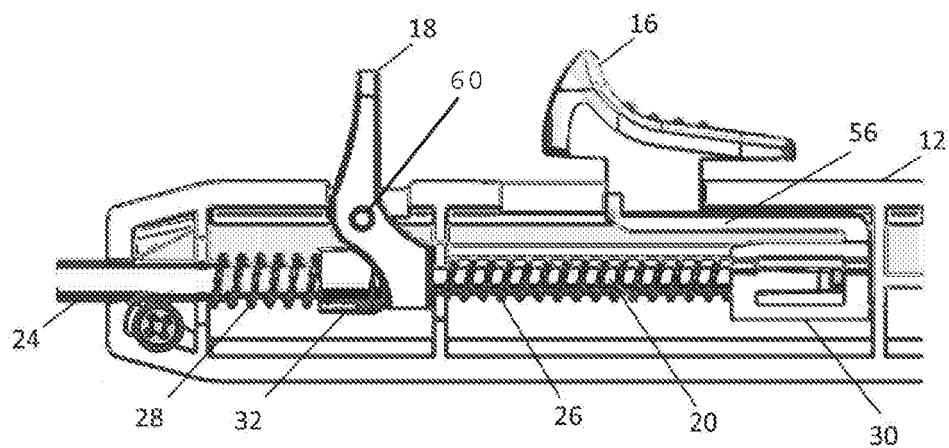


FIG. 7

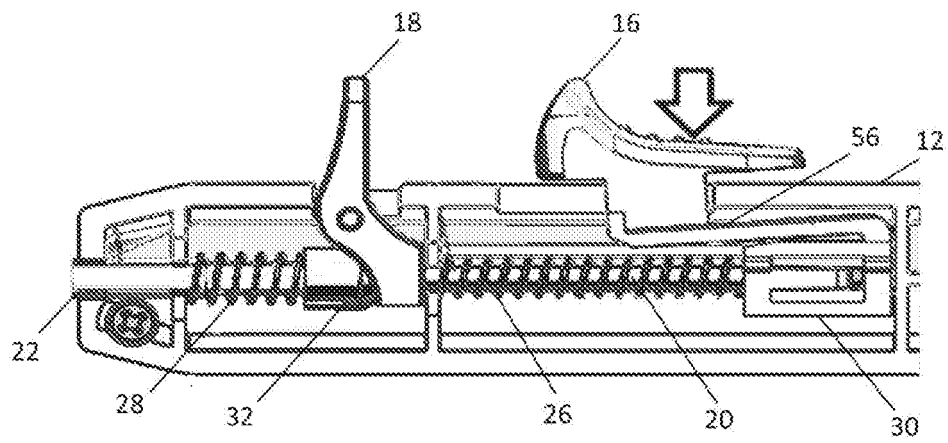


FIG. 8

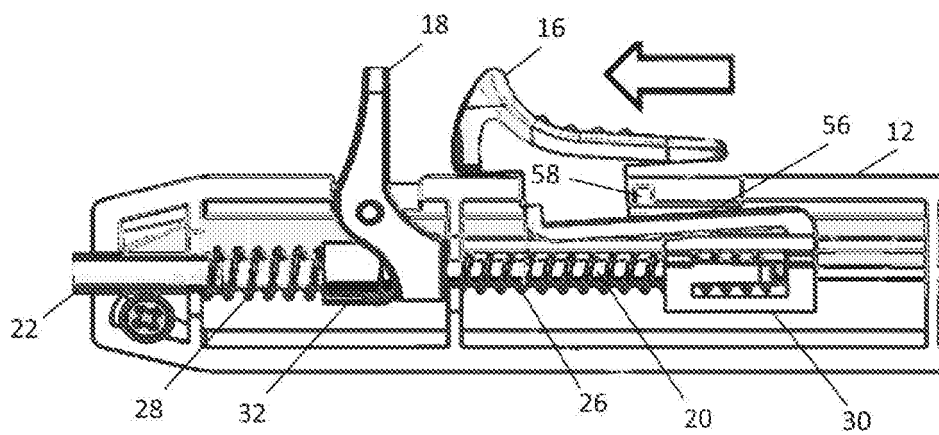


FIG. 9

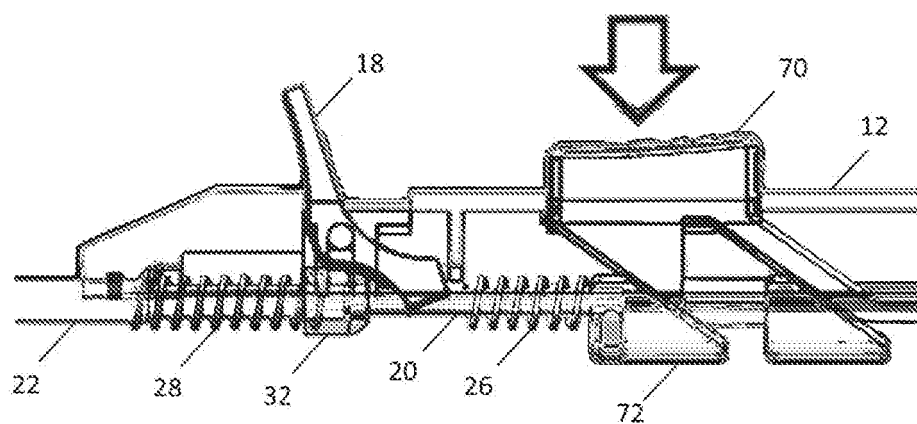


FIG. 10

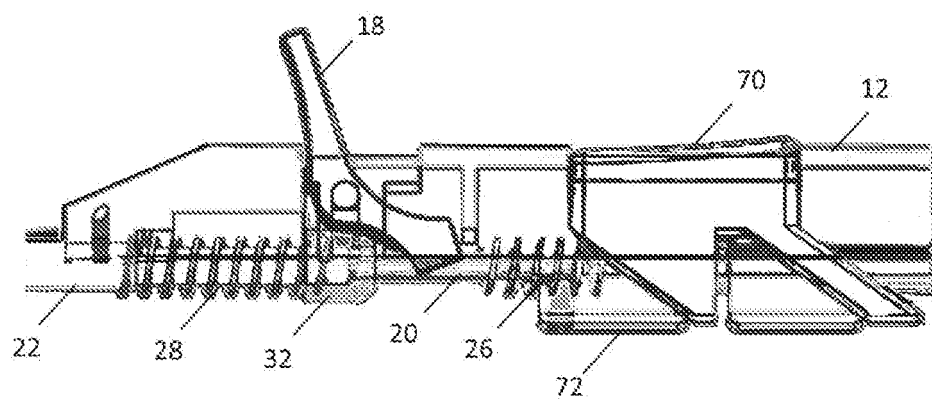


FIG. 11

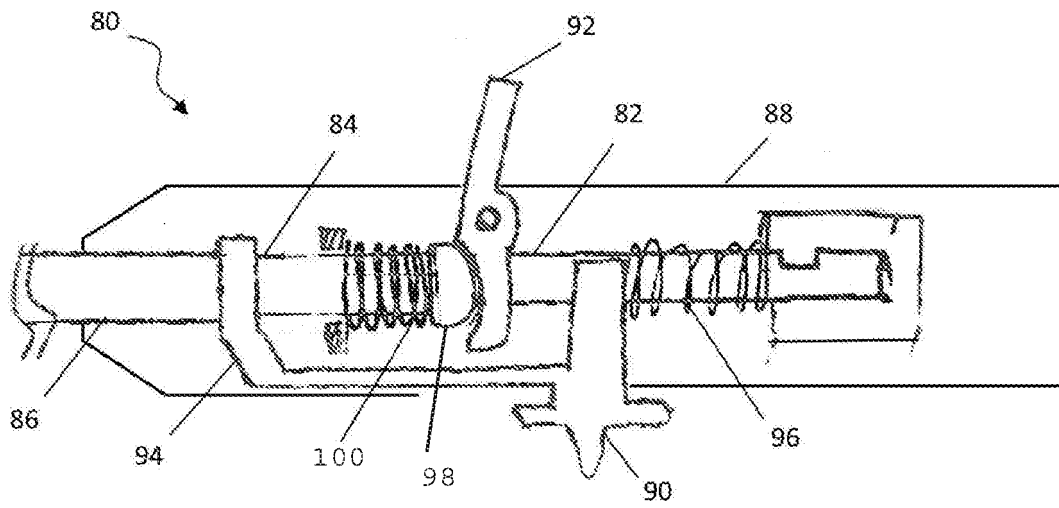


FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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