ELECTRONIC COMPARISON OF WRITTEN DESCRIPTION OF
SWAYZE (US 2005/0178813; ORIGINAL) TO
SHELTON II (US 2006/0175375; UNDERLINE/STRIKETHROUGH)

Description

CROSS REFERENCE TO RELATED APPLICATIONS

~~The present application is a continuation in part of U.S. pat. appln Ser. No. 10/673,930 entitled "SURGICAL STAPLING INSTRUMENT INCORPORATING A FIRING MECHANISM HAVING A LINKED RACK TRANSMISSION", to Jeffrey S. Swayze, Frederick E. Shelton IV, filed 29 Sep. 2003, the disclosure of which is hereby incorporated by reference in its entirety.~~

The present application is related to commonly-owned U.S. ~~Pat. Appln.~~patent application Ser. No. _____ filed on even date herewith, entitled "SURGICAL STAPLING INSTRUMENT INCORPORATING A MULTI-STROKE FIRING MECHANISM WITH ~~RETURN SPRING ROTARY MANUAL~~AUTOMATIC END OF FIRING TRAVEL RETRACTION ~~SYSTEM~~", to ~~F.~~Kevin Ross Doll, Jeffrey S. Swayze, Frederick E. Shelton~~, K. Doll, D. Hoffinan, M.~~ IV, Douglas B. Hoffman, and Michael Earl Setser~~, and J. Swayze~~, the disclosure of which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates in general to surgical stapler instruments that are capable of applying lines of staples to tissue while cutting the tissue between those staple lines and, more particularly, to improvements relating to stapler instruments and improvements in processes for forming various components of such stapler instruments that accomplish firing with multiple strokes of a trigger.

BACKGROUND OF THE INVENTION

Endoscopic surgical instruments are often preferred over traditional open surgical devices since a smaller incision tends to reduce the post-operative recovery time and complications. Consequently, significant development has gone into a range of endoscopic surgical instruments that are suitable for precise placement of a distal end effector at a desired surgical site through a cannula of a trocar. These distal end effectors engage the tissue in a number of ways to achieve a diagnostic or therapeutic effect (e.g., endocutter, grasper, cutter, staplers, clip applier, access device, drug/gene therapy delivery device, and energy device using ultrasound, RF, laser, etc.).

Known surgical staplers include an end effector that simultaneously makes a longitudinal incision in tissue and applies lines of staples on opposing sides of the incision. The end effector includes a pair of cooperating jaw members that, if the instrument is intended for endoscopic or laparoscopic applications, are capable of passing through a cannula passageway. One of the jaw members receives a staple cartridge having at least two laterally spaced rows of staples. The other jaw member defines an anvil having staple-forming pockets aligned with the rows of staples in the cartridge. The instrument includes a plurality of reciprocating wedges which, when driven distally, pass through openings in the staple cartridge and engage drivers supporting the staples to effect the firing of the staples toward the anvil.

An example of a surgical stapler suitable for endoscopic applications is described in U.S. Pat. No. 5,465,895, which advantageously provides distinct closing and firing actions. Thereby, a clinician is able to close the jaw members upon tissue to position the tissue prior to firing. Once the clinician has determined that the jaw members are properly gripping tissue, the clinician can then fire the surgical stapler with a single firing stroke, thereby severing and stapling the tissue. The simultaneous severing and stapling avoids complications that may arise when performing such actions sequentially with different surgical tools that respectively only sever or staple.

One specific advantage of being able to close upon tissue before firing is that the clinician is able to verify via an endoscope that ~~the~~a desired location for the cut has been achieved, including ~~that~~ a sufficient amount of tissue has been captured between opposing jaws. Otherwise, opposing jaws may be drawn too close together, especially pinching at their distal ends, and thus not effectively forming closed staples in the severed tissue. At the other extreme, an excessive amount of clamped tissue may cause binding and an incomplete firing.

Generally, a single closing stroke followed by a single firing stroke is a convenient and efficient way to perform severing and stapling. However, in some instances, it would be desirable for multiple firing strokes to be required. For example, surgeons are able to select ~~a~~from a range of jaw sizes with a corresponding length of staple cartridge for the desired length of cut ~~from a range of jaw sizes~~. Longer staple cartridges require a longer firing stroke. Thus, to effect the firing, a hand-squeezed trigger is required to exert a larger force for these longer staple cartridges in order to sever more tissue and drive more staples as compared to a shorter staple cartridge. It would be desirable for the amount of force to be lower ~~and comparable to shorter cartridges~~ so as not to exceed the hand strength of some surgeons. In addition, some surgeons, not familiar with the larger staple cartridges, may become concerned that binding or other malfunction has occurred when an unexpectedly higher force is required.

One approach for lowering the required force for a firing stroke is a ratcheting mechanism that allows a firing trigger to be stroked multiple times, as described in U.S. Pat. Nos. 5,762,256 and 6,330,965. These known surgical stapling instruments with multiple-stroke firing mechanisms do not have the advantages of a separate closure and firing action. Moreover, the ratcheting mechanism relies upon a toothed rack and driving pawl to achieve the ratcheting motion, with the length of a handle encompassing these components thus increased to accommodate the toothed rack. This increased length is inconvenient~~,~~ given the close confines and increasing amount of equipment associated with a surgical procedure.

While these multiple firing ~~strokes~~stroke mechanisms would have advantages, some features of a single firing stroke mechanism have advantages as well. For instance, a single-stroke firing trigger may be directly coupled to the firing mechanism even during release of the firing trigger. Thus, any spring bias on the single-stroke firing trigger assists in retracting the knife from the end effector. If binding occurs, the surgeon may urge the firing trigger outward to effect retraction since the firing trigger is directly coupled to the firing mechanism.

By contrast, the multiple-stroke firing trigger is uncoupled from the firing mechanism during return strokes. While a retraction bias force is advantageously incorporated to retract the knife from the staple applying assembly, this retraction force thus needs to be prevented from performing retraction of the knife before full firing travel is achieved. Thus, the retraction force is desirably moderated so as to not increase the manual loads felt at the firing trigger. In addition, the retraction force is moderated as well so as to not over power an anti-backup mechanism.

However, instances occur when assistance is required to retract the firing mechanism. Otherwise, it may be difficult to release the end effector from clamped tissue to complete the surgical procedure. For instance, tissue may cause binding in the instrument. As another example, a malfunction may occur that increases binding within the instrument or otherwise reduces the retraction force. With the multiple stroke firing trigger uncoupled during return strokes, another way to effect retraction of the firing mechanism is desirable. As another example, firing may have commenced partially, but the surgeon decides that firing must be stopped and the end effector opened. This may occur if an expended staple cartridge was in the end effector and partial firing occurred until the instrument locked out further firing.

Consequently, a significant need exists for a surgical stapling instrument having a multiple stroke firing mechanism ~~that~~with automatically ~~retracts~~retraction after full firing travel ~~yet does not inadvertently retract between firing strokes~~.

BRIEF SUMMARY OF THE INVENTION

The invention overcomes the above-noted and other deficiencies of the prior art by providing a surgical stapling and severing instrument that ~~advantageously incorporates a multiple firing stroke handle that actuates a long end effector without undue manual force required by a surgeon. A firing member that transfers the firing force to the end effector is proximally biased to assist in retraction. To avoid retraction between firing strokes, an anti-backup mechanism binds the firing member when released by a firing mechanism. An anti-backup release mechanism consistent with aspects of the invention responds to full firing travel of the firing member by disabling the anti-backup release mechanism so that the firing member will retract~~includes an end effector responsive to a longitudinal firing motion to perform a surgical operation. This end effector is positioned through a body opening (e.g., cannula of a trocar) by externally manipulating a handle that is attached to the end effector via a shaft. The handle produces a firing motion that is imparted by a firing mechanism through a rack to a firing member that is slidingly received in the shaft. A gear mechanism rotates with the rack to run a retraction member that is externally visible on the handle. Thereby, the user is able to manually assist in retracting the firing mechanism.

In one aspect of the invention, a handle of the surgical instrument has ~~an end effector that includes jaws of an elongate channel and~~ a ~~pivotally attached anvil that hold a staple cartridge and clamp tissue. The firing member causes stapling and severing of clamped tissue. A~~ firing mechanism ~~selectively engages a pawl into engagement with the firing member~~ that is responsive to ~~distally move the firing member in a series~~a plurality of firing strokes ~~of~~from a

firing trigger~~. Automatically~~ causing the rack and thus the firing member to advance down the shaft. A retraction ~~is facilitated by an anti-backup release lever tipping to the perpendicular a locking plate of~~spring biases the firing member proximally away from the shaft to assist in retraction. To prevent inadvertent retraction between firing strokes, an anti-backup mechanism ~~that is biased to a nonperpendicular binding state against~~binds the firing member~~. The anti-backup release lever is cammed into this position~~ in response to ~~the~~a proximal movement thereof. After firing ~~member approaching full firing travel.~~, an anti-backup release mechanism disengages the anti-backup mechanism for retraction. Advantageously, a manual retraction mechanism has a transmission gear coupled by a one-way clutch to an externally accessible actuator. Thus, assistance may be given when the automatic retraction is incapable of retraction. This avoids situations where the end effector may otherwise remain in a closed and clamped condition onto stapled and severed tissue.

These and other objects and advantages of the present invention shall be made apparent from the accompanying drawings and the description thereof.

~~BRIEF~~ DESCRIPTION OF THE FIGURES

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and, together with the general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the present invention.

FIG. 1 is a right side elevation view of a surgical stapling and severing instrument (traction biased pawl) in an open (start) condition, with a shaft partially cut away to expose a closure tube and firing rod.

FIG. 2 is a left side elevation view taken along line 2-2 in the longitudinal cross section of an end effector at a distal portion of the surgical stapling instrument of FIG. 1.

FIG. 3 is a front perspective view of the end effector of FIG. 2.

FIG. 4 is a perspective, exploded view of an implement portion of the surgical stapling and severing instrument of FIG. 1.

FIG. 5 depicts a left side elevation view in section of the end effector of FIG. 3 of the surgical instrument of FIG. 1, the section generally taken along lines 5-5 of FIG. 3 to expose portions of a staple cartridge but also depicting the firing bar along the longitudinal centerline.

FIG. 6 depicts a left side elevation view in section of the end effector of FIG. 5 after the firing bar has fully fired.

FIG. 7 is a left side elevation view of the handle of the surgical stapling and severing instrument of FIG. 1 with a left handle housing removed.

FIG. 8 is a perspective, exploded view of the handle of FIG. 7.

FIG. 9 is a perspective view from an elevated, aft, left vantage point of the linked transmission firing mechanism of the handle of FIG. 7.

FIG. 10 is a detail left side elevation view of the linked rack of the firing mechanism of FIG. 9.

FIGS. 11-14 are left side elevation views in cross section generally along the longitudinal axis of the ramped central track of the linked rack and the pawl of the firing mechanism, and additionally showing the firing trigger, biasing wheel and ramp of the traction biasing mechanism, depicting a sequence during a firing stroke.

FIG. 15 is a right-side elevation view partially disassembled to expose a distal portion of an anti-backup mechanism (lateral kick-out type) in a locked condition in the surgical stapling and severing instrument of FIG. 1.

FIG. 16 is a perspective view from a top, aft, right vantage point of the anti-backup mechanism of FIG. 15 with the anti-backup cam tube removed.

FIG. 17 is a right-side elevation view partially disassembled to expose a distal portion of an anti-backup mechanism in an unlocked condition in the surgical stapling and severing instrument of FIG. 1.

FIG. 18 is a right-side elevation view partially disassembled to expose a distal portion of an anti-backup mechanism in an unlocked condition in the surgical stapling and severing instrument of FIG. 1.

FIG. 19 is a rear elevation view of the surgical stapling and severing instrument of FIG. 1 with the right half shell of the handle housing removed to expose the anti-backup release lever in phantom in a locking condition and in an unlocked condition.

FIGS. 20-25 are detail views of the anti-backup release lever of FIG. 18 depicting respectively a firing sequence of unfired, one firing stroke, two firing strokes, three firing strokes, returning or release button pushed, and fully returned.

FIGS. 26-27 are perspective views from a top, left, distal vantage point of the surgical stapling and severing instrument with the right half shell of the handle housing removed to expose a closure release lockout mechanism, respectively in an initial position with ~~the~~ lockout removed and ~~the~~ closure release button depressed, and then a lockout being activated during initial firing.

FIG. 28 is perspective view of a surgical stapling and severing instrument in an open condition similar to FIG. 1 but incorporating a top-accessible retraction lever.

FIG. 29 is a left side elevation view of the surgical stapling and severing instrument of FIG. 28 with the left half shell of the handle housing removed to expose an intermittently toothed indicator gear presenting a first dwell area to the idler gear.

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