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(54) **SUTURE CLIP APPLIER**

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USPC **606/142**; 606/136; 606/143; 606/232

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See application file for complete search history.

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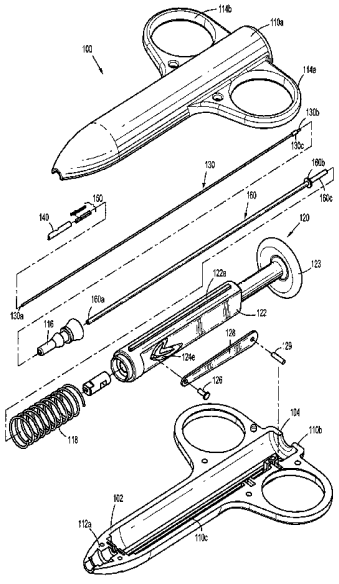
(57) **ABSTRACT**

Suture clip appliers, suture clips and methods of their use for securing sutures during an endoscopic or laparoscopic procedure are provided, wherein the method includes the steps of providing a suture clip applier having a working tip configured to retain and fire a suture clip; providing a suture clip having a biased closed configuration; loading the suture clip into the working tip of the clip applier; translating the suture clip distally relative to the working tip to a first position wherein the suture clip is splayed open; inserting a suture into the opened suture clip; and translating the suture clip distally relative to the working tip such that the suture clip is ejected from the working tip and biased to the closed configuration to close on and to retain the suture.

15 Claims, 9 Drawing Sheets



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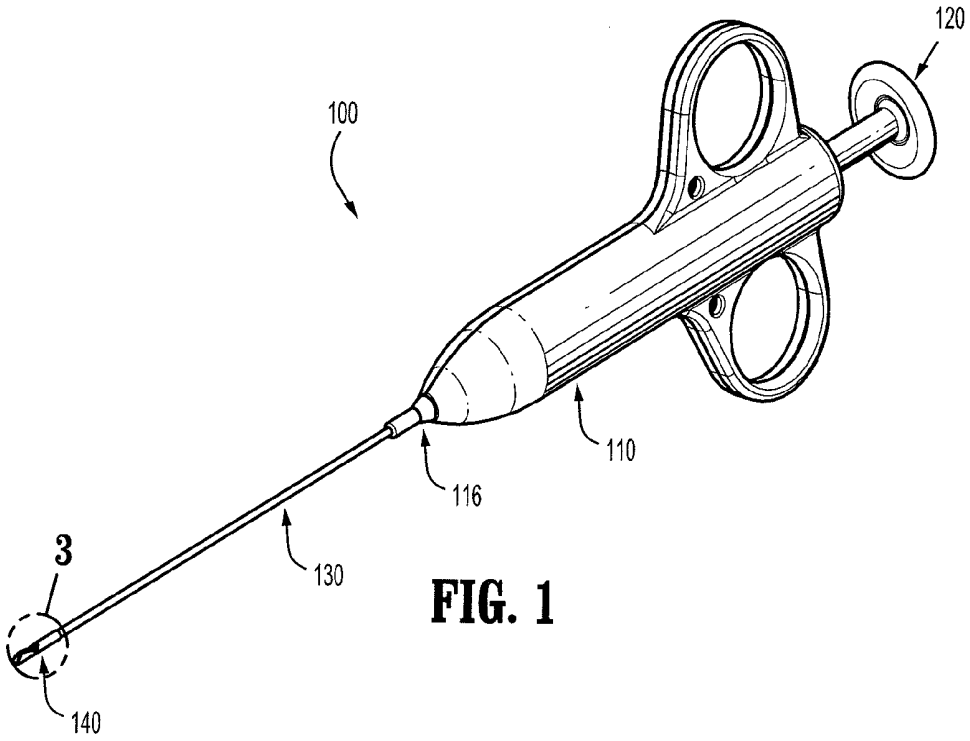
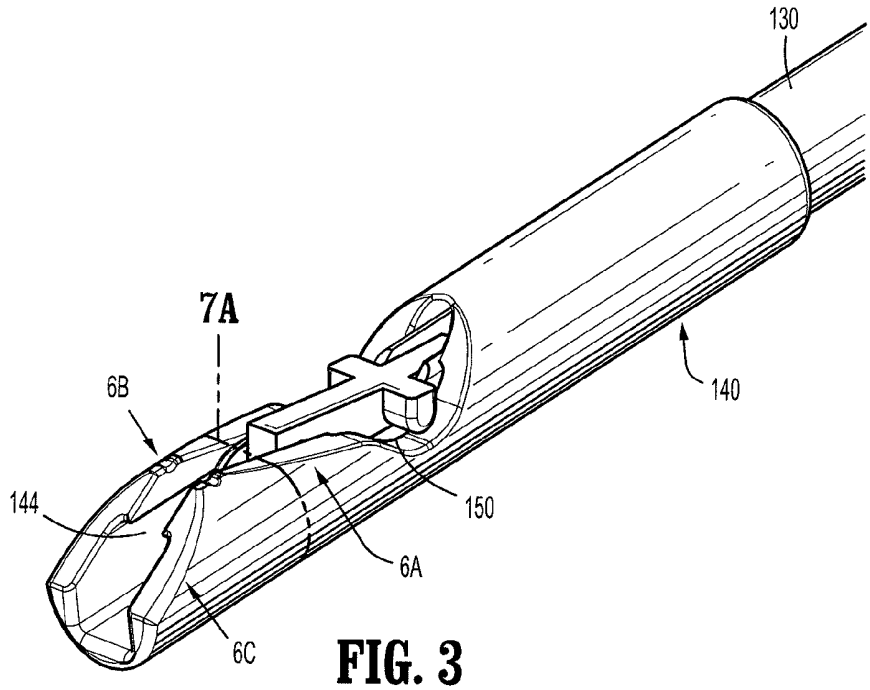


FIG. 1



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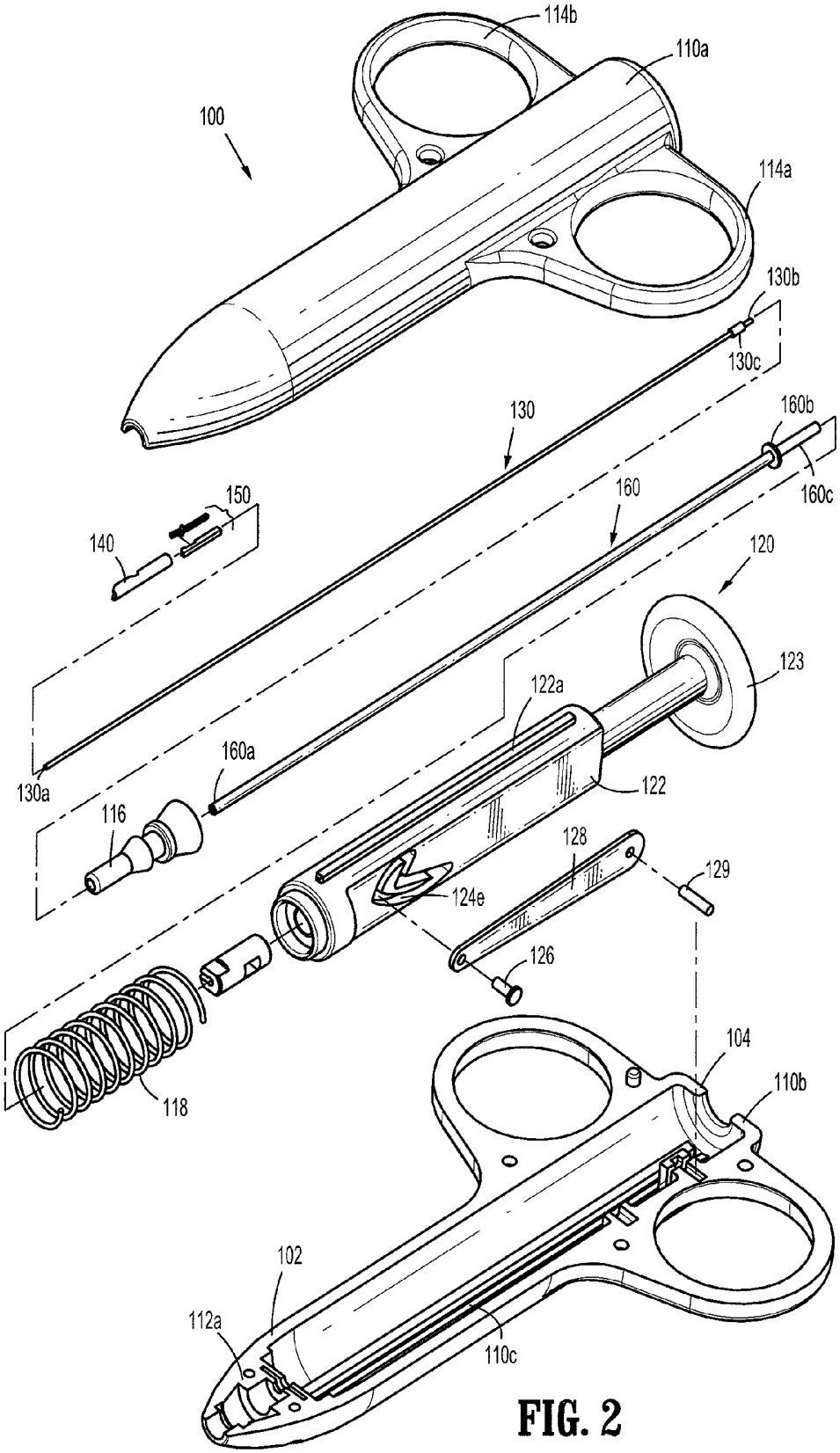
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112a
110c

FIG. 2

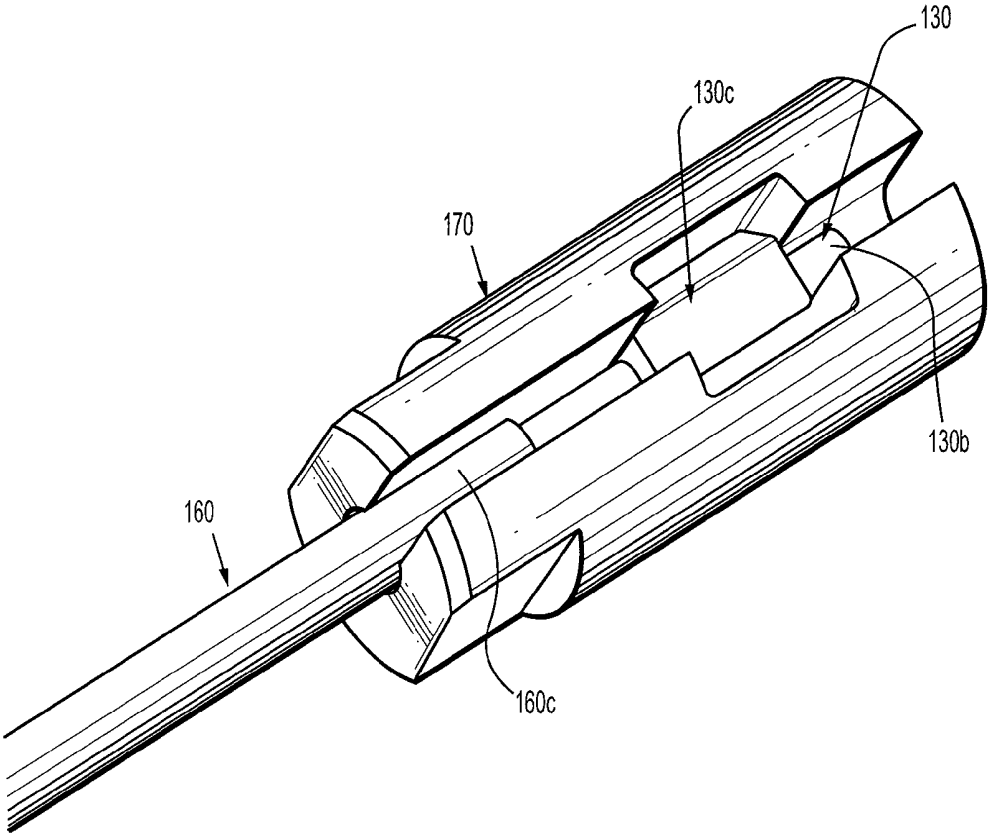
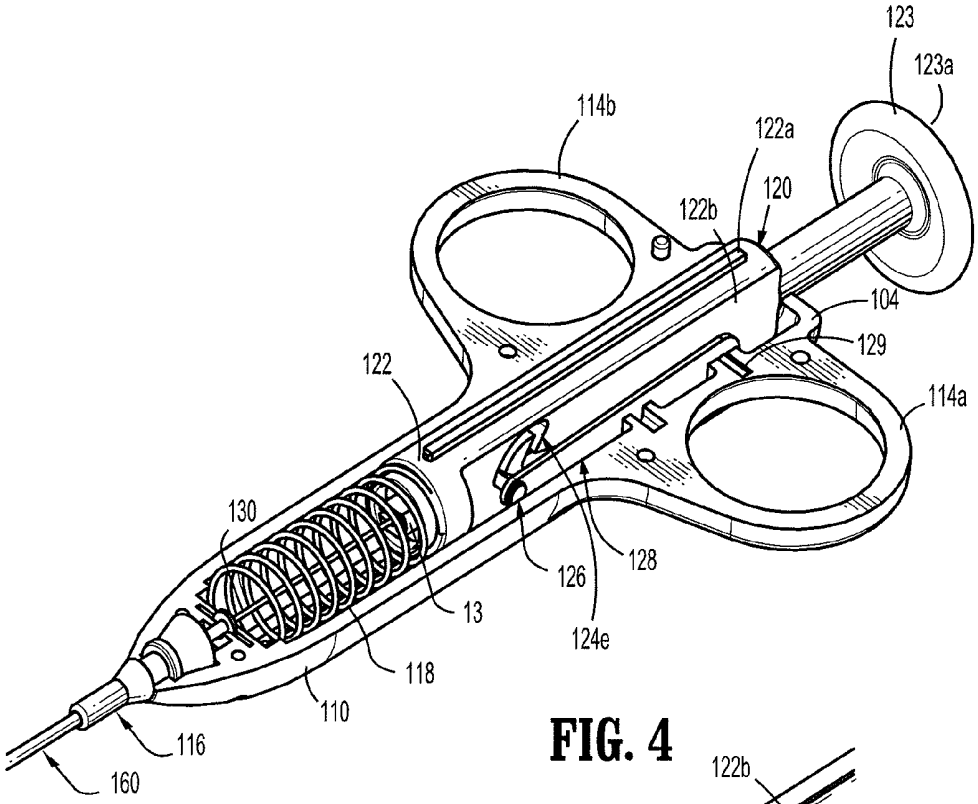


FIG. 2A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116
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FIG. 4

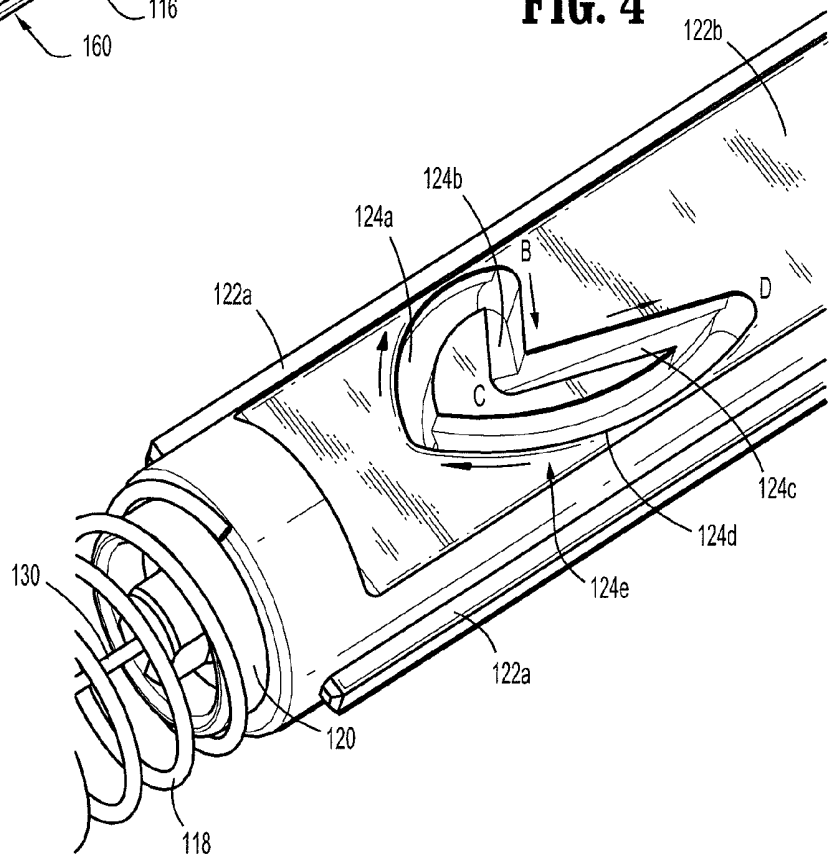
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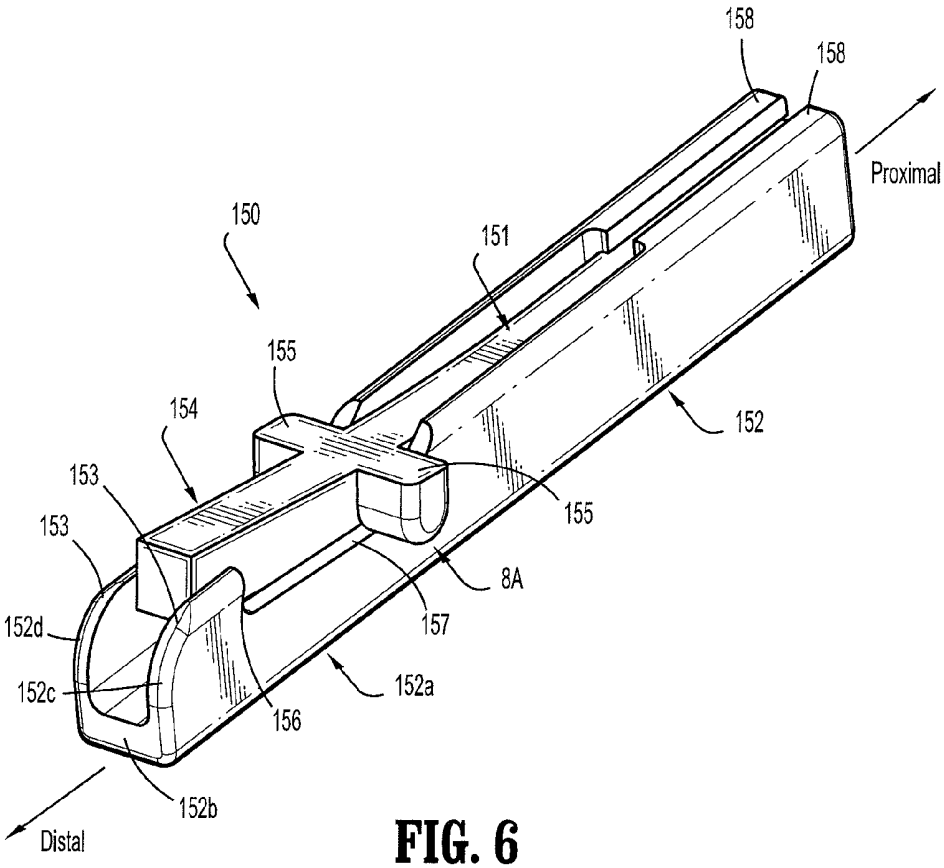
FIG. 5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152c
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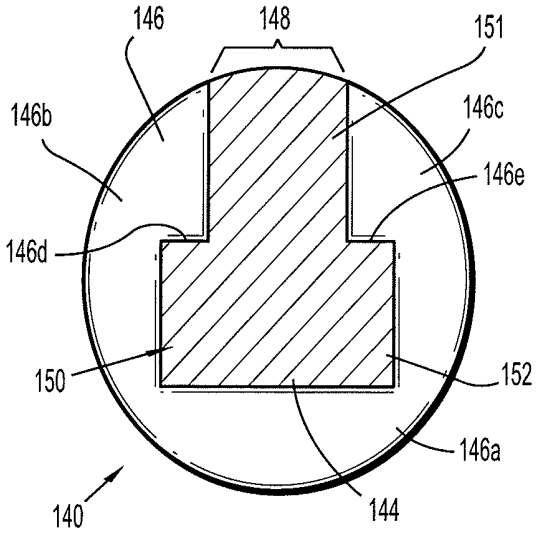
152b
Distal

FIG. 6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146c
146e
146d
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152
146a
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144

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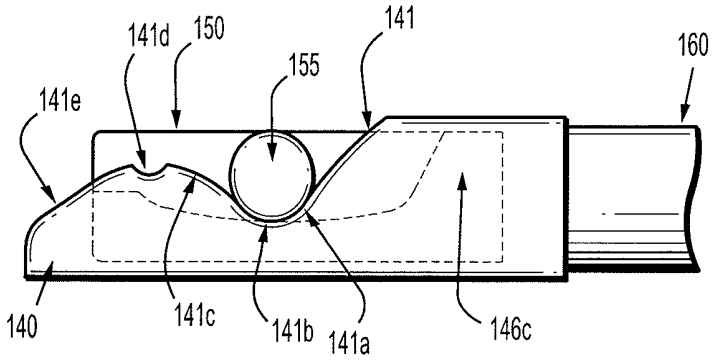
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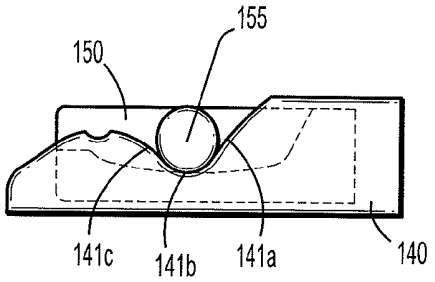

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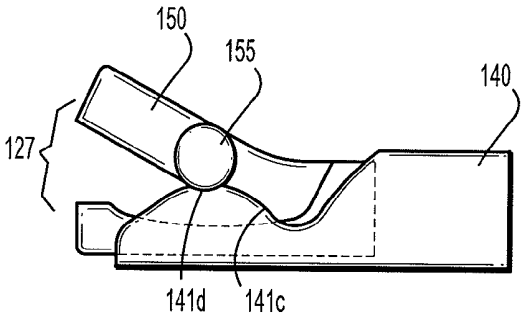

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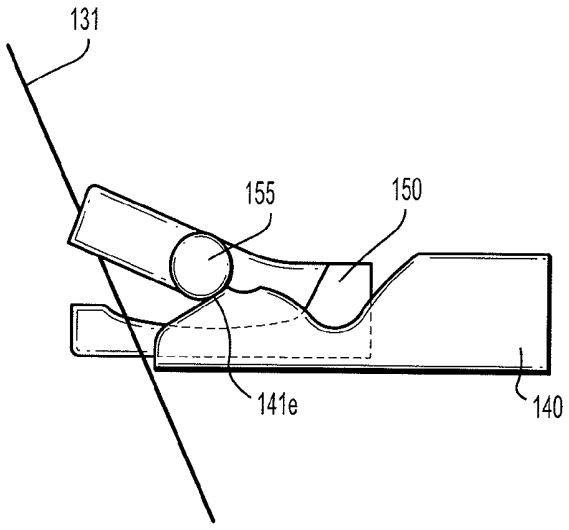


FIG. 8C

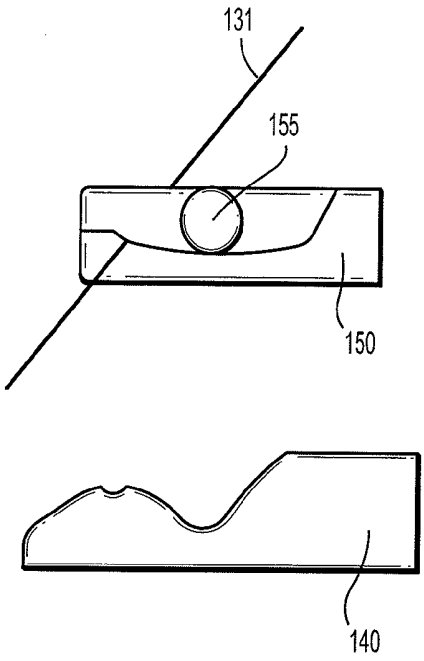


FIG. 8D

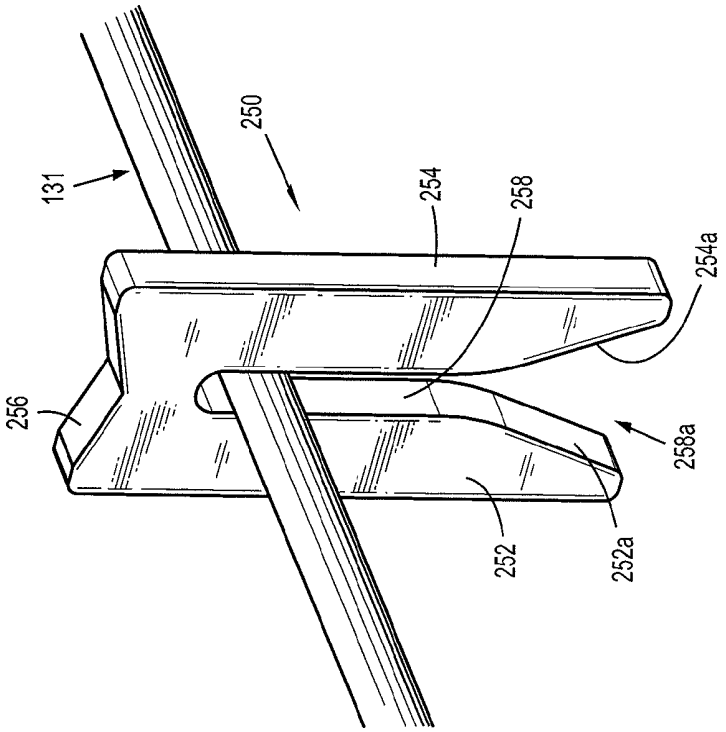


FIG. 11

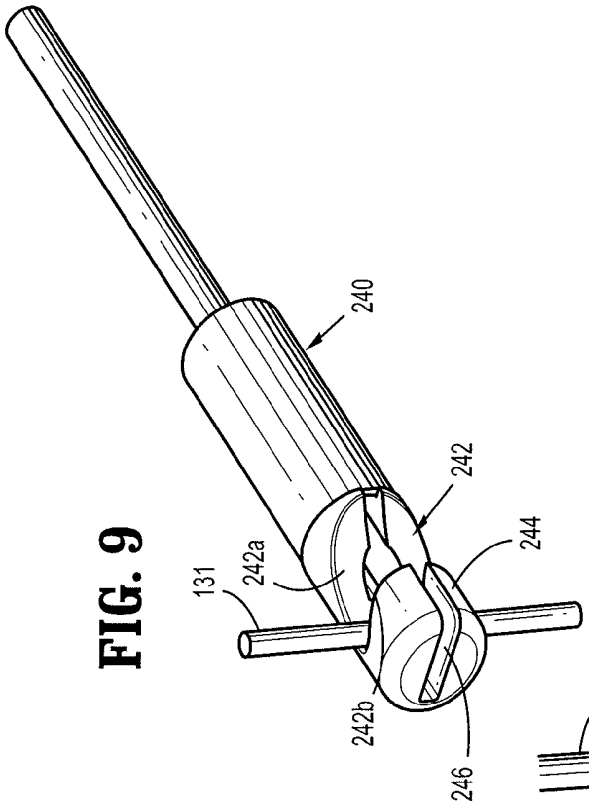


FIG. 9

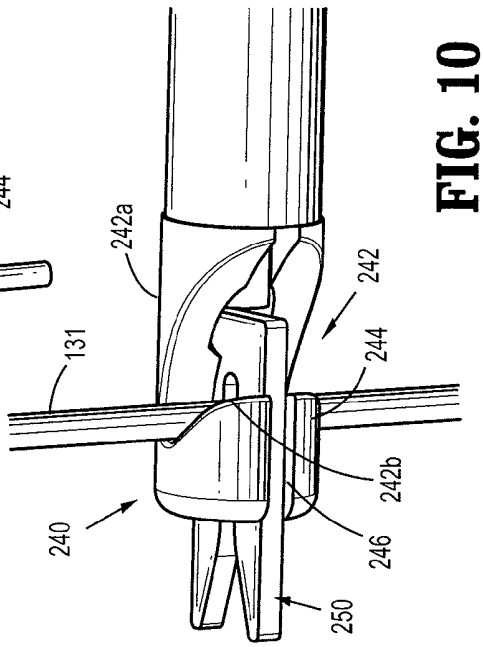


FIG. 10

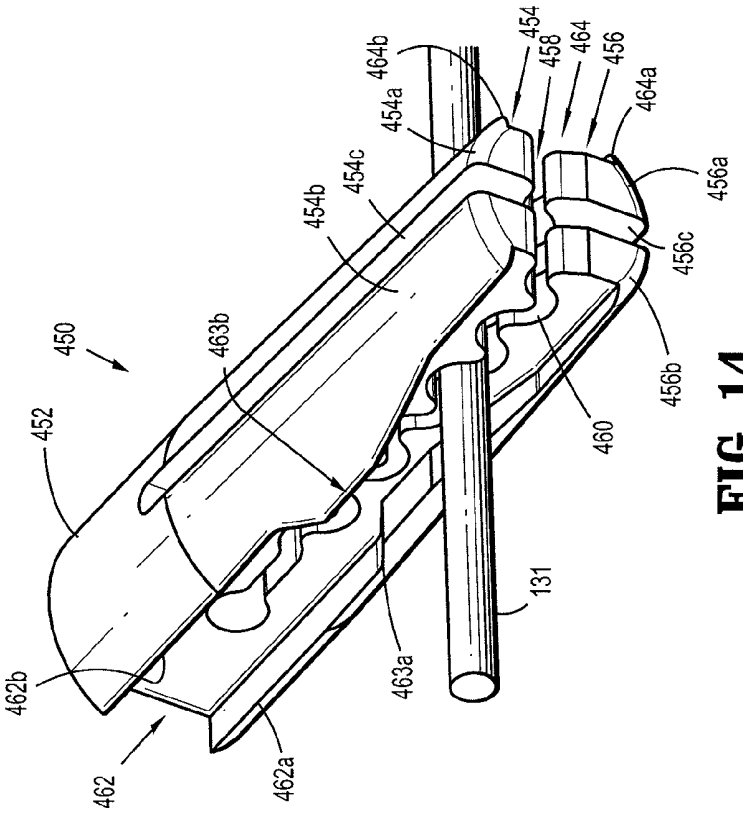
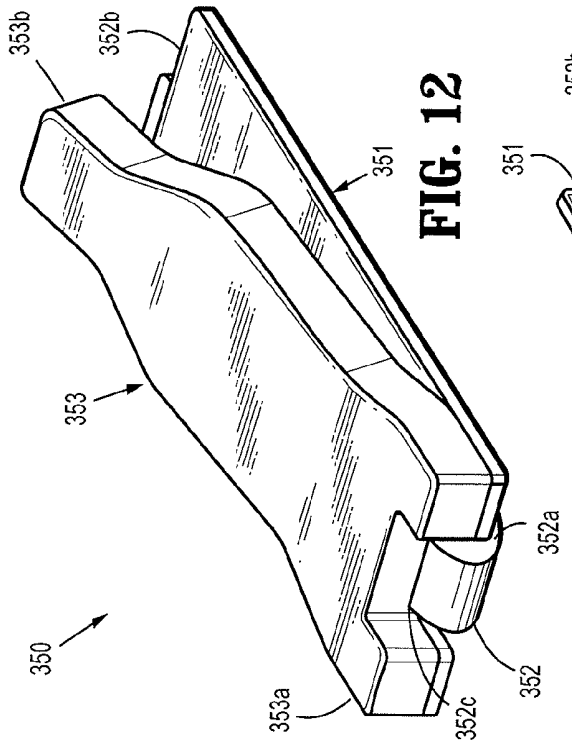


FIG. 14



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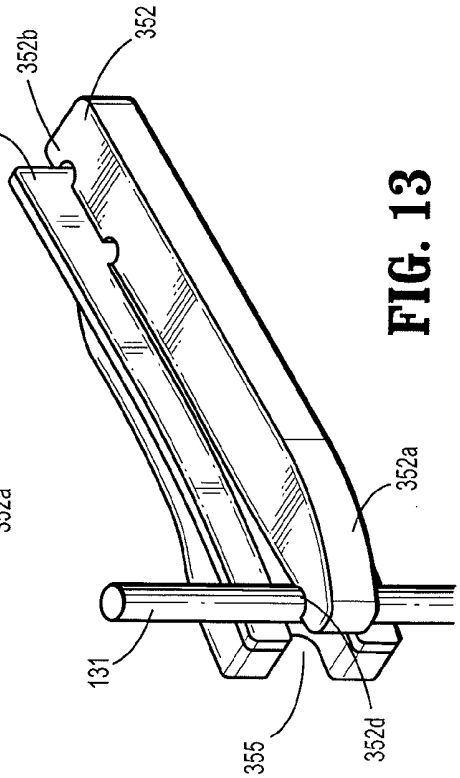

FIG. 13

SUTURE CLIP APPLIER

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of and priority to U.S. Provisional Application Ser. No. 61/250,894, filed on Oct. 13, 2009, the entire content of which is incorporated herein by reference.

BACKGROUND

1. Technical Field

The present disclosure relates to a device for use in a surgical procedure. More particularly, the present disclosure relates to a surgical suture clip applier adapted for securing sutures during an endoscopic or laparoscopic procedure.

2. Background of Related Art

In surgical operations it is well known that surgical sutures are applied to repair the body tissue. Such sutures generally are of the non-absorbable or the absorbable type and are generally applied with the use of surgical needles. If the sutures are non-absorbable, they may or may not be removed after an estimated predetermined healing period has passed. Absorbable sutures are absorbed gradually over time by coming in contact with moisture in the human body.

In many surgical procedures, application of sutures generally involves knotting or tying the suture after it is applied to the body tissue in order to retain its position with respect to the tissue and to maintain the tissue in the repaired position. In cases where the surgeon has full access to the operative site by virtue of a large incision, knotting the suture or applying knotting or equivalent devices is relatively simple due to the access provided by the incision.

In endoscopic and laparoscopic procedures, on the other hand, large incisions are avoided. In laparoscopic procedures surgery is performed in the interior of the abdomen through a small incision; in endoscopic procedures surgery is performed in any hollow viscus of the body through narrow endoscopic tubes inserted through small entrance wounds in the skin. Laparoscopic and endoscopic procedures generally require that any instrumentation inserted into the body be sealed, i.e., provisions must be made to ensure that gases do not enter or exit the body through the laparoscopic or endoscopic incision as, for example, in surgical procedures in which the surgical region is insufflated. Moreover, laparoscopic and endoscopic procedures often require the surgeon to act on organs, tissues, and vessels far removed from the incision, thereby requiring that instruments to be used in such procedures generally be both long and narrow.

In laparoscopic and endoscopic procedures surgical sutures are generally applied by directing and manipulating needled sutures through an aperture in the body or through elongated narrow tubes known as cannulae with the assistance of specially designed needle graspers, needle drivers, and the like. However, tying the sutures in such procedures can be relatively difficult due to the limited access afforded to the surgeon through the narrow tubes. In particular, since biocompatible, preferably bioabsorbable, sutures are generally used in such procedures it would be desirable to have available a cinching device and system that facilitates tying the sutures through the tubes in a manner to retain their position in the body tissue at least until the healing process is in full progress. The use of the term "endoscopic" herein contemplates endoscopic as well as laparoscopic procedures.

SUMMARY

The present disclosure relates to surgical suture clip appliers, suture clips and methods of their use for securing sutures during an endoscopic or laparoscopic procedure.

According to an aspect of the present disclosure, a suture clip applier is provided and includes a housing; an elongated plunger slidably supported in the housing, the plunger having a distal end portion disposed within the housing and a proximal end portion extending from a proximal end of the housing; a hollow tube extending distally from the housing and defining a lumen therethrough; an actuation member having a distal end extending into the hollow tube and a proximal end operatively engaged with the plunger; and a working tip coupled to a distal end of the hollow tube. The working tip has a substantially U-shaped transverse cross-sectional profile defining a channel having a base wall and a pair of spaced apart side walls. The working tip defines a lower contact surface along an internal face of the base wall, and an upper contact surface defined along an upper end surface of each side wall. The upper contact surface of each side wall includes a distal recess formed near a distal end of thereof and a proximal recess formed proximal of the distal recess; and an internal retaining surface on both side walls parallel to the base wall. In use, the distal end of the actuation member is configured to engage a suture clip loaded into the working tip.

The plunger may define a race formed in a surface thereof. The race may include a plurality of portions each defining a cam surface of varying depth. The clip applier may include a rocker arm having a distal end portion and proximal end portion. The rocker arm may have a follower pin extending therefrom near the distal end portion thereof and a retaining pin near the proximal end portion thereof. The rocker arm may be pivotally attached to the housing by the retaining pin and the follower pin may be slidably disposed within the race of the plunger to modulate the motion of the plunger and actuation member.

The race may define four interconnected cam portions, with each cam portion having a start position and an end position, and each cam is deepest at its respective start position and shallowest at its respective end position.

The rocker arm may be elastically deformable laterally from the plunger thereby providing a biasing force upon the follower pin and plunger relative to the body.

The clip applier may further include finger loops extending from the housing.

The actuation member may be configured to transmit axial translative forces to the suture clip.

The clip applier may further include a biasing member disposed within the housing and providing a proximal bias upon the plunger relative to the housing. The biasing member may be a coil spring.

The distal recess and the proximal recess, formed in each vertical side wall, may be interconnected by a camming surface.

According to another aspect of the present disclosure, a suture clip for selective attachment to a suture is provided and includes an elongated flexible beam having a distal end portion, a proximal end portion, a top surface and a bottom surface, the flexible beam further including a pair of arms extending laterally therefrom; and an elongated rigid channel, wherein the elongated rigid channel has a substantially U-shaped transverse cross-sectional profile with a horizontal base wall and vertical side walls having a distal end portion and proximal end portion, wherein each vertical side wall defines a holding step formed in an upper edge thereof. The flexible beam and the channel are coupled to one another at

their proximal end portions; and the pair of arms of the flexible beam are in registration with a corresponding holding step framed in the upper edge of the vertical side walls.

A proximal end portion of the pair of vertical side walls of the channel of the suture clip may include inwardly projecting lips for retaining the proximal end portion of the beam within the channel. The proximal end portions of the beam and channel may be adhesively coupled to one another.

The pair of arms of the flexible beam may project beyond the pair of vertical side walls of the channel.

According to a further aspect of the present disclosure, a suture clip applier system is provided and includes a suture clip applier for filing a suture clip onto a suture. The clip applier includes a housing; an elongated plunger slidably supported in the housing, the plunger having a distal end portion disposed within the housing and a proximal end portion extending from a proximal end of the housing; a hollow tube extending distally from the housing and defining a lumen therethrough; an actuation member having a distal end extending into the hollow tube and a proximal end operatively engaged with the plunger; and a working tip coupled to a distal end of the hollow tube. The working tip has a substantially U-shaped transverse cross-sectional profile defining a channel having a base wall and a pair of spaced apart side walls. The working tip defines a lower contact surface along an internal face of the base wall, and an upper contact surface defined along an upper end surface of each side wall. The upper contact surface of each side wall includes a distal recess formed near a distal end thereof and a proximal recess formed proximal of the distal recess; and an internal retaining surface on both side walls parallel to the base wall. The distal end of the actuation member is configured to engage a suture clip loaded into the working tip

The suture clip applier system further includes a suture clip loadable into and deployable from the working tip. The suture clip includes an elongated flexible beam having a distal end portion, a proximal end portion, a top surface and a bottom surface, the flexible beam further including a pair of arms extending laterally therefrom; and an elongated rigid channel, wherein the elongated rigid channel has a substantially U-shaped transverse cross-sectional profile with a horizontal base wall and vertical side walls having a distal end portion and proximal end portion, wherein each vertical side wall defines a holding step formed in an upper edge thereof. The flexible beam and the channel are coupled to one another at their proximal end portions. The pair of arms of the flexible beam are in registration with a corresponding holding step formed in the upper edge of the vertical side walls; and, in use, as the suture clip is urged in a distal direction relative to the working tip, the flexible beam is splayed apart from the channel to open the suture clip for receipt of a suture therein.

The plunger of the clip applier defines a race formed in a surface thereof, the race includes a plurality of portions each defining a cam surface of varying depth; and the clip applier includes a rocker arm having a distal end portion and proximal end portion, the rocker arm has a follower pin extending therefrom near the distal end portion thereof and a retaining pin near the proximal end portion thereof. The rocker arm is pivotally attached to the housing by the retaining pin and the follower pin is slidably disposed with in the race of the plunger to modulate the motion of the plunger and actuation member.

The race may define four interconnected cam portion, with each cam portion having a start position and an end position and each cam is deepest at its respective start position and shallowest at its respective end position.

The rocker arm of the clip applier may be elastically deformable laterally from the plunger thereby providing a biasing force upon the follower pin and plunger relative to the body.

The clip applier may further include a biasing member disposed within the housing and providing a proximal bias upon the plunger relative to the housing. The distal recess and the proximal recess formed in each vertical side wall may be interconnected by a camming surface.

A proximal end portion of the pair of vertical sides walls of the channel of the suture clip may include inwardly projecting lips for retaining the proximal end portion of the beam within the channel. The pair of arms of the suture clip may project beyond the pair of vertical side walls of the channel thereof.

According to yet another aspect of the present disclosure, a method of securing a suture through an incision is provided. The method includes the steps of providing a suture clip applier having a working tip configured to retain and fire a suture clip; providing a suture clip having a biased closed configuration; loading the suture clip into the working tip of the clip applier; translating the suture clip distally relative to the working tip to a first position wherein the suture clip is splayed open; inserting a suture into the opened suture clip; and translating the suture clip distally relative to the working tip such that the suture clip is ejected from the working tip and biased to the closed configuration to close on and to retain the suture.

According to still another embodiment of the present disclosure, a method of securing a suture through an incision is provided and includes the steps of providing a suture clip applier having a working tip, and providing a suture clip. The working tip of the suture clip has a substantially U-shaped transverse cross-sectional profile defining a channel having a base wall and a pair of spaced apart side walls. The working tip defines a lower contact surface along an internal face of the base wall; and an upper contact surface defined along an upper end surface of each side wall. The upper contact surface of each side wall includes a distal recess formed near a distal end of thereof and a proximal recess formed proximal of the distal recess; and an internal retaining surface projecting inwardly from both side walls of the channel. The suture clip includes an elongated flexible beam having a distal end portion, a proximal end portion, a top surface and a bottom surface, the flexible beam further including a pair of aims extending laterally therefrom; and an elongated rigid channel. The elongated rigid channel of the suture clip has a substantially U-shaped transverse cross-sectional profile with a horizontal base wall and a pair of spaced apart vertical side walls having a distal end portion and a proximal end portion. Each vertical side wall of the suture clip defines a holding step formed in an upper edge thereof. The flexible beam and the channel of the clip are coupled to one another at their proximal end portions; and the pair of arms of the flexible beam are in registration with a corresponding holding step formed in the upper edge of the vertical side walls of the channel of the clip.

The method further includes the steps of loading a suture clip into the working tip such that the vertical side walls of the clip channel abut the retaining surface of the working tip, and the laterally extending arms of the flexible beam rest in the proximal recess of the working tip; and translating the suture clip distally relative to the working tip such that the laterally extending arms of the suture clip are translated from the proximal recess of the working tip channel to the distal recess of the working tip while the clip channel is retained by the internal retaining surfaces of the working tip such that the distal ends of the flexible beam and the channel of the suture

clip are separated to define an opening, and so that the distal end of the suture clip protrudes from the working tip.

The method further includes the steps of inserting a suture into the opening of the suture clip; and translating the suture clip distally relative to the working tip such that the suture clip is ejected from the working tip and the flexible beam and the channel of the clip are biased toward one another to close on and retain the suture.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure will be more fully appreciated as the same becomes better understood from the following detailed description when considered in connection with the following drawings, in which:

FIG. **1** is a perspective view of a clip applier according to an embodiment of the present disclosure;

FIG. **2** is a perspective view, with the parts separated, of the clip applier of FIG. **1**;

FIG. **2**A is an enlarged perspective view illustrating the connection of a crimp of an actuating member in a set screw;

FIG. **3** is an enlarged perspective view of the indicated area of detail of FIG. **1**, illustrating a clip loaded in a distal end of the clip applier;

FIG. **4** is a perspective cut-away view of the clip applier of FIG. **1**, illustrated with a body half-section removed therefrom;

FIG. **5** is an enlarged view of the proximal end portion of the suture clip applier of FIG. **3**;

FIG. **6** is an enlarged perspective view of a suture clip according to an embodiment of the present disclosure, for use in the clip applier of FIGS. **1-5**;

FIG. **7**A is an enlarged cross-sectional view of the working tip and clip according to section A of FIG. **2**;

FIG. **7**B is a side view of the working tip and clip of FIG. **2**;

FIGS. **8**A-D are schematic illustrations showing a sequence of operation of the clip applier of FIGS. **1-5**;

FIG. **9** is a perspective view of a clip applier according to another embodiment of the present disclosure including a hook-shaped working tip for use with a flat suture clip;

FIG. **10** is a perspective view of the hook-shaped working tip illustrating an attachment of the suture clip to a suture;

FIG. **11** is a perspective view of the suture clip shown secured upon a suture;

FIG. **12** is a perspective view of another embodiment of a spring clip according to the present disclosure and shown in its neutral position;

FIG. **13** is a perspective view of the suture clip of FIG. **12** shown on a suture; and

FIG. **14** is a perspective view of a suture clip according to yet another embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENTS

While embodiments of the present disclosure are susceptible to various modifications and alternative constructions, certain illustrated embodiments thereof have been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the embodiments of the present disclosure to the specific form disclosed, but, on the contrary, the embodiments are intended to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the present disclosure as defined in the claims.

While various embodiments of the invention are described herein, it is to be distinctly understood that this invention is not limited thereto but may be variously embodied to practice within the scope of the following claims. The present invention may be understood more readily by reference to the following detailed description of the invention taken in connection with the accompanying drawing figures, which form a part of this disclosure. It is to be understood that this invention is not limited to the specific devices, methods, conditions or parameters described and/or shown herein, and that the terminology used herein is for the purpose of describing particular embodiments by way of example only and is not intended to be limiting of the claimed invention.

The present disclosure relates to devices and methods for applying suture clips in an endoscopic, endoluminal, laparoscopic, or other surgical setting. Throughout the following description, the term "proximal," will refer to the end of a device or system that is closest to the operator, while the term "distal" will refer to the end of the device or system that is farthest from the operator.

With reference to FIGS. **1-7**B, a clip applier, in accordance with the present disclosure, is generally designated as **100**. Clip applier **100** includes a body or housing **110**, a plunger **120** disposed substantially within body **110**, a hollow outer tube **160** extending from and operatively supported by body **110**, a working tip **140** supported on at a distal end of outer tube **160** and configured for operation on or with a suture clip **150**, and an actuation member **130** extending through body **110** and hollow outer tube **160** and coupled at a proximal end thereof to plunger **120**.

With reference to FIGS. **1**, **2** and **4**, body **110** is a hollow, elongated, annular member with a distal end portion **102** and proximal end portion **104** defining a longitudinal axis. The distal end portion **102** of body **110** has a frustoconical profile which narrows to define a distal opening **112***a* which is coincident with the exterior circumference of and supports a proximal end **160***b* of outer tube **160**. As seen in FIG. **2**, body **110** may be formed in a pair of half-sections **110***a*, **110***b* that are joined to one another using know techniques in the art, such as, for example, gluing, welding, fastening and the like.

As shown in FIGS. **1** and **2**, it is contemplated that a substantially frustoconical, hollow strain relief **116**, substantially composed of a complaint material, is disposed or supported at a distal end portion **102** of body **110**. Strain relief **116** is configured to permit outer tube **160** to pass therethrough in order to provide a bias to outer tube **160** in order to help maintain outer tube in substantially parallel relation with the longitudinal axis.

With further reference to FIGS. **1**, **2** and **4**, a proximal end portion **104** of body **110** further includes opposing co-planar annular projections defining finger engaging loops **114***a*, **114***b*.

With reference to FIG. **4**, plunger **120** is an elongated substantially cylindrical member defining a distal body portion **122** disposed within body **110** and a proximal end portion **123** projecting from the proximal end portion **104** of body **110**. Distal body portion **122** of plunger **120** has a pair of opposed, protruding, longitudinally extending rails **122***a* (see FIG. **5**) configured to be slidably retained within a complementary recess **110***c* (only one recess shown in FIG. **2**) formed in an internal face of body half **110***b* of body **110** so as to facilitate linear translation along the longitudinal axis of body **110**.

Proximal end portion **123** of plunger **120** protrudes from body **110**. Proximal end portion **123** of plunger **120**, which protrudes from body **110**, defines an actuation portion **123***a* which may be configured to be actuated by an operator's thumb, linear actuator, or other linear motion device known in the art.

Clip applier **100** includes a biasing member **118** disposed within body **110** and retained between the distal end of plunger **120** and an internal distal surface of body **110**. Biasing member **118** may be an elastically deformable helical coil which provides a biasing force upon plunger **120** relative to body **110**.

With reference to FIGS. **4** and **5**, one or more sides of distal body portion **122** of plunger **120** are flattened to define a surface **122***b*. Further, distal body portion **122** includes an audible/tactile feedback member defined by a race **124***e* formed in surface **122***b* of distal body portion **122**. Race **124***e* includes a series of cam channels **124***a*-**124***d*, each defining stepped or sloping cam surfaces **125***a*-**125***d*. The depth of cam channels **124***a*-**124***d* is such that they are deepest at the furthest counter-clockwise point along their respective paths. Race **124***e* accommodates a follower pin **126** that is coupled to and projects traversely from an end of a rocker arm **128** which is itself pivotally connected to body **110** by a proximal pin **129**. Rocker arm **128** may be in the form of a biasing member, such as a leaf spring, to thereby exert a force upon follower pin **126** relative to body **110** so as to bias follower pin **126** against sloping cam surfaces **125***a*-**125***d* of race **124***e* which provides control of the plunger stop positions as further detailed below.

The motion of plunger **120**, actuating member **130** and clip **150** are modulated by the travel of follower pin **126** through race **124***e*. Plunger **120**, actuating member **130**, and clip **150** cannot be displaced until the proximal end portion **123** of plunger **120** is translated distally relative to body **110** by the operator, with sufficient force to overcome the biasing forces of biasing member **118** and rocker arm **128** and displace follower pin **126** along cam surfaces **125***a*-**125***d* of race **124***e*. When plunger **120** is so actuated, follower pin **126** is caused to travel clockwise through the aforementioned cams. As follower pin **126** translates along a particular cam channel **124***a*-**124***d*, respective cam surface **125***a*-**125***d* urges follower pin **126** out of race **124***e* and exerts a biasing force on rocker arm **128**. As follower pin **126** passes from one cam channel **124***a*-**124***d* to an adjacent cam channel **124***a*-**124***d*, across the step defined between adjacent cam surfaces **125***a*-**125***d*, the bias force of the rockers arm **128** drive follower pin **126** against a cam surface **125***a*-**125***d*, thereby creating an audible/tactile indication to the user. An audible/tactile indication may be provided for each stage of the firing sequence.

With reference to FIGS. **1** and **2**, outer tube **160** of clip applier **100** is a hollow elongated tubular member including a distal end portion **160***a*, a proximal end portion **160***b*, and a lumen extending therethrough. Actuation member **130** is slidably disposed at least partially within the lumen of outer tube **160**. It is contemplated that outer tube **160** may be rigid or flexible. It is further contemplated that outer tube **160** is a hollow tube with a substantially elliptical or rectilinear traverse cross-sectional profile.

With continued reference to FIGS. **1** and **2**, actuation member **130** of clip applier **100** is a solid shaft like member including a distal end portion **130***a* and a proximal end portion **130***b*. As mentioned above, distal end portion **130***a* of actuation member **130** extends through the lumen of outer tube **160**, and proximal end portion **130***b* of actuation member **130** is connected or secured to distal body portion **122** of plunger **120**.

As seen in FIGS. **2**, **2**A, **4** and **5**, clip applier includes a set screw **170** disposed in plunger **120** and secured to actuation member **130**. In particular, set screw **170** defines a shaped cavity **170***a* configured to receive a stop or crimp **130***c* affixed to proximal end **130***b* of actuation member **130**, whereby set screw **170** is axially and rotatably fixed with respect to actuation member **130**. Additionally, a proximal end **160***c* of outer tube **160** is received and secured within a distal end of set screw **170**. It is contemplated that proximal end **160***c* of outer tube **160** is threadably connected to set screw **170**. In this manner, as set screw **170** is rotated with respected to outer tube **160**, outer tube **160** is axially displaced relative to actuation member **130**. In this manner, set screw **170** functions to enable fine tuning of the position of a distal tip or distal end portion **130***a* of actuation member **130** relative to distal end **160***a* of outer tube **160**.

With reference to FIGS. **3** and **7**A, working tip **140** of clip applier **100** is operatively supported at its proximal end portion **140***a* to a distal end **160***a* of outer hollow tube **160**. Working tip **140** has a substantially centrally disposed lumen **144** having a transverse cross-sectional profile, at the distal end of working tip **140**, that is configured to retain clip **150**. The shape of working tip **140** is described in greater detail hereinbelow.

With reference to FIGS. **3**, **7**A and **7**B, lumen **144** of working tip **140** is enclosed near a proximal end portion **140***b* thereof. Meanwhile, a distal end portion **140***a* of working tip **140** has been cut away to reveal or expose lumen **144**, thereby defining a channel **146** having a pair of contact or cam surfaces **141** along which a cross beam **155** of suture clip **150** can travel, as will be described in greater detail below.

With reference to FIG. **7**A, channel **146** of working tip **140** includes a base wall **146***a* and a pair of upstanding side walls **146***b*, **146***c*. Each side wall **146***b*, **146***c* defines a respective ledge **146***d*, **146***e*, extending into lumen **146** and extending substantially along the length of working tip **140**.

With reference to FIG. **7**B, upstanding side walls **146***b*, **146***c* have material removed therefrom defining a cam surface **141** along which traverse cross beams **155** of clip **150** can travel. Cam surface **141** includes, beginning with the proximal-most portion of the cam surface **141**, a proximal shoulder **141***a*, a proximal retaining groove **141***b*, a medial incline **141***c*, a distal retaining groove **141***d*, and a distal ejection shoulder **141***e*.

As shown in FIG. **6**, a suture clip **150**, according to the present disclosure, includes a clip beam **151** connected to a clip channel **152**. A distal end **152***a* of clip channel **152** has a substantially U-shaped traverse cross-sectional profile with a base wall **152***b* and a pair of spaced apart upstanding side walls **152***c*, **152***d*. The upstanding side walls **152***c*, **152***d* of clip channel **152** each have a rounded forward edge **153**, a distal retaining step or shoulder **156**, and a clip beam recess **157** cut into the upper surface thereof. Clip channel **152** is dimensioned for slidable reception in lumen **144** of working tip **140** such that upstanding side walls **152***c*, **152***d* of clip channel **152** are disposed beneath ledges **146***d*, **146***e* of side walls **146***b*, **146***c* of channel **146** of working tip **140**.

Clip beam **151** has a pair of transverse cross beams **155** extending therefrom at a location disposed proximally from distal tip **154** of clip beam **153**. When the components of clip **150** are assembled, clip beam **151** is disposed between upstanding side walls **152***c*, **152***d* of clip channel **152**. Further, clip beam **151** and clip channel **152** are secured or coupled at their proximal ends and separable at their distal ends. The proximal ends of clip beam **151** and clip channel **152** are coupled to one another by retaining bends **158** extending from side walls **152***c*, **152***d*. It is contemplated that the proximal ends of clip beam **151** and clip channel **152** may be coupled by a pin, chemical adhesive, weld, or other coupling or laminating method known in the art.

It is contemplated that clip beam **151** is constructed of a flexible, resilient, spring-like-material urging or biasing the assembled clip into a "closed" configuration wherein the

distance between the distal ends of the clip beam **151** and clip channel **152** is minimized. It is further contemplated that clip beam **151** may be substantially composed of a permanent material such as a metal (stainless steel or titanium) or a polymer, or a non-permanent material such as bio-absorbable natural or manmade polymer.

Referring now to FIGS. **8**A-**8**D, a method of using clip applier **100** and suture clip **150** is shown and will be discussed. Initially, as shown in FIG. **8**A, a clip **150** is placed or loaded into the lumen **144** of the working tip **140** either by manually inserting clip **150** or by an automatic dispensing mechanism such that the proximal end of clip **150** abuts the distal end of the actuation member **130** and the lateral cross beams **155** of clip **150** rest within cam surfaces **141** of working tip **140**. In particular, lateral cross-beams **155** of clip **150** rest in the nadir **141***b* of cam surfaces **141**, between a proximal shoulder **141***a* and medial incline **141***c* of cam surface **141**. In this initial configuration, plunger **122** is disposed at a proximal most position relative to body **110** such that follower pin **126** is disposed in a first cam channel portion **124***a* of race **124***e* (see FIG. **5**).

Next, as shown in FIGS. **5** and **8**B, as plunger **120** is depressed (i.e., translated distally relative to body **110**), follower pin **126** is translated through race **124***e* from first cam channel portion **124***a* to second cam channel portion **124***b*. As follower pin **126** is translated from first cam channel portion **124***a* to second cam channel portion **124***b*, an audible/tactile indication is created, in the manner described above.

By depressing plunger **120** to translate plunger **120** distally, actuation member **130** is also translated distally which translates clip **150** distally such that cross-beam **155** is disposed upon distal retaining groove **141***d* of cam surfaces **141** of working tip **140**. The translation of cross beam **155** to distal retaining groove **141***d* urges clip beam **151** away from beam channel **152** which is retained by ledges **146***d*, **146***e*. This separates distal beam tip **154** from clip channel **152** to define opening **127** exposing suture retaining step **156**.

Next, as shown in FIG. **8**C, clip applier **100** is maneuvered to capture a suture **131** in opening **127** or a suture **131** is moved into opening **127**. With suture **131** disposed within opening **127**, plunger **120** is further depressed (i.e., translated distally relative to body **110**), thereby translating follower pin **126** through race **124***e* from second cam channel portion **124***b* to third cam channel portion **124***c*. As follower pin **126** is translated from second cam channel portion **124***b* to third cam channel portion **124***c*, an audible/tactile indication is created, in the manner described above. As plunger **120** is further depressed, actuating member **130** is further translated in a distal direction thereby translating clip **150** distally until cross beams **155** are moved onto respecting distal ejection shoulders **141***e* of working tip **140**, thus partially closing clip **150** (i.e., approximating clip beam **151** and clip channel **152**) onto suture **131**.

Next, as plunger **120** is fully depressed, follower pin **126** is translated from third cam channel portion **124***c* to fourth channel portion **124***d*. As follower pin **126** is translated from third cam channel portion **124***c* to fourth cam channel portion **124***d*, an audible/tactile indication is created, in the manner described above. As plunger **120** is fully depressed, actuating member **130** is fully translated in a distal direction to a distal-most portion of its stroke and ejecting clip **150** from the working tip **140**. As clip **150** is fully ejected, suture **131** is captured between clip beam **151** and clip channel **152** of clip **150**.

Finally, as shown in FIG. **8**D, after clip **150** has been ejected from working tip **140** of clip applier **100**, clip **150** securely holds a suture **131** between clip channel **151** and clip beam **152**.

Turning now to FIGS. **9-11**, an embodiment of a suture clip **250** and a working tip **240** for a clip applier, according to another embodiment of the present disclosure, is shown and described. Working tip **240** has a substantially hook-like profile. In particular, with reference to FIG. **9**, the hook-like profile of working tip **240** includes a transverse recess or notch **242** defined by a pair of coincident curved surfaces **242***a*, **242***b*, wherein recess **242** is angled or oriented so as to define a proximally extending hook **244**. As shown in FIG. **9**, working tip **240** further defines a longitudinally axially extending slot **246** configured and dimensioned to receive suture clip **250** therein.

As shown in FIG. **11**, suture clip **250** has a substantially rectangular, flattened profile having a distal end portion and proximal end portion. Suture clip **250** includes a pair of spaced apart legs **252**, **254** joined to one another by a crown or backspan **256**. Legs **252**, **254** are separated from one another to define a slot **258** therebetween. Each leg **252**, **254** includes a respective angled surface **252***a*, **254***a* thereby defining a widened mouth or entry **258***a* of slot **258** for better receiving a suture **131** therein. A proximal end of slot **258** is dimensioned so as to cinch and retain suture **131** therein. Backspan **256** of suture clip **250** may have a generally V-shaped profile.

In use, as shown in FIGS. **9** and **10**, with suture clip **250** loaded into slot **246** of working tip **240**, such that mouth **258***a* of suture clip **250** is disposed proximal of notch **242** of working tip **240**, a suture **131** is placed into notch **242** of working tip **240**. Preferably, suture **131** is disposed at a base of notch **242**. With suture **131** so positioned, an actuating member of the clip applier is manipulated to engage suture clip **250** and urge suture clip **250** in a distal direction. Suture clip **250** is translated distally such that suture is first received in mouth **258***a* and then advanced into the proximal end of slot **258** of suture clip **250**. With suture clip **250** secured to suture **131**, the actuation member of the clip applier may be retracted and working tip **240** may be disengaged from suture clip **250**.

Turning now to FIGS. **12** and **13**, another embodiment of a suture clip, according to the present disclosure, is generally designated as suture clip **350**. Suture clip **350** includes a leaf spring **351**, a beam **352**, and a lever **353**. The leaf spring **351** is fixably attached to a proximal end **352***b* of beam **352** by, for example, a weld. Meanwhile, leaf spring **351** is fixably attached to a distal end **353***a* of lever **353** by, for example, a weld. Beam **352** defines a traverse groove **352***c* formed near distal end **353***a* and being configured to receive a suture therein. It is further contemplated that the attachment of beam **352** to lever **353** and leaf spring **351** may be achieved using a pin, staple, chemical adhesive or other attachment method known in the art.

As shown in FIG. **12**, in its neutral configuration or at rest, leaf spring **351** maintains the distal ends **352***a*, **353***a* of beam **352** and lever **353** in contact with one another and maintains the proximal ends **352***b*, **353***b* of beam **352** and lever **353** separate from one another. With reference to FIG. **13**, when a compressive force is applied to proximal ends **352***b*, **353***b* of beam **352** and lever **353**, the distal ends **352***c* of beam **352** and lever **353** are separated from one another to open suture clip **350** and define a suture entry area **355**. With suture clip **350** in an open condition, a suture **131** may be inserted through suture entry area **355** and captured into the suture retaining groove **352***d* of beam **352**. Once the compressive force is

removed, leaf spring acts on beam **352** and lever **353** to close the suture retaining area **355** and secure the suture therebetween.

Turning now to FIG. **14**, yet another embodiment of a suture clip, according to the present disclosure, is generally designated as suture clip **450**. Suture clip **450** includes a backspan or crown **452** and a pair of spaced apart legs **454**, **456** extending therefrom, with each leg **454**, **456** being divided into a pair of spaced apart first and second legs **454***a*, **454***b*, and first and second legs **456***a*, **456***b*, respectively.

As seen in FIG. **14**, first and second legs **454***a*, **454***b* of leg **454** are separated from one another by a relatively smooth longitudinally extending slot **454***c*. First and second legs **456***a*, **456***b* of leg **456** are separated from one another by a relatively smooth longitudinally extending slot **456***c*.

Further as seen in FIG. **14**, first leg **454***a* of leg **454** and first leg **456***a* of leg **456** are separated from one another by a longitudinally extending slot **458** having an undulating or sinusoidal profile. Also, second leg **454***b* of leg **454** and second leg **456***b* of leg **456** are separated from one another by a longitudinally extending slot **460** having an undulating or sinusoidal profile.

Suture clip **450** further includes a pair of longitudinally extending channels **462**, **464** formed in opposed outer surfaces thereof and extending along an entire length thereof. Each channel **462**, **464** is defined by a pair of opposed ledges or shoulders **462***a*, **462***b* and **464***a*, **464***b*, respectively. Each ledge or shoulder **462***a*, **462***b* and **464***a*, **464***b* of respective channel **462**, **464** includes a respective cam surface **463***a*, **463***b* (the cam surfaces of ledge or shoulder **464***a*, **464***b* not being visible in FIG. **14**) projecting towards one another.

As shown in FIG. **14** and as can be appreciated by one skilled in the art, suture clip **450** may be used with a clip applier that is configured to bias leg **454** and leg **456** apart from one another to receive a suture **131** therebetween. It is contemplated that as suture clip **450** is advanced in a distal direction relative to the clip applier that legs **454**, **456** may be biased apart from one another as the cam surfaces **463***a*, **463***b* of legs **454***b*, **456***b* and the cam surfaces of legs **454***a*, **456***a* ride against a corresponding cam surface of the clip applier.

Although the illustrative embodiments of the present disclosure have been described herein with reference to the accompanying drawings, it is to be understood that the disclosure is not limited to those precise embodiments, and that various other changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the disclosure.

Those skilled in the art, having the benefit of the teachings of the present invention as herein and above set forth, may effect modifications thereto. Such modifications are to be construed as lying within the scope of the present invention, as defined by the appended claims.

Although specific features of the suture clip applier are shown in some of the drawings and not in others, this is for convenience only as each feature may be combined with any or all of the other features in accordance with the aspects of the present disclosure. Other embodiments will occur to those skilled in the art and are within the following claims.

It is to be understood that the illustrated embodiments are for the purpose of example, and that numerous other configurations of wound dressing systems having a plurality of beads exist. Accordingly, the illustrated and described embodiments are not intended to limit the scope of the inventive subject matter only to those embodiments.

What is claimed is:

1. A suture clip applier, comprising:

a housing;

an elongated plunger slidably supported in the housing, the plunger having a distal end portion disposed within the housing and a proximal end portion extending from a proximal end of the housing, wherein the plunger defines a race formed in a surface thereof, the race includes a plurality of portions each defining a cam surface of varying depth;

a hollow tube extending distally from the housing and defining a lumen therethrough;

an actuation member having a distal end extending into the hollow tube and a proximal end operatively engaged with the plunger;

a working tip coupled to a distal end of the hollow tube, wherein the working tip has a substantially U-shaped transverse cross-sectional profile defining a channel having a base wall and a pair of spaced apart side walls, wherein the working tip defines:

a lower contact surface along an internal face of the base wall, and

an upper contact surface defined along an upper end surface of each side wall, wherein the upper contact surface of each side wall includes:

a distal recess formed near a distal end of thereof and a proximal recess formed proximal of the distal recess; and

an internal retaining surface on both side walls parallel to the base wall,

wherein the distal end of the actuation member is configured to engage a suture clip loaded into the working tip; and

a rocker arm having a distal end portion and proximal end portion, the rocker arm has a follower pin extending therefrom near the distal end portion thereof and a retaining pin near the proximal end portion thereof,

whereby the rocker arm is pivotally attached to the housing by the retaining pin and the follower pin is slidably disposed with in the race of the plunger to modulate the motion of the plunger and actuation member.

2. The clip applier according to claim **1**, wherein the race defines four interconnected cam portion, with each cam portion having a start position and an end position and each cam is deepest at its respective start position and shallowest at its respective end position.

3. The clip applier according to claim **1**, wherein the rocker arm is elastically deformable laterally from the plunger thereby providing a biasing force upon the follower pin and plunger relative to the body.

4. The clip applier according to claim **1**, further comprising finger loops extending from the housing.

5. The clip applier according to claim **1**, wherein the actuation member is configured to transmit axial translative forces to the suture clip.

6. The clip applier according to claim **1**, further comprising a biasing member disposed within the housing and providing a proximal bias upon the plunger relative to the housing.

7. The clip applier according to claim **6**, wherein the biasing member is a coil spring.

8. The clip applier according to claim **1**, wherein the distal recess and the proximal recess formed in each vertical side wall are interconnected by a camming surface.

9. A suture clip applier system, comprising:

a suture clip applier for filing a suture clip onto a suture, the clip applier including:

a housing;

an elongated plunger slidably supported in the housing, the plunger having a distal end portion disposed within the housing and a proximal end portion extend-

ing from a proximal end of the housing, the plunger defining a race formed in a surface thereof, the race including a plurality of portions each defining a cam surface of varying depth;

a hollow tube extending distally from the housing and defining a lumen therethrough;

an actuation member having a distal end extending into the hollow tube and a proximal end operatively engaged with the plunger;

a working tip coupled to a distal end of the hollow tube, wherein the working tip has a substantially U-shaped transverse cross-sectional profile defining a channel having a base wall and a pair of spaced apart side walls, wherein the working tip defines:

a lower contact surface along an internal face of the base wall, and

an upper contact surface defined along an upper end surface of each side wall, wherein the upper contact surface of each side wall includes:

a distal recess formed near a distal end thereof and a proximal recess formed proximal of the distal recess; and

an internal retaining surface on both side walls parallel to the base wall,

wherein the distal end of the actuation member is configured to engage a suture clip loaded into the working tip; and

a rocker arm having a distal end portion and proximal end portion, the rocker arm has a follower in extending therefrom near the distal end portion thereof and a retaining pin near the proximal end portion thereof,

whereby the rocker arm is pivotally attached to the housing by the retaining in and the follower in is slidably disposed with in the race of the plunger to modulate the motion of the plunger and actuation member; and

a suture clip loadable into and deployable from the working tip, the suture clip including:

an elongated flexible beam having a distal end portion, a proximal end portion, a top surface and a bottom surface, the flexible beam further including a pair of arms extending laterally therefrom; and

an elongated rigid channel, wherein the elongated rigid channel has a substantially U-shaped transverse cross-sectional profile with a horizontal base wall and vertical side walls having a distal end portion and proximal end portion, wherein each vertical side wall defines a holding step formed in an upper edge thereof;

wherein the flexible beam and the channel are coupled to one another at their proximal end portions;

wherein the pair of arms of the flexible beam are in registration with a corresponding holding step formed in the upper edge of the vertical side walls; and

wherein, as the suture clip is urged in a distal direction relative to the working tip, the flexible beam is splayed apart from the channel to open the suture clip for receipt of a suture therein.

10. The suture clip applier system according to claim **9**, wherein the race defines four interconnected cam portion, with each cam portion having a start position and an end position and each cam is deepest at its respective start position and shallowest at its respective end position.

11. The suture clip applier system according to claim **9**, wherein the rocker arm of the clip applier is elastically deformable laterally from the plunger thereby providing a biasing force upon the follower pin and plunger relative to the body.

12. The suture clip applier system according to claim **9**, wherein the clip applier further comprises a biasing member disposed within the housing and providing a proximal bias upon the plunger relative to the housing.

13. The suture clip applier system according to claim **9**, wherein the distal recess and the proximal recess formed in each vertical side wall are interconnected by a camming surface.

14. The suture clip applier system according to claim **9**, wherein a proximal end portion of the pair of vertical sides walls of the channel of the suture clip include inwardly projecting lips for retaining the proximal end portion of the beam within the channel.

15. The suture clip applier system according to claim **9**, wherein the pair of arms of the suture clip project beyond the pair of vertical side walls of the channel thereof.

* * * * *

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公开(公告)号	US8734469	公开(公告)日	2014-05-27
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[标]申请(专利权)人(译)	柯惠有限合伙公司		
申请(专利权)人(译)	泰科医疗集团LP		
当前申请(专利权)人(译)	COVIDIEN LP		
[标]发明人	PRIBANIC RUSSELL MARCZYK STANISLAW		
发明人	PRIBANIC, RUSSELL MARCZYK, STANISLAW		
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摘要(译)

提供了缝合夹施加器，缝合夹以及它们在内窥镜或腹腔镜手术期间用于固定缝合线的方法，其中该方法包括提供缝合线施夹器的步骤，该缝线夹施加器具有构造成保持和点燃缝线夹的工作尖端;提供具有偏置闭合配置的缝合夹;将缝合夹装入夹具施工器的工作尖端;将缝合夹相对于工作尖端向远侧平移到第一位置，其中缝合夹张开;将缝合线插入打开的缝线夹中;并且将缝合夹相对于工作尖端向远侧平移，使得缝合夹从工作尖端弹出并偏置到闭合构型以闭合并保持缝合线。