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## **CARTRIDGE BUTTRESS ATTACHMENT FOR SURGICAL STAPLING APPARATUS**

**[0001]** This Application claims priority from U.S. Provisional Patent Application 63/447,929, filed 24 February 2024, the entire content of which is incorporated herein by reference.

### **FIELD**

**[0002]** This disclosure relates generally to surgical devices, and more particularly, to surgical buttress attachment assemblies and methods for releasably securing a surgical buttress to a surgical stapling apparatus.

### **BACKGROUND**

**[0003]** Surgical stapling apparatus are employed by surgeons to sequentially or simultaneously apply one or more rows of fasteners, e.g., staples or two-part fasteners, to body tissue for the purpose of joining segments of body tissue together. Such apparatus generally include a pair of jaws or finger-like structures between which the body tissue to be joined is placed. When the surgical stapling apparatus is actuated, or “fired”, longitudinally moving firing bars contact staple drive members in one of the jaws. The staple drive members push the surgical staples through the body tissue and into an anvil in the opposite jaw which forms the staples. If body tissue is to be removed or separated, a knife blade can be provided in the jaws of the apparatus to cut the body tissue between the lines of staples.

**[0004]** Surgical supports, e.g., meshes or buttress materials, may be used in combination with surgical stapling apparatus to bridge, repair, and/or reinforce tissue defects within a patient. A clinician may manually attach buttress material(s) to the surgical stapling apparatus in the operating room during a surgical procedure, or utilize a surgical stapling apparatus including buttress material(s) pre-installed thereon. The buttress material reinforces the staple or suture line as well as covers the juncture of the body tissues to reduce leakage prior to healing.

### **SUMMARY**

**[0005]** This disclosure relates to cartridge side buttress material attachment onto a jaw assembly of a surgical stapling apparatus. Surgical buttress attachment assemblies and methods of this disclosure are designed to make surgical buttress attachment a simple, straightforward, and cost-effective procedure.

**[0006]** The surgical buttress attachment assemblies of this disclosure may enable low cost manufacture and assembly by, for example, not requiring tight tolerances and/or reducing the number of components required to affix a surgical buttress to a staple cartridge. The surgical buttress attachment assemblies may include a surgical buttress having attachment features fabricated to the tolerance of a staple cartridge on which the surgical buttress is releasably secured to provide, for example, ease in loading the surgical buttress onto the staple cartridge (e.g., by the manufacture or by a user) and/or ease of clinical preparation and use. The surgical buttress attachment assemblies may include a staple cartridge having molded attachment features that may provide cost savings and/or ease in manufacture as compared to surgical buttress attachment features and methods requiring additional materials and/or processing steps.

**[0007]** The surgical buttress attachment assemblies may enable manufacturer and/or user side assembly with a reduced number of assembly steps as compared to conventional methods of loading a surgical buttress onto a staple cartridge which, in turn, may reduce assembly costs and/or assembly inconsistencies or errors. Further, the surgical buttress attachment assemblies may also minimize or prevent the surgical buttress from being elongated and/or deformed during assembly, enabling the staple lines to remain flush with the surgical buttress so that staple formation is not adversely affected during use. Further still, the surgical buttress attachment assemblies may enable fixation of the surgical buttress on the staple cartridge during transport and use of the surgical stapling apparatus. Movement of the surgical buttress relative to the staple cartridge may be minimized or prevented (e.g., while shipping, during pre-wetting processes, introduction into tissue (e.g., via a trocar), manipulation within tissue, etc.) until the surgical stapling apparatus is fired.

**[0008]** In aspects, this disclosure provides a surgical buttress attachment assembly for use with a surgical stapling apparatus including a staple cartridge and a surgical buttress. The staple cartridge includes a tissue facing surface having staple pockets and a central longitudinal slot defined therein. The staple cartridge includes proximal fingers extending outwardly from the tissue facing surface. Each of the proximal fingers includes an elongate body and a free end portion. The proximal fingers have a first state in which the free end portions extend along an axis defined by the respective elongate body and a second state in which the free end portions of the proximal fingers are deformed away from the axis. The surgical buttress includes proximal openings defined therethrough. The surgical buttress is positioned on the tissue

facing surface of the staple cartridge with the proximal fingers extending through the proximal openings when the proximal fingers are in the first state, and the surgical buttress is secured to the staple cartridge when the proximal fingers are in the second state.

[0009] The proximal fingers may be disposed on opposed sides of the central longitudinal slot. The proximal fingers may be disposed proximal to the staple pockets. The proximal fingers may be permanently deformed to the second state. The proximal fingers may be hollow.

[0010] In some aspects, each of the proximal openings of the surgical buttress includes a base portion sized and shaped to receive the proximal finger of the staple cartridge therethrough, and a wing portion extending away from the base portion. In certain aspects, the wing portions of the proximal openings extend across the central longitudinal slot of the staple cartridge.

[0011] In some aspects, the staple cartridge includes a cartridge tip having a distal tongue extending outwardly therefrom, and the surgical buttress includes a distal opening sized and shaped to receive the distal tongue therethrough. In certain aspects, the distal tongue has a first state in which the distal tongue is axially aligned with the central longitudinal slot, and a second state in which a free end portion of the distal tongue is deformed towards the cartridge tip. A distal portion of the surgical buttress may include perforations extending proximally and distally beyond the distal opening. The perforations may be axially aligned with the central longitudinal slot of the staple cartridge.

[0012] In aspects, this disclosure provides a method of loading a surgical buttress onto a staple cartridge including: positioning a surgical buttress over a tissue facing surface of a staple cartridge such that proximal openings defined through the surgical buttress engage proximal fingers extending outwardly from the tissue facing surface of the staple cartridge, each of the proximal fingers including an elongate body and a free end portion, the proximal fingers disposed in a first state in which the free end portions extend along axis defined by the respective elongate body; and moving the proximal fingers to a second state in which the free end portions of the proximal fingers are deformed away from the axis and overlie a portion of the surgical buttress.

[0013] In some aspects, moving the proximal fingers to the second state includes heat-staking the free end portions.

**[0014]** In aspects, this disclosure provides a surgical buttress attachment assembly for use with a surgical stapling apparatus including a staple cartridge and a surgical buttress. The staple cartridge includes a tissue facing surface having staple pockets and a central longitudinal slot defined therein. The staple cartridge includes proximal slots defined therein and proximal fingers disposed within the proximal slots. The proximal fingers have a buttress loading position in which proximal end portions of the proximal fingers are disposed outside of the proximal slots, and a buttress capture position in which the proximal end portions of the proximal fingers are disposed within the proximal slots. The surgical buttress includes a proximal end portion having proximal openings defined therethrough. The proximal end portion of the surgical buttress is attachable to the proximal end portions of the proximal fingers of the staple cartridge when the proximal fingers are disposed in the buttress loading position, and the proximal end portion of the surgical buttress are securable to the staple cartridge when the proximal fingers are moved to the buttress capture position.

**[0015]** Each of the proximal fingers may include a distal end portion hingedly coupled to the staple cartridge. The proximal end portion of each of the proximal fingers may include a proximally-facing notch defining a proximal hook configured to be received through the proximal opening of the surgical buttress.

**[0016]** In some aspects, the staple cartridge further includes a distal tongue defined therein, and the surgical buttress includes a distal end portion having a distal opening defined therethrough, the distal opening sized and shaped to receive the distal tongue therethrough. In certain aspects, the distal tongue is defined in an inner surface of a cartridge tip of the staple cartridge.

**[0017]** In some aspects, the surgical buttress attachment assembly further includes a buttress loading tool including a base having proximal posts extending outwardly therefrom. The staple cartridge is positionable on the base such that the proximal posts are received within the proximal slots. The proximal posts are configured to move the proximal fingers from the buttress capture position to the buttress loading position. In certain aspects, the proximal end portion of each of the proximal fingers includes a camming surface configured to engage the proximal post of the buttress loading tool. The buttress loading tool may further include side guides and a distal guide extending outwardly from the base. When the staple cartridge is positioned on the base, the staple cartridge may be received between the side guides and a distal end of the staple cartridge may abut the distal guide.

[0018] The details of one or more aspects of this disclosure are set forth in the accompanying drawings and the description below. Other aspects, as well as features, objects, and advantages of the aspects described in this disclosure will be apparent from the description and drawings, and from the claims.

#### BRIEF DESCRIPTION OF DRAWINGS

[0019] Various aspects of this disclosure are described hereinbelow with reference to the drawings, which are incorporated in and constitute a part of this specification, wherein:

[0020] FIG. 1 is a perspective view of a surgical stapling apparatus in accordance with aspects of the disclosure;

[0021] FIG. 2 is a close-up view of the area of detail 2 indicated in FIG. 1, showing a tool assembly of the surgical stapling apparatus of FIG. 1;

[0022] FIG. 3 is a perspective view, with parts separated, of a surgical buttress attachment assembly of the tool assembly of FIG. 2, the surgical buttress attachment assembly including a staple cartridge and a surgical buttress in accordance with an aspect of the disclosure;

[0023] FIG. 4 is a close-up view of the area of detail 4 indicated in FIG. 3, showing a proximal end portion of the staple cartridge of the surgical buttress attachment assembly of FIG. 3;

[0024] FIG. 5 is a top view of the surgical buttress of the surgical buttress attachment assembly of FIG. 3;

[0025] FIG. 6 is a perspective view of the surgical buttress attachment assembly of FIG. 3, showing the surgical buttress positioned onto the staple cartridge with proximal fingers of the staple cartridge disposed in a buttress loading state;

[0026] FIG. 7 is a close-up view of the area of detail 7 indicated in FIG. 6;

[0027] FIG. 8 is a perspective view of the surgical buttress attachment assembly of FIG. 6, showing the proximal fingers disposed in a buttress capture state;

[0028] FIG. 9 is a close-up view of the area of detail 9 indicated in FIG. 8;

[0029] FIG. 10 is a perspective view of a proximal end portion of the surgical buttress attachment assembly of FIG. 3, showing proximal fingers of the staple cartridge in a buttress capture state in accordance with another aspect of the disclosure;

[0030] FIG. 11 is a perspective view of a distal end portion of the surgical buttress attachment assembly of FIG. 3, showing a distal tongue of the staple cartridge in a buttress capture state in accordance with an aspect of the disclosure;

[0031] FIG. 12 is a perspective view of the surgical buttress of FIG. 5, shown secured to tissue;

[0032] FIG. 13 is a close-up view of the area of detail 13 indicated in FIG. 12, showing a portion of a proximal tab of the surgical buttress;

[0033] FIG. 14 is a perspective view, with parts separated, of a surgical buttress attachment assembly including a surgical buttress, a staple cartridge, and a buttress loading tool in accordance with another aspect of the disclosure;

[0034] FIG. 15 is a close-up view of the area of detail 15 indicated in FIG. 14, showing a proximal end portion of the staple cartridge of the surgical buttress attachment assembly of FIG. 14;

[0035] FIG. 16 is a cross-sectional view of the staple cartridge of FIG. 15, taken along section line 16-16 of FIG. 15, showing a proximal finger of the staple cartridge biased in a buttress capture position;

[0036] FIG. 17 is a perspective view of the surgical buttress attachment assembly of FIG. 14, showing the staple cartridge positioned on the buttress loading tool;

[0037] FIG. 18 is a close-up view of the area of detail 18 indicated in FIG. 17, showing a proximal end portion of the staple cartridge of the surgical buttress attachment assembly;

[0038] FIG. 19 is a cross-sectional view of the staple cartridge of FIG. 18, taken along section line 19-19 of FIG. 18, showing a proximal finger of the staple cartridge disposed in a buttress loading position and the surgical buttress positioned on the staple cartridge;



[0039] FIG. 20 is a cross-sectional view of the staple cartridge of FIG. 19, shown after the staple cartridge has been removed from the buttress loading tool and the proximal finger returns to the buttress capture position of FIG. 16; and

[0040] FIG. 21 is a perspective view of the proximal end portion of the staple cartridge of FIG. 20.

## DETAILED DESCRIPTION

[0041] Aspects of this disclosure will now be described in detail with reference to the drawing figures wherein like reference numerals identify similar or identical elements. Throughout this description, the term “proximal” refers to a portion of a structure, or component thereof, that is closer to a user, and the term “distal” refers to a portion of the structure, or component thereof, that is farther from the user.

[0042] Turning now to FIG. 1, an exemplary surgical device or surgical stapling apparatus 100 is shown in accordance with aspects of the disclosure. The surgical stapling apparatus 100 generally includes a handle assembly 110, an adapter assembly 120, and a loading unit 130. The handle assembly 110 is configured for selective connection with the adapter assembly 120 and, in turn, the adapter assembly 120 is configured for selective connection with the loading unit 130.

[0043] The surgical stapling apparatus 100 will further be described to the extent necessary to disclose aspects of the disclosure. For a detailed description of the structure and function of an exemplary surgical stapling apparatus 100, reference may be made to U.S. Patent No. 10,426,468, the entire content of which is incorporated herein by reference.

[0044] The handle assembly 110 includes a handle housing 112 housing a power-pack (not shown) configured to power and control various operations of the surgical stapling apparatus 100, and a plurality of actuators 114 (e.g., finger-actuated control buttons, knobs, toggles, slides, interfaces, and the like) for activating various functions of the surgical stapling apparatus 100. The adapter assembly 120 includes a knob housing 122 configured for operable connection to the handle assembly 110 and an elongate tubular body 124 configured for operable connection to the loading unit 130. Alternatively, the elongate tubular body 124 may be supported directly on the handle assembly 110 (e.g., permanently affixed to or integrally formed with the handle assembly).

[0045] The loading unit 130 is a disposable loading unit (“DLU”) that is releasably secured to the elongated tubular body 124 and thus, replaceable with a new loading unit 130. The loading unit 130 may be a single use loading unit (“SULU”) that is used one time and then replaced to facilitate multiples uses of the surgical stapling apparatus 100 on a patient. For example, during a surgical procedure, the surgical stapling apparatus 100 can be used to staple and cut tissue, and the entire SULU is replaced after each staple and cut operation of the surgical stapling apparatus 100. The loading unit 130 may be a multi-use loading unit (“MULU”) that is re-useable a predetermined number of times. For example, during a surgical procedure, the surgical stapling apparatus 100 can be used to staple and cut tissue, and a reload (e.g., a staple cartridge 154, as seen in FIG. 2) of the MULU is replaced after each staple and cut operation of the surgical stapling apparatus 100 a pre-determined number of times before the entire MULU needs to be replaced. Alternatively, the loading unit 130 may be permanently affixed to the elongated tubular body 124.

[0046] The loading unit 130 includes a housing portion 132 and a tool or jaw assembly 134 including first and second jaws 134a, 134b. The first jaw 134a and/or the second jaw 134b is pivotable with respect to the housing portion 132 such that the tool assembly 134 is movable between an open position in which the first and second jaws 134a, 134b are spaced apart with respect to each other, and a closed position in which the first and second jaws 134a, 134b are substantially adjacent each other.

[0047] FIG. 2 illustrates the first jaw 134a of the tool assembly 134, which includes an anvil assembly 140, and the second jaw 134b of the tool assembly 134, which includes a staple cartridge assembly 150 having a surgical buttress 170 releasably attached thereto. The anvil assembly 140 includes an anvil plate 142 having a tissue facing surface 144, and a cover plate 146 secured over the anvil plate 142. The staple cartridge assembly 150 includes a cartridge carrier 152 and a staple cartridge 154 selectively received and supported within the cartridge carrier 152. The staple cartridge 154 may be removably and/or replaceably attached to the cartridge carrier 152 by, for example, a snap-fit connection, a detent, a latch, among other types of connectors within the purview of those skilled in the art.

[0048] As shown in FIG. 3, the staple cartridge 154 includes a cartridge body 156 having an inner or tissue facing surface 158 defining staple pockets or retention slots 155 that support staples (not shown) therein. A central longitudinal slot 157 is also defined in the tissue facing surface 158 and extends along a substantial length of the cartridge body 156 to facilitate

passage of a knife (not shown) therethrough. A cartridge tip 160 extends from the cartridge body 156 distal to the staple pockets 155. The cartridge tip 160 includes an inner surface 162 contiguous with and extending distally from the tissue facing surface 158 of the cartridge body 156. The inner surface 162 may be angled or tapered distally away from the cartridge body 156.

[0049] Proximal fingers 164 extend outwardly from the tissue facing surface 158 of the cartridge body 156 proximal to the staple pockets 155, and a distal tongue 166 extends outwardly from the inner surface 162 of the cartridge tip 160 distal to the staple pockets 155. The proximal fingers 164 and the distal tongue 166 may be respectively secured to or integrally formed with the tissue facing surface 158 of the cartridge body 156 and the inner surface 162 of the cartridge tip 160. In aspects, the staple cartridge 154 is molded to include the proximal fingers 164 and the distal tongue 166. In some aspects, the proximal fingers 164 and the distal tongue 166 are hollow to minimize the amount of material in the proximal fingers 164 such that upon deformation from a first or buttress loading state or position (see e.g., FIG. 4) to a second or buttress capture state or position (see e.g., FIGS. 9 and 10), the portions of the proximal fingers 164 positioned above the surgical buttress 170 transition from extending beyond the surgical buttress 170 to be substantially flat against the surgical buttress 170.

[0050] As shown in FIGS. 3 and 4, the proximal fingers 164 are disposed on opposed sides of the central longitudinal slot 157 of the cartridge body 156 in the first or buttress loading state or position. While shown as including two proximal fingers 164, one on each side of the central longitudinal slot 157, it should be understood that the number of proximal fingers 164 may vary (e.g., two proximal fingers on each side of the central longitudinal slot 157). Each of the proximal fingers 164 is axially aligned with an innermost row of the staple pockets 155, however, it should be understood that the proximal fingers 164 may be otherwise laterally positioned relative to the staple pockets 155. Each of the proximal fingers 164 extends outwardly from the tissue facing surface 158 of the cartridge body 156 towards the anvil assembly 140. In aspects, the proximal fingers 164 extend along an axis that is generally transverse to a longitudinal axis “X” defined through the staple cartridge 154. It should be understood that the proximal fingers 164 may extend at other orientations relative to the tissue facing surface 158, such as at a proximally extending angle.

[0051] Each of the proximal fingers 164 includes an elongate body 164a extending outwardly from the tissue facing surface 158 of the cartridge body 156 and a free end portion

164b at a terminal end of the elongate body 164a. The proximal fingers 164 are shown as truncated cylinders each having an elongate body 164a that is cylindrical in shape and a free end portion 164b that is elliptical in shape and extends at an angle (e.g., an acute angle) with respect to the elongate body 164a. The proximal fingers 164 may be pins, posts, poles, columns, etc., among other types of projections of various configurations and shapes within the purview of those skilled in the art to which a proximal end portion 170a of the surgical buttress 170 may be secured.

**[0052]** As seen in FIG. 3, the distal tongue 166 includes an elongate body 166a extending distally from the inner surface 162 of the cartridge tip 160 towards a distal end 154b of the staple cartridge 154. The distal tongue 166 may extend distally beyond the distal end 154b of the staple cartridge 154. In aspects, the distal tongue 166 extends along, or generally parallel to, the longitudinal axis “X” defined through the staple cartridge 154 and, in some aspects, the distal tongue 166 is axially aligned with the central longitudinal slot 157 defined in the cartridge body 156. Similar to the proximal fingers 164, the number of distal tongues 166 may vary and the distal tongue 166 may have other configurations and shapes, and/or orientations relative to the inner surface 162 of the cartridge tip 160.

**[0053]** As shown in FIGS. 3 and 5, the surgical buttress 170 includes a buttress body 172 having a generally rectangular shape corresponding to the shape of the tissue facing surface 158 of the staple cartridge 154 and configured for positioning over the staple pockets 155 of the tissue facing surface 158 of the staple cartridge 154. Proximal and distal end portions 170a, 170b of the surgical buttress 170 respectively include proximal and distal tabs 174, 176. The proximal and distal tabs 174, 176 respectively extend proximally and distally from proximal and distal ends 172a, 172b of the buttress body 172.

**[0054]** The proximal tab 174 is sized and shaped for positioning over a proximal end portion 154a of the staple cartridge 154 that is proximal to the staple pockets 155, and the distal tab 176 is sized and shaped for positioning over the cartridge tip 160. It should be understood that the proximal and distal tabs 174, 176 may have other sizes and shapes so long as they are configured to respectively engage the proximal fingers 166 and the distal tongue 166 of the staple cartridge 154, as described below.

**[0055]** The proximal tab 174 includes proximal openings 175 defined therethrough. Each of the proximal openings 175 includes a base portion 175a corresponding in size and shape

with the proximal finger 164 of the staple cartridge 154 (e.g., circular in shape) to accommodate passage of the proximal finger 164 therethrough. Each of the proximal openings 175 includes a wing portion 175b tapering away from the base portion 175a to a wing tip 175c. The wing portions 175b are sized and shaped to overlie the central longitudinal slot 157 of the staple cartridge 154 when the surgical buttress 170 is positioned on the tissue facing surface 158 of the staple cartridge 154.

**[0056]** The proximal openings 175 are pre-defined through the proximal tab 174 with the base portions 175a being laterally spaced with respect to each other (e.g., corresponding to the position of the proximal fingers 164a of the staple cartridge 154), and the wing portions 175b extending toward the other of the base portions 175a so that the wing portions 175b are axially aligned with each other (e.g., corresponding to the position of the central longitudinal slot 157 of the staple cartridge 154). In aspects, the proximal openings 175 are substantially teardrop shaped, however, other shapes and configurations are envisioned. Each proximal opening 175 has a length sufficient such that the respective wing portions 175b extend across the central longitudinal slot 157 of the cartridge body 156.

**[0057]** The distal tab 176 includes a distal opening 177 defined therethrough that is sized and shaped to engage the distal tongue 166 of the cartridge tip 160. The distal opening 177 may be larger about a proximal portion 177a of the distal opening 177 and smaller at a distal portion 177b of the distal opening 177. In aspects, the distal opening 177 tapers distally. The distal tab 176 includes perforations 178 extending the length (e.g., the entire length) of the distal tab 176 that are aligned with the central longitudinal slot 157 of the staple cartridge 154. In aspects, the perforations 178 extend through a distal portion 172c of the buttress body 172 so that a portion of the perforations 178 overlie the central longitudinal slot 157 when the surgical buttress 170 is positioned on the staple cartridge 154. The perforations 178 may be laser cut or stamped into the surgical buttress 170. The proximal and distal openings 175, 177 are positioned in the respective proximal and distal tabs 174, 176 such that when the surgical buttress 170 is loaded onto the staple cartridge 154 the buttress body 172 is flush against the staple cartridge 154.

**[0058]** The surgical buttress 170 is fabricated from biocompatible materials which are bioabsorbable or non-absorbable, natural or synthetic materials. It should be understood that a single or combination of natural, synthetic, bioabsorbable, and/or non-bioabsorbable materials may be used to form the surgical buttress 170. In aspects, the surgical buttress 170 is a single

sheet of material that is formed and cut to shape. In other aspects, the surgical buttress 170 is formed from a plurality of sheets of material, that are fabricated from the same or different materials, and/or the components (e.g., the body, the proximal tab, the distal tab, etc.) of the surgical buttress 170 are formed from the same or different materials that are attached to one another by, for example, welding, using adhesive, tying sutures, etc.

[0059] The surgical buttress 170 may be porous, non-porous, or combinations thereof. Suitable porous structures include, for example, fibrous structures (e.g., knitted structures, woven structures, and non-woven structures) and/or foams (e.g., open or closed cell foams). Suitable non-porous structures include, for example, films. The surgical buttress 170 may be a single porous or non-porous layer, or may include a plurality of layers including any combination of porous and non-porous layers. For example, the surgical buttress 170 may include multiple porous and non-porous layers that are stacked in an alternating manner. In another example, the surgical buttress 170 may be formed in a “sandwich-like” manner wherein the outer layers are porous and the inner layer(s) are non-porous, or vice versa.

[0060] Porous layer(s) in the surgical buttress 170 may enhance the ability of the surgical buttress 170 to absorb fluid, reduce bleeding, and/or seal a wound. Also, the porous layer(s) may allow for tissue ingrowth to fix the surgical buttress 170 in place. Non-porous layer(s) in the surgical buttress 170 may enhance the ability of the surgical buttress 170 to resist tears and perforations during the manufacturing, shipping, handling, and/or stapling processes. Also, non-porous layer(s) may retard or prevent tissue ingrowth from surrounding tissues thereby acting as an adhesion barrier and preventing the formation of unwanted scar tissue.

[0061] In a method of loading the surgical buttress 170 onto the staple cartridge 154, the surgical buttress 170 is positioned over the tissue facing surface 158 of the staple cartridge 154 such that the proximal openings 175 defined in the proximal tab 174 engage the proximal fingers 164 of the staple cartridge 154, and the distal opening 177 defined in the distal tab 176 engages the distal tongue 166 of the staple cartridge 154, as seen in FIGS. 6 and 7. In some aspects, the distal portion 170b of the surgical buttress 170 is first aligned with, and moved toward, the staple cartridge 154 so that the distal tongue 166 of the staple cartridge 154 extend through the distal opening 177 and engages the distal tab 176 of the surgical buttress 170, and then the proximal portion 170a of the surgical buttress 170 is aligned with, and moved over, the proximal fingers 164 so that the proximal fingers 164 extend through the proximal openings 175 and engage the proximal tab 174 of the surgical buttress 170. Once assembled, as seen in

FIG. 6, the buttress body 172 of the surgical buttress 170 lies flush against the tissue facing surface 158 (FIG. 3) of the staple cartridge 154.

[0062] As shown in FIGS. 8 and 9, the proximal fingers 164, which extend outwardly beyond the surgical buttress 170, are deformed from the buttress loading state seen in FIGS. 6 and 7 in which the free end portions 164b of the proximal fingers 164 extend along an axis defined by the elongate bodies 164a and no portion of the proximal fingers 164 overlie the surgical buttress, to the second or buttress capture state or position as seen in FIGS. 8 and 9 in which the free end portions 164b of the proximal fingers 164 are deformed away from the axis and overlie a portion of the surgical buttress 170 to secure the surgical buttress 170 to the staple cartridge 154. In aspects, the proximal fingers 164 are deformed by application of heat and/or pressure and, in some aspects, the proximal fingers 164 are deformed by heat staking. Other processes may be utilized to change the state or position of the proximal fingers 164, e.g., mechanical deformation, to bend, fold, or otherwise move the free end portions 164b of the proximal fingers 164 over the surgical buttress 170. In some aspects, the proximal fingers 164 are permanently deformed to the second state.

[0063] While the proximal fingers 164 are shown in FIG. 9 with the free end portions 164b extending proximally over the proximal tab 174, it should be understood that the proximal fingers 164 may be deformed in any direction so long as the proximal fingers 164 do not cover the wing portions 175b of the proximal openings 175 (e.g., so they do not overlap the central longitudinal slot 157 (FIG. 3) of the staple cartridge 154). For example, as shown in FIG. 10, the free end portions 164b of the proximal fingers 164 may be melted and/or pressed towards the staple cartridge 154 to form enlarged heads 164c at the end of the elongate body 164a extending over the surgical buttress 170. Further, in some aspects, the distal tongue 166 may also be deformed from the first or buttress loading state seen in FIG. 8, to a second or buttress capture state, as seen, for example, in FIG. 11. In such aspects, a free end portion 166b of the distal tongue 166 may be melted and/or pressed towards the cartridge tip 160 of the staple cartridge 154 to capture the distal tab 176 of the surgical buttress 170.

[0064] With the proximal and distal tabs 174, 176 of the surgical buttress 170 secured to the staple cartridge 154, the staple cartridge 154 is now loaded with the surgical buttress 170. The staple cartridge 154 may be pre-loaded with the surgical buttress 170 (e.g., by the manufacturer) or may be loaded with the surgical buttress 170 (e.g., by an end-user).

[0065] The anvil assembly 140 (FIG. 2) may also have a surgical buttress (e.g., a surgical buttress 171, as seen in FIG. 12) releasably attached thereto. The surgical buttress 171 may be retained on the anvil assembly 140 by any suitable attachment feature within the purview of those skilled in the art, such as, for example, mechanical attachment features (e.g., a suture), chemical attachment features (e.g., adhesive), and/or attachment methods (e.g., welding).

[0066] The surgical stapling apparatus 100 (FIG. 1), with the staple cartridge assembly 150 including the staple cartridge 154 loaded with the surgical buttress 170, is ready for use. The surgical stapling apparatus 100 is used in accordance with methods known by those skilled in the art. Once the anvil and staple cartridge assemblies 140, 150 are clamped onto tissue, the surgical stapling apparatus 100 is fired, thereby stapling the surgical buttress 170 to the tissue. During firing, a knife (not shown) travels distally between the anvil and staple cartridge assemblies 140, 150 (e.g., through the central longitudinal slot 157 of the staple cartridge 154) and substantially simultaneously cuts and divides the tissue and the surgical buttress 170 disposed between the rows of formed staples. When firing is complete and the anvil and staple cartridge assemblies 140, 150 are unclamped and removed from the surgical site, as shown in FIG. 12, the body 172 of the surgical buttress 170, is stapled to the tissue “T”.

[0067] Specifically, as the knife (not shown) travels through the proximal portion 170a of the surgical buttress 170, the knife cuts the proximal tab 174 through the wing portions 175b of the proximal openings 175, as shown in FIG. 13, such that when the staple cartridge assembly 150 (FIG. 2) is pulled away from the stapled tissue, the proximal tab 174 of the surgical buttress 170 slides away from staple cartridge 154 by allowing passage of the proximal fingers 164 through the wing portions 175b of the proximal openings 175 thereby freeing the proximal tab 174 from the proximal fingers 164 and thus, from the staple cartridge 154. As the knife continues its travel through the buttress body 172 of the surgical buttress 170, the knife encounters the perforations 178 (FIG. 8) such that when the staple cartridge assembly 150 is pulled away from the stapled tissue, the distal portion 170b of the surgical buttress 170 separates along the perforations 178 thereby freeing the distal tab 176 from the distal tongue 166 and thus, from the staple cartridge 154. The used staple cartridge 154 may then be removed from the tool assembly 134 and replaced with a new staple cartridge 154. A new surgical buttress 170 may be installed onto the new staple cartridge 154, as needed or desired, as described above.



[0068] Turning now to FIG. 14, a surgical buttress attachment assembly 201 in accordance with another aspect of this disclosure is shown. The surgical buttress attachment assembly 201 includes a surgical buttress 170, a staple cartridge 254, and a buttress attachment fixture or loading tool 280. The features of the staple cartridge 254 that are substantially similar or identical to the staple cartridge 154 of FIG. 3 and will be described briefly herein, and the differences will be described in detail herein. Accordingly, it should be understood that various components of the disclosure, such as those numbered in the 100 series, correspond to components of the disclosure similarly numbered in the 200 series, such that redundant explanation of similar components need not be repeated herein.

[0069] The staple cartridge 254 includes a cartridge body 256 having a tissue facing surface 258 including staple pockets 255 and a central longitudinal slot 257 formed therein. As shown in FIG. 15, the staple cartridge 254 includes proximal slots 259 disposed on opposed sides of the central longitudinal slot 257 of the cartridge body 256. Each of the proximal slots 259 includes a proximal finger 264 disposed therein. As shown in FIG. 16, each of the proximal fingers 264 includes an elongate body 264a having a distal end portion 264d secured to, or integrally formed with, the cartridge body 256 and a proximal or free end portion 264b. The distal end portion 264d of the proximal finger 264 acts as a hinge about which the elongate body 264a can pivot to move the free end portion 264b into and out of the proximal slot 259 between a buttress loading position, as seen in FIG. 18, and a buttress capture position, as seen in FIG. 21. The free end portion 264b of the proximal finger 264 includes a camming surface or ledge 265a disposed at an angle with respect to the elongate body 264a and a proximally-facing notch 265b defining a proximal hook 265c configured to engage a proximal portion 170a of the surgical buttress 170.

[0070] With continued reference to FIG. 14, the staple cartridge 254 also includes a cartridge tip 260 having a cutout 261 extending through an inner surface 262 of the cartridge tip 260 to define a distal tongue 266. In aspects, the distal tongue 266 is flush with the inner surface 262 of the cartridge tip 260. While the distal tongue 266 is shown as being substantially U-shaped, it should be understood that the distal tongue 266 may have other configurations so long as the distal tongue 269 is capable of retaining the distal portion 170b of the surgical buttress 170 on the staple cartridge 254.

[0071] The buttress loading tool 280 includes a base 282 having a first surface 284 that is substantially planar and on which the staple cartridge 254 is placed. The first surface 284

includes side guides 286 and a distal guide 288 extending outwardly therefrom that are configured to align the staple cartridge 254 on the base 282. The side guides 286 and the distal guide 288 may be rails, bumps, among other projections or protuberances extending from the first surface 284 that are configured to engage respective side surfaces 254c and the distal end 254b of the staple cartridge 254. In some aspects, the side and distal guides 286, 288 are connected to form a single guide. Alternatively, the first surface 284 of the base 282 may include a depression in which the staple cartridge 254 is placed. Proximal posts 290 extend from a proximal end portion 282a of the base 282 and are configured to be received within the proximal slots 259 of the staple cartridge 254. The proximal posts 290 are sized and shaped to engage the camming surfaces 265a (FIG. 16) of the proximal fingers 264 when the staple cartridge 254 is positioned on the base 282 of the buttress loading tool 280 to move the proximal fingers 264 out of the proximal slots 259.

[0072] In a method of loading the surgical buttress 170 onto the staple cartridge 254, as shown in FIG. 17, the staple cartridge 254 is placed on the loading tool 280 such that the cartridge body 256 is positioned between the side guides 286 and the distal end 254b of the staple cartridge 254 is adjacent (e.g., abuts) the distal guide 288. As shown in FIGS. 17-19, the proximal posts 290 extend into the staple cartridge 254 and contact the camming surface 265a of the proximal fingers 264 to move the free end portion 264b of the proximal fingers 264 out of the proximal slots 259 and above the tissue facing surface 258 of the staple cartridge 254 to the buttress loading position. With the staple cartridge 254 positioned on the buttress loading tool 280, the proximal hooks 265c of the proximal fingers 264 are free to receive the proximal tab 174 of the surgical buttress 170.

[0073] The surgical buttress 170, as seen in FIG. 14, is then placed on the staple cartridge 254 such that the distal opening 177 in the distal tab 176 of the surgical buttress 170 engages the distal tongue 266 of the staple cartridge 254 in a similar manner as described above with respect to the distal tongue 166 of FIG. 3, and the proximal openings 175 in the proximal tab 174 of the surgical buttress 170 engage the proximal hooks 265c of the proximal fingers 264, as shown in FIG. 19. Once positioned, the staple cartridge 254 is removed from the buttress loading tool 280 and the proximal fingers 264 return back into the proximal slots 259 to the buttress capture position, as shown in FIGS. 20 and 21, to capture the proximal tab 174 of the surgical buttress 170 to the staple cartridge 254. The staple cartridge 254 is now loaded with the surgical buttress 170. The surgical stapling apparatus 100 (FIG. 1), with the staple cartridge

assembly 150 (FIG. 2) including the assembled surgical buttress attachment assembly 201, is used as described above with regard to the surgical buttress attachment assembly 101 of FIG. 3.

[0074] While the surgical buttress attachment assemblies of this disclosure are described and shown for a surgical buttress attachment on the second jaw of the tool assembly, it should be understood that surgical buttress attachment assemblies may additionally or alternatively be configured for use on the first jaw of the tool assembly. For example, the anvil assembly may include proximal fingers and/or distal tongues similar to those shown on the staple cartridge.

[0075] While illustrated as being used on a handheld powered surgical device hereinabove, it is contemplated, and within the scope of the disclosure for the surgical buttress attachment assemblies to be configured for use with handheld manually-actuated surgical devices, as well as other electrosurgical instruments. For example, the surgical buttress assemblies may be used on handheld manually actuated surgical devices, such as those shown and described in U.S. Patent Nos. 4,473,077, 5,915,616, 5,964,394, 6,330,965, 7,128,253, and 7,334,717, the entire contents of each of which are incorporated herein by reference. As another example, the surgical buttress attachment assemblies may be used on robotic surgical systems, such as the robotic surgical system shown and described in U.S. Patent No. 8,828,023, the entire contents of which are incorporated herein by reference.

[0076] While aspects of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. It is to be understood, therefore, that the disclosure is not limited to the precise aspects described, and that various other changes and modifications may be made by one skilled in the art without departing from the scope or spirit of the disclosure. Additionally, the elements and features shown and described in connection with certain aspects of the disclosure may be combined with the elements and features of certain other aspects without departing from the scope of the disclosure, and that such modifications and variation are also included within the scope of the disclosure. Therefore, the above description should not be construed as limiting, but merely as exemplifications of aspects of the disclosure. Thus, the scope of the disclosure should be determined by the appended claims and their legal equivalents, rather than by the examples given.

**WHAT IS CLAIMED IS:**

1. A surgical buttress attachment assembly for use with a surgical stapling apparatus, the surgical buttress attachment assembly comprising:

a staple cartridge including a tissue facing surface having staple pockets and a central longitudinal slot defined therein, the staple cartridge including proximal fingers extending outwardly from the tissue facing surface, each of the proximal fingers including an elongate body and a free end portion, the proximal fingers having a first state in which the free end portions extend along an axis defined by the respective elongate body and a second state in which the free end portions of the proximal fingers are deformed away from the axis; and

a surgical buttress including proximal openings defined therethrough, the surgical buttress positionable on the tissue facing surface of the staple cartridge with the proximal fingers extending through the proximal openings when the proximal fingers are in the first state and the surgical buttress secured to the staple cartridge when the proximal fingers are in the second state.

2. The surgical buttress attachment assembly according to claim 1, wherein the proximal fingers are disposed on opposed sides of the central longitudinal slot.

3. The surgical buttress attachment assembly according to claim 1, wherein the proximal fingers are disposed proximal to the staple pockets.

4. The surgical buttress attachment assembly according to claim 1, wherein the proximal fingers are permanently deformed to the second state.

5. The surgical buttress attachment assembly according to claim 1, wherein the proximal fingers are hollow.

6. The surgical buttress attachment assembly according to claim 1, wherein each of the proximal openings of the surgical buttress includes a base portion sized and shaped to receive one of the proximal fingers of the staple cartridge therethrough, and a wing portion extending away from the base portion.

7. The surgical buttress attachment assembly according to claim 6, wherein the wing portions of the proximal openings extend across the central longitudinal slot of the staple cartridge.

8. The surgical buttress attachment assembly according to claim 1, wherein the staple cartridge includes a cartridge tip having a distal tongue extending outwardly therefrom, and the surgical buttress includes a distal opening sized and shaped to receive the distal tongue therethrough.

9. The surgical buttress attachment assembly according to claim 8, wherein the distal tongue has a first state in which the distal tongue is axially aligned with the central longitudinal slot and a second state in which a free end portion of the distal tongue is deformed towards the cartridge tip.

10. The surgical buttress attachment assembly according to claim 8, wherein a distal portion of the surgical buttress includes perforations extending proximally and distally beyond the distal opening, the perforations axially aligned with the central longitudinal slot of the staple cartridge.

11. A method of loading a surgical buttress onto a staple cartridge, the method comprising:  
positioning a surgical buttress over a tissue facing surface of a staple cartridge such that proximal openings defined through the surgical buttress engage proximal fingers extending outwardly from the tissue facing surface of the staple cartridge, each of the proximal fingers including an elongate body and a free end portion, the proximal fingers disposed in a first state in which the free end portions extend along axis defined by the respective elongate body; and  
moving the proximal fingers to a second state in which the free end portions of the proximal fingers are deformed away from the axis and overlies a portion of the surgical buttress.

12. The method according to claim 11, wherein moving the proximal fingers to the second state includes heat-staking the free end portions.

13. A surgical buttress attachment assembly for use with a surgical stapling apparatus, the surgical buttress attachment assembly comprising:

a staple cartridge including a tissue facing surface having staple pockets and a central longitudinal slot defined therein, the staple cartridge including proximal slots defined therein and proximal fingers disposed within the proximal slots, the proximal fingers having a buttress loading position in which proximal end portions of the proximal fingers are disposed outside of the proximal slots and a buttress capture position in which the proximal end portions of the proximal fingers are disposed within the proximal slots; and

a surgical buttress including a proximal end portion having proximal openings defined therethrough, the proximal end portion of the surgical buttress attachable to the proximal end

portions of the proximal fingers of the staple cartridge when the proximal fingers are disposed in the buttress loading position, and the proximal end portion of the surgical buttress securable to the staple cartridge when the proximal fingers are moved to the buttress capture position.

14. The surgical buttress attachment assembly according to claim 13, wherein each of the proximal fingers includes a distal end portion hingedly coupled to the staple cartridge.

15. The surgical buttress attachment assembly according to claim 13, wherein the proximal end portion of each of the proximal fingers includes a proximally-facing notch defining a proximal hook configured to be received through the proximal opening of the surgical buttress.

16. The surgical buttress attachment assembly according to claim 13, wherein the staple cartridge further includes a distal tongue defined therein, and the surgical buttress includes a distal end portion having a distal opening defined therethrough, the distal opening sized and shaped to receive the distal tongue therethrough.

17. The surgical buttress attachment assembly according to claim 16, wherein the distal tongue is defined in an inner surface of a cartridge tip of the staple cartridge.

18. The surgical buttress attachment assembly according to claim 13, further including a buttress loading tool including a base having proximal posts extending outwardly therefrom, and wherein the staple cartridge is positionable on the base such that the proximal posts are received within the proximal slots, the proximal posts configured to move the proximal fingers from the buttress capture position to the buttress loading position.

19. The surgical buttress attachment assembly according to claim 18, wherein the proximal end portion of each of the proximal fingers includes a camming surface configured to engage the proximal post of the buttress loading tool.

20. The surgical buttress attachment assembly according to claim 18, wherein the buttress loading tool further includes side guides and a distal guide extending outwardly from the base, and wherein, when the staple cartridge is positioned on the base, the staple cartridge is received between the side guides and a distal end of the staple cartridge abuts the distal guide.

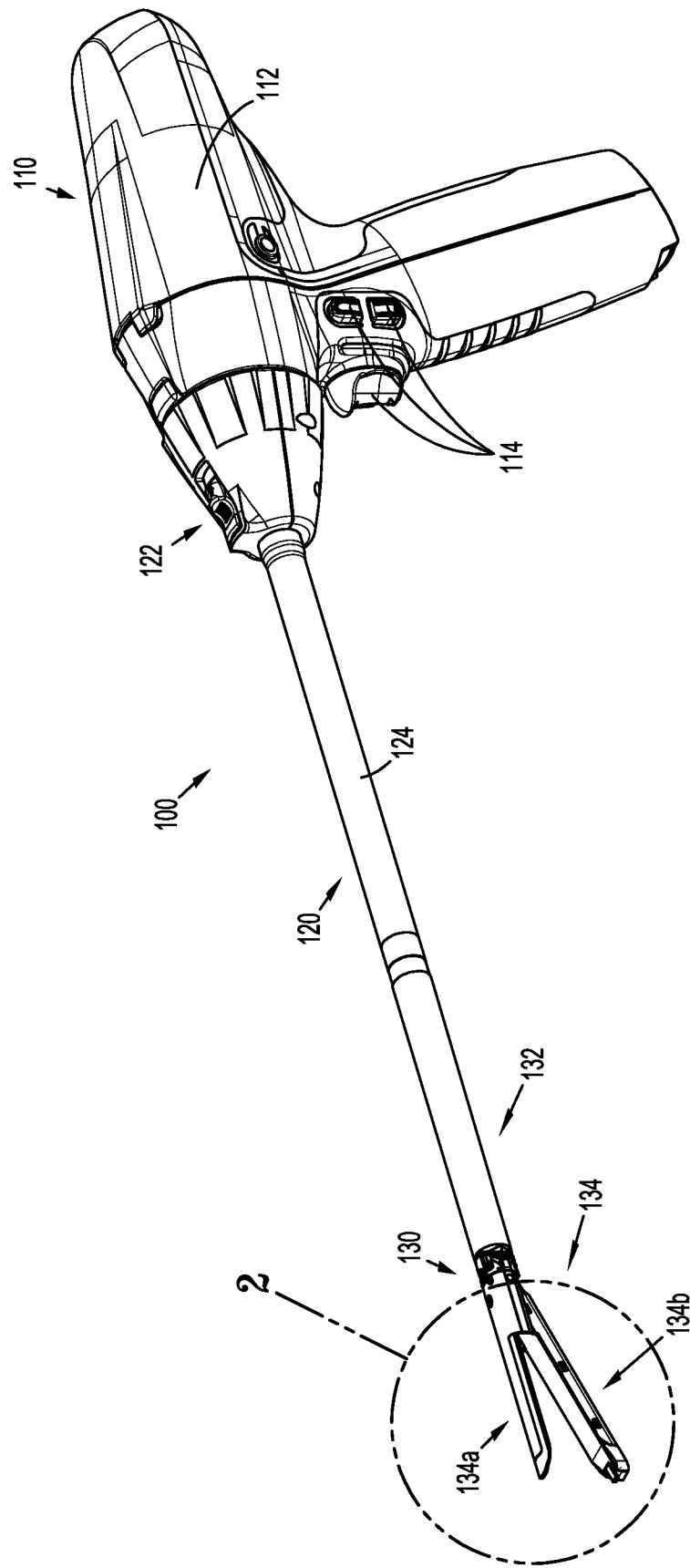
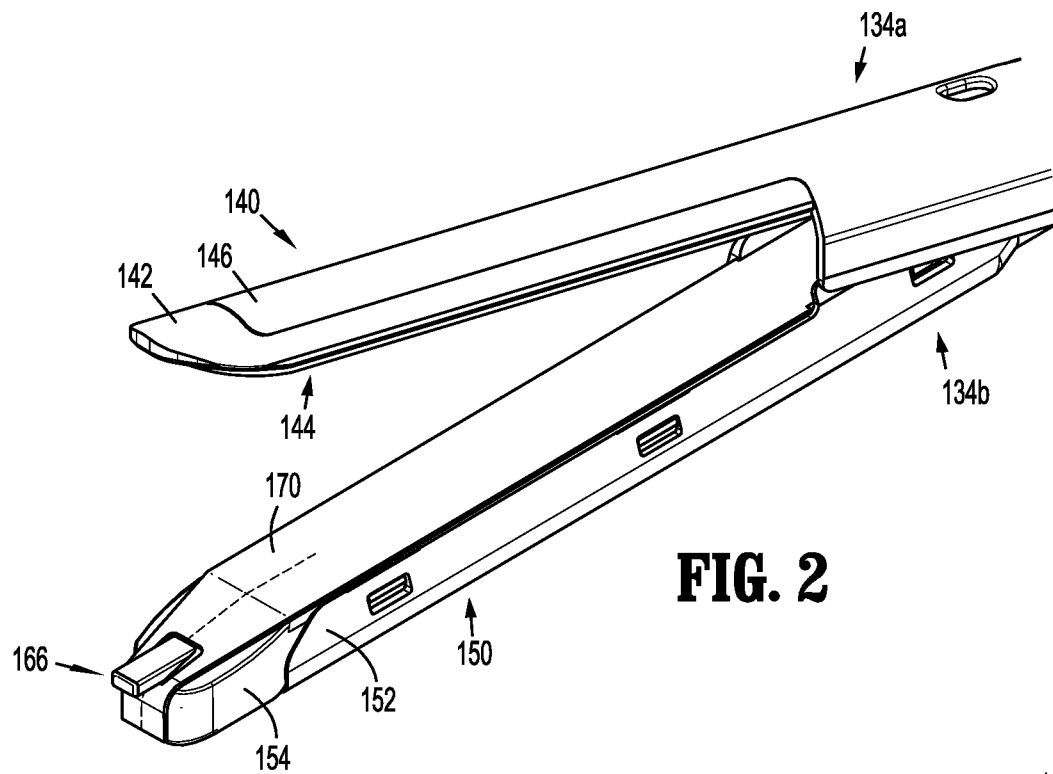
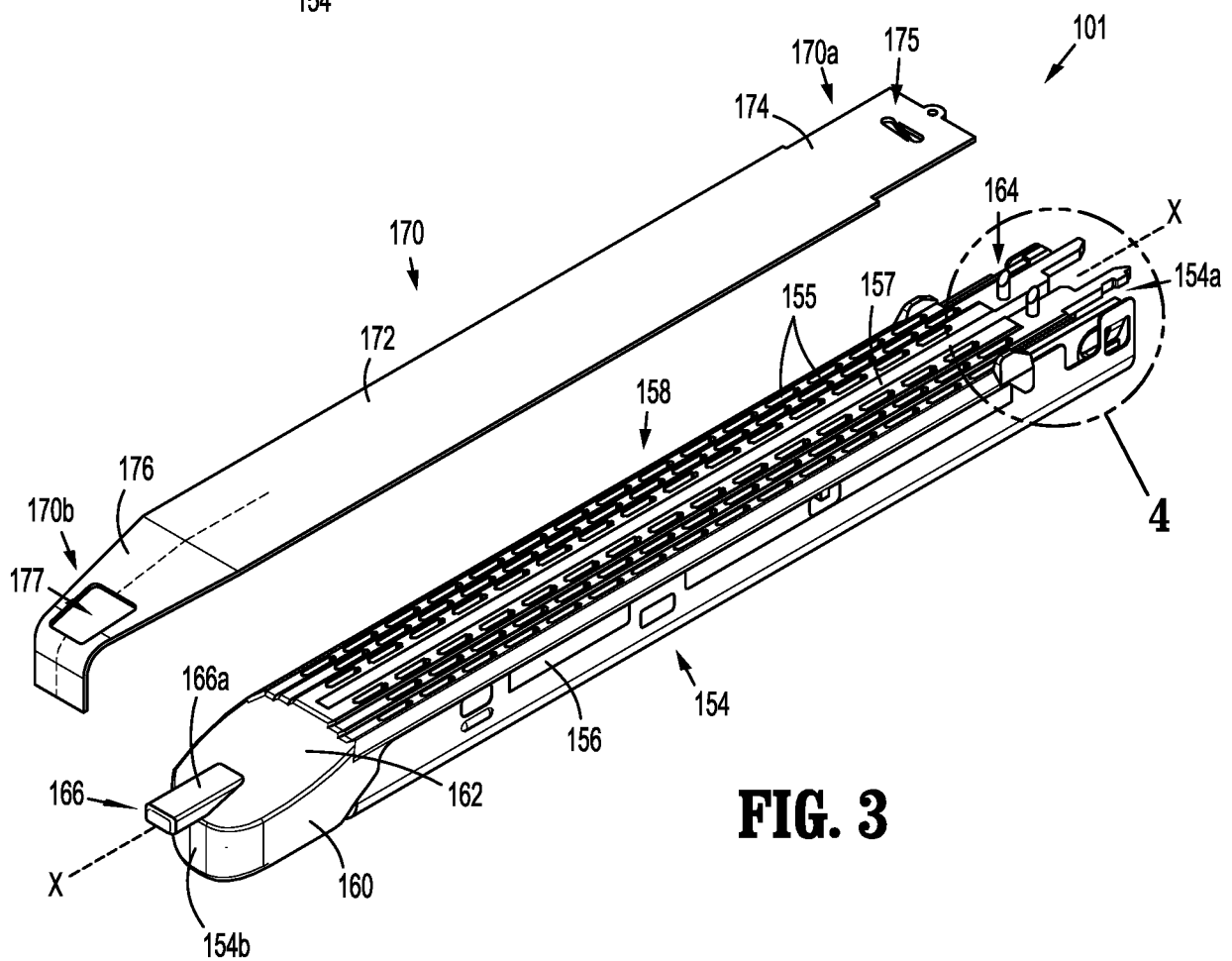


FIG. 1



**FIG. 2**



**FIG. 3**



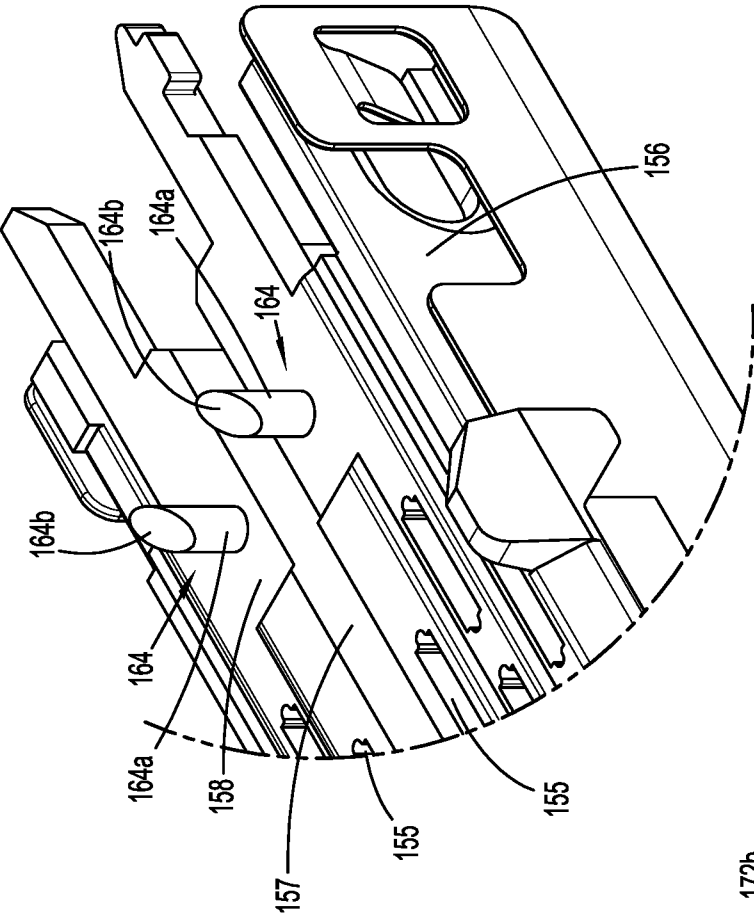


FIG. 4

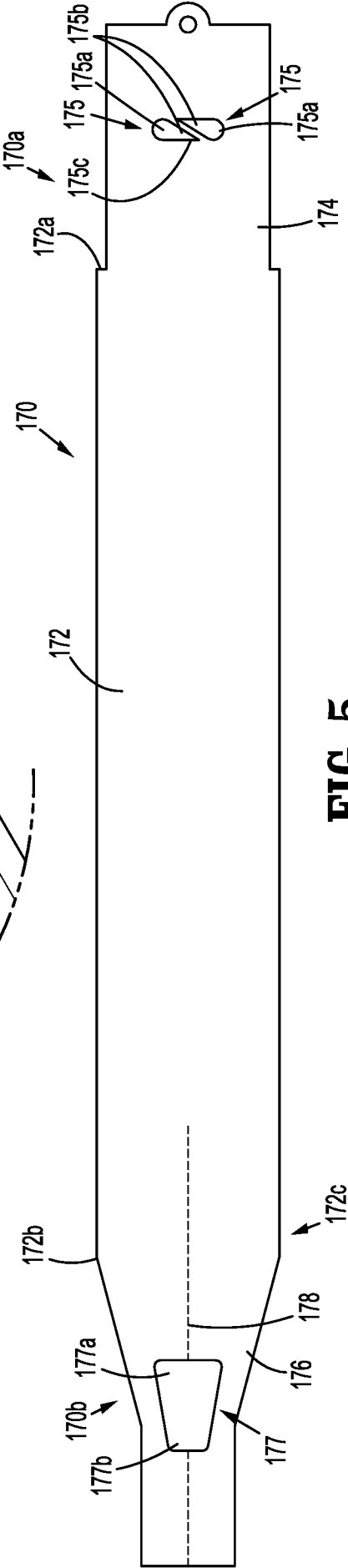
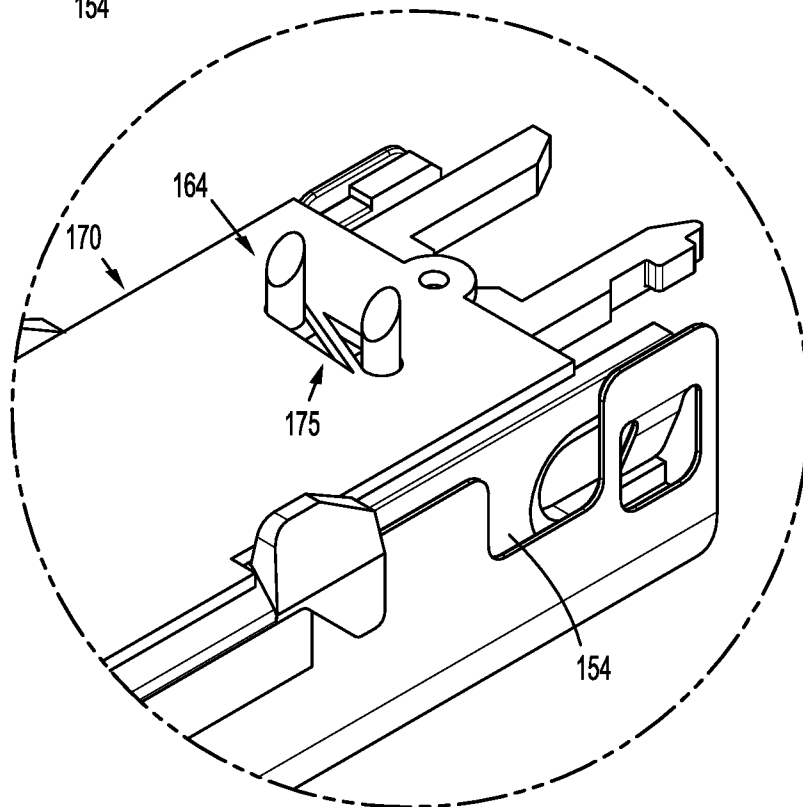
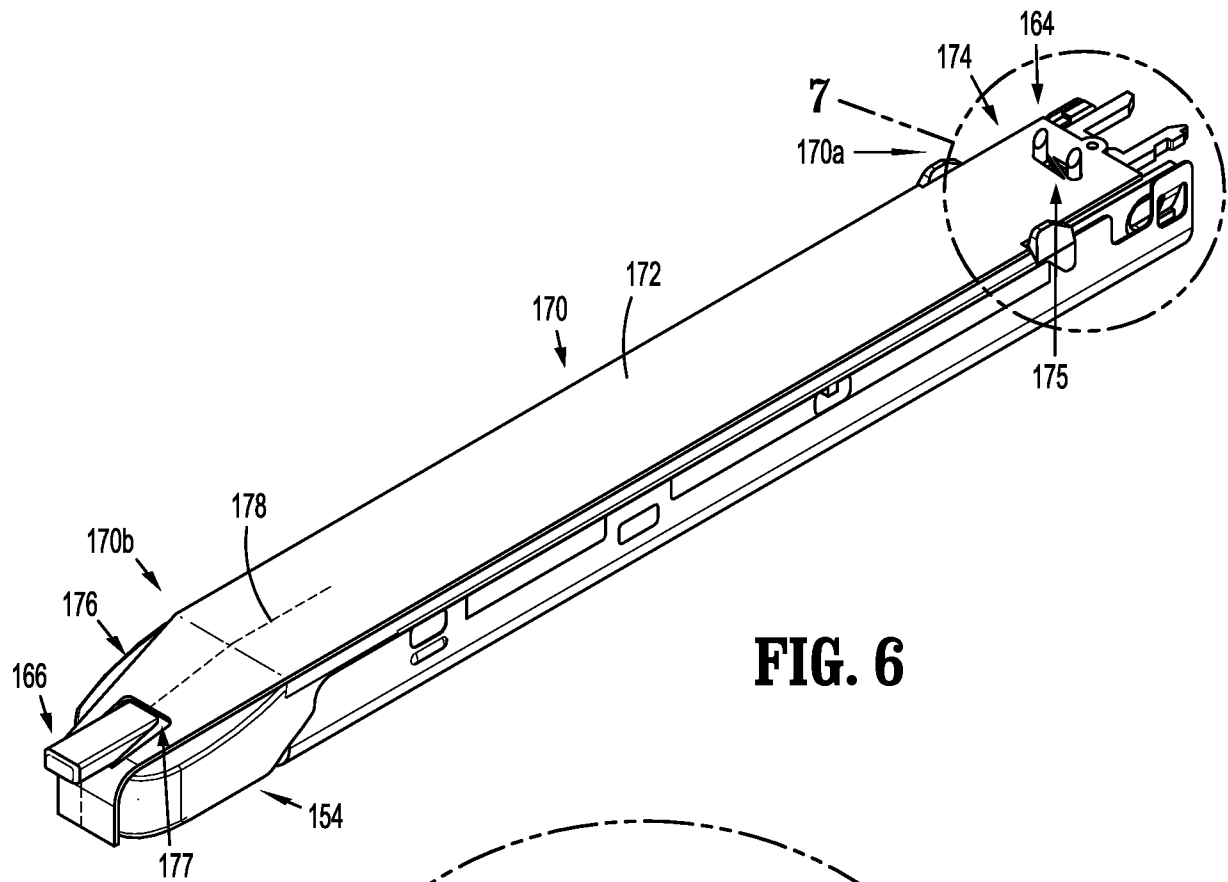
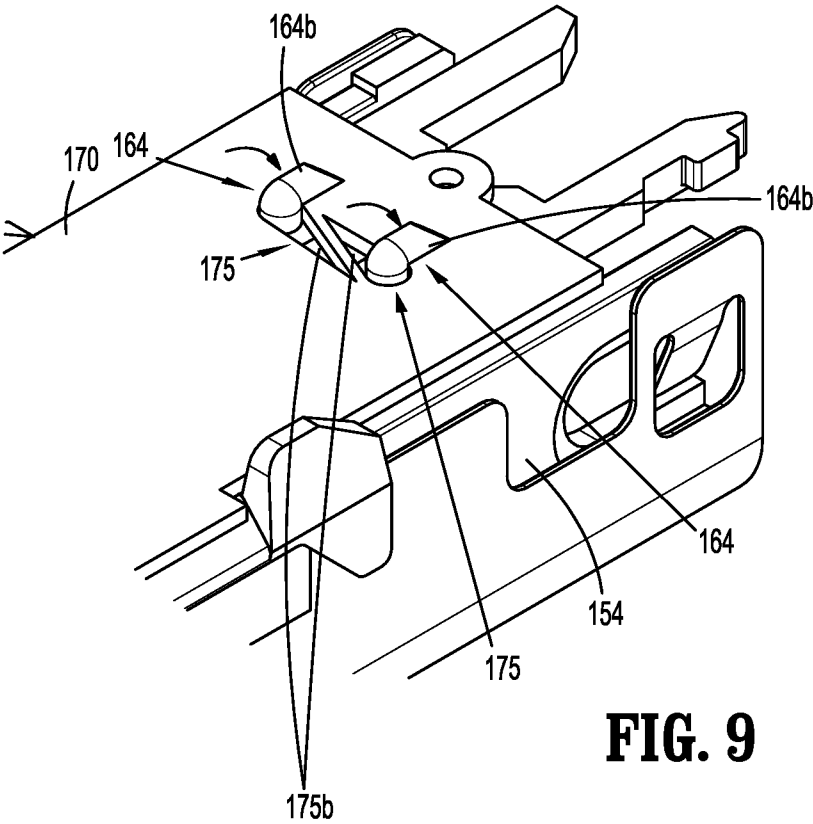
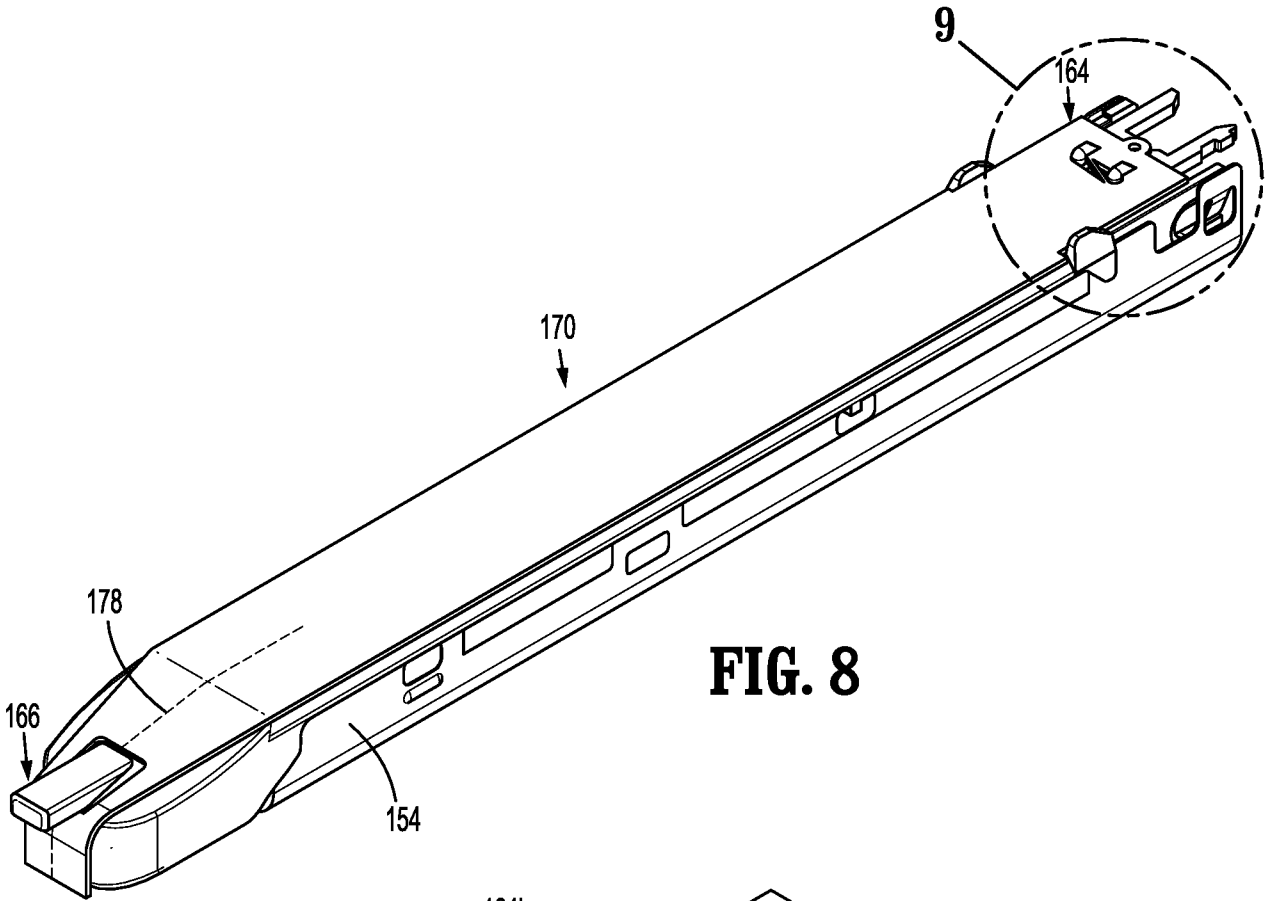
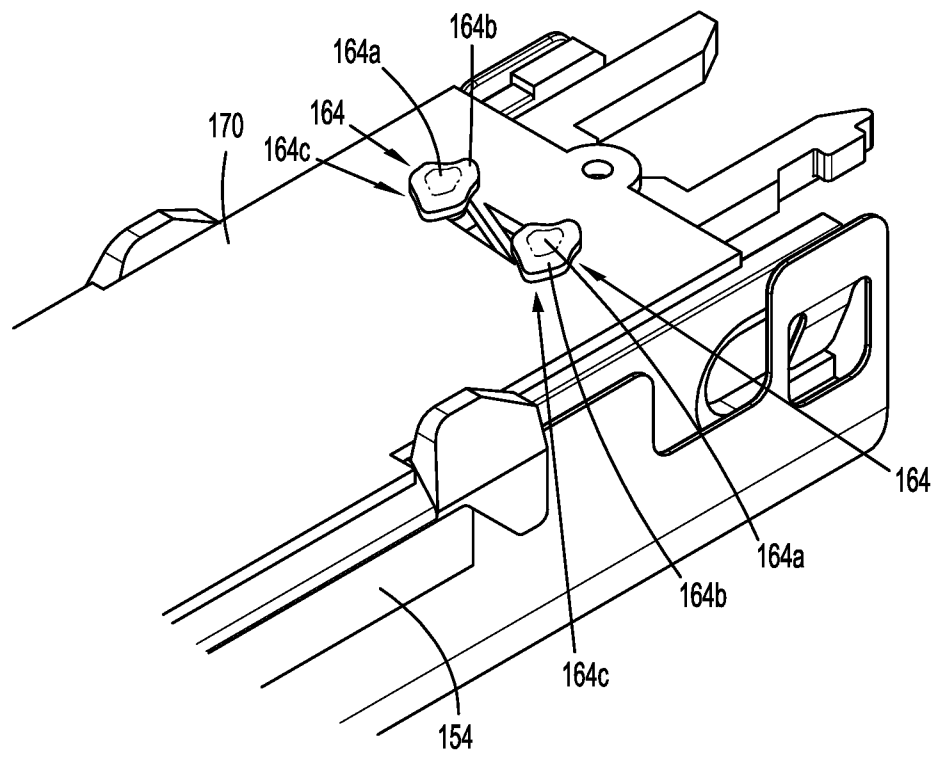


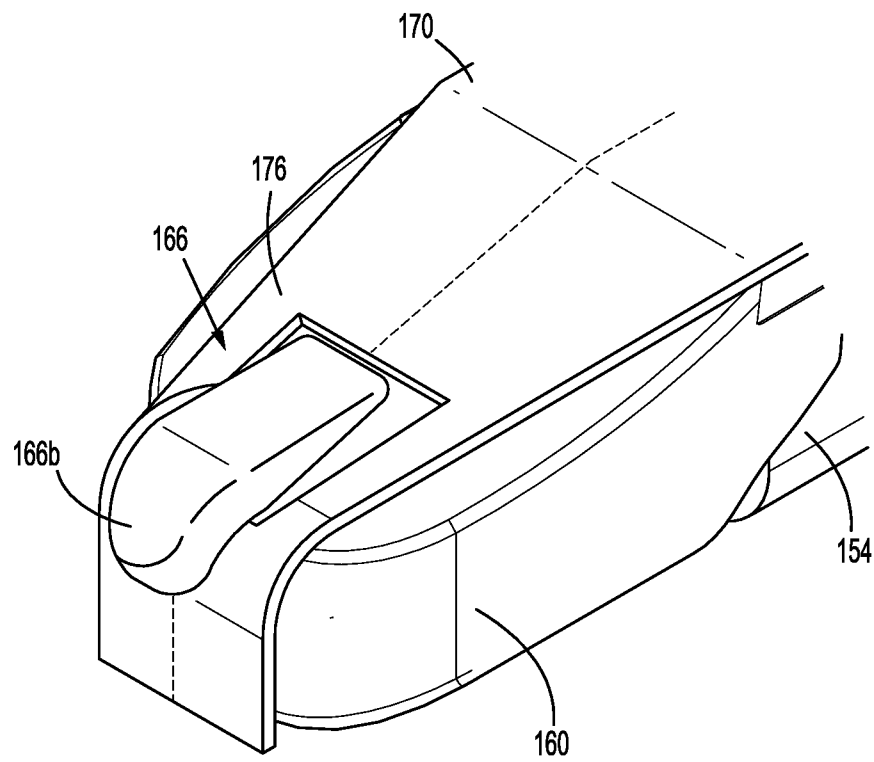
FIG. 5



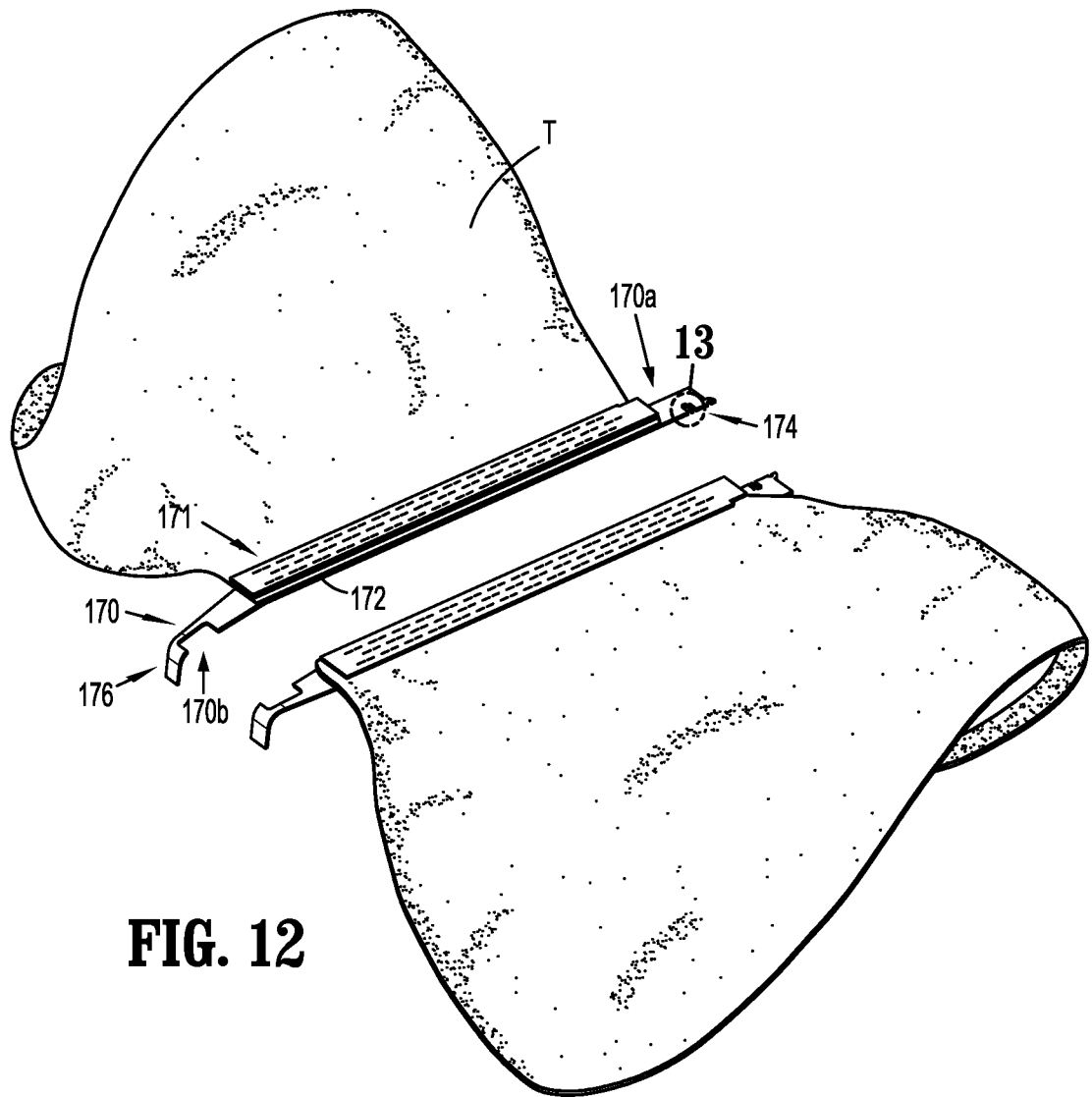




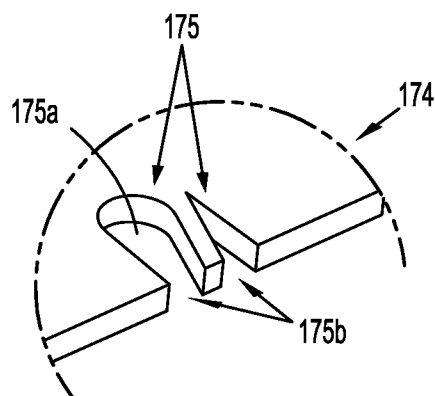
**FIG. 10**



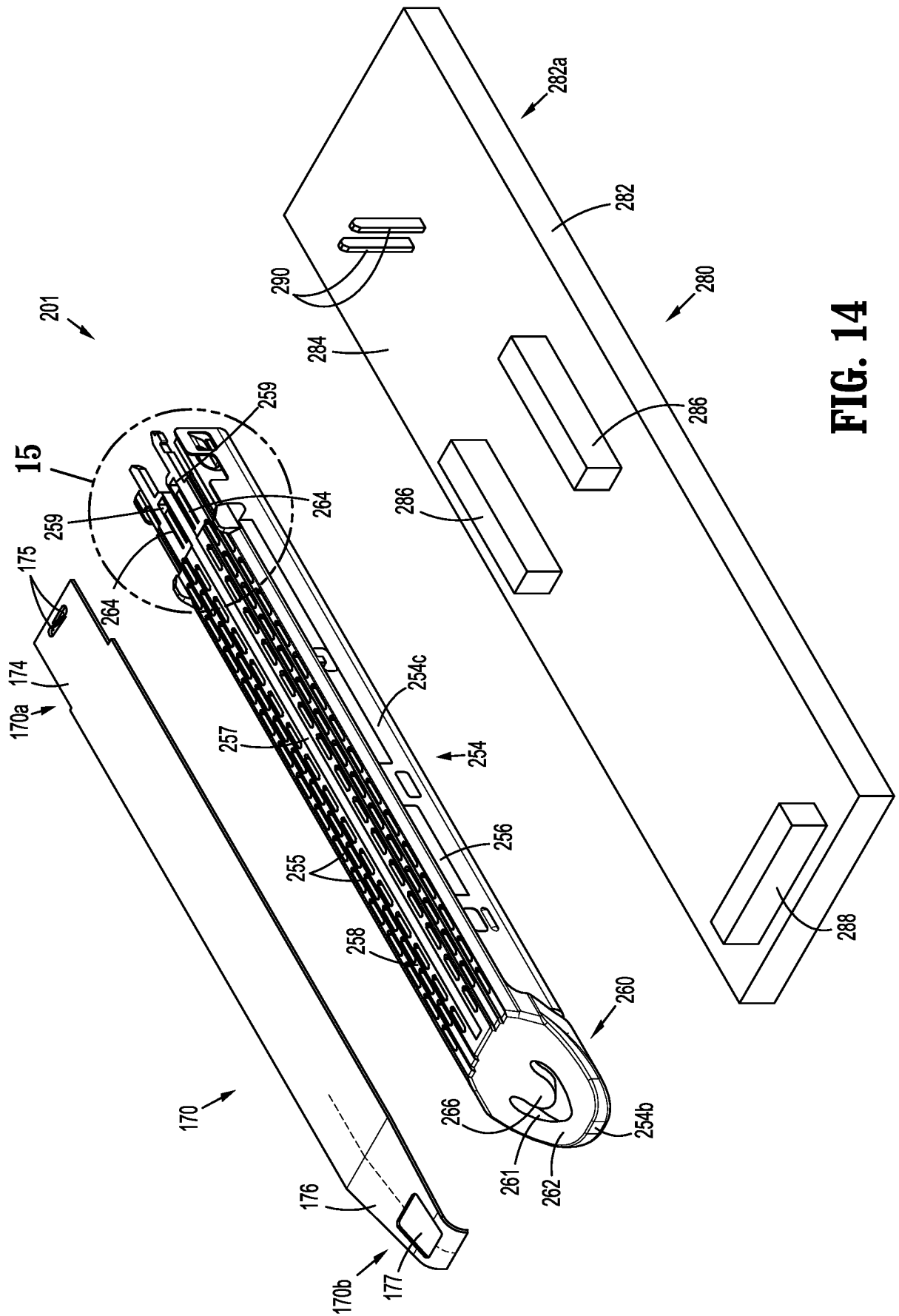
**FIG. 11**



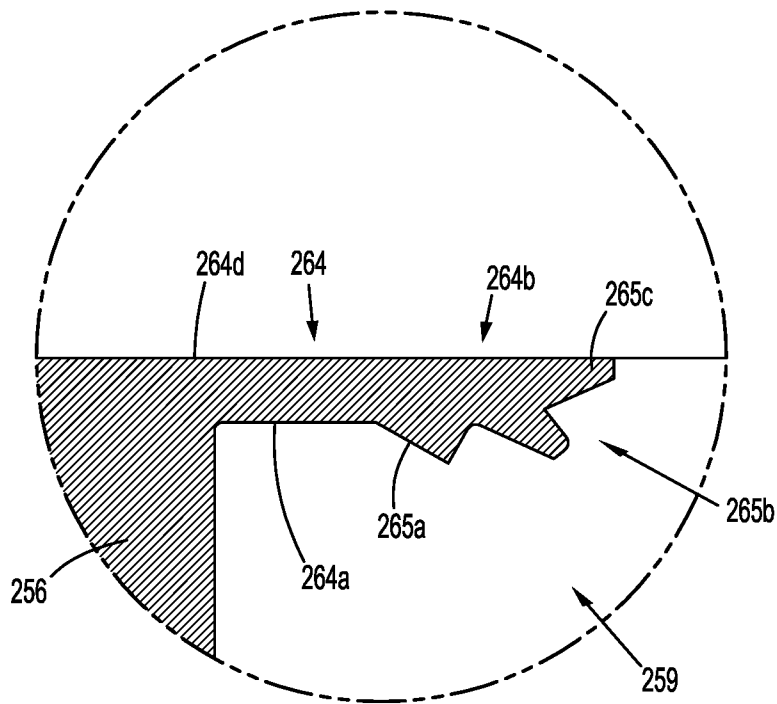
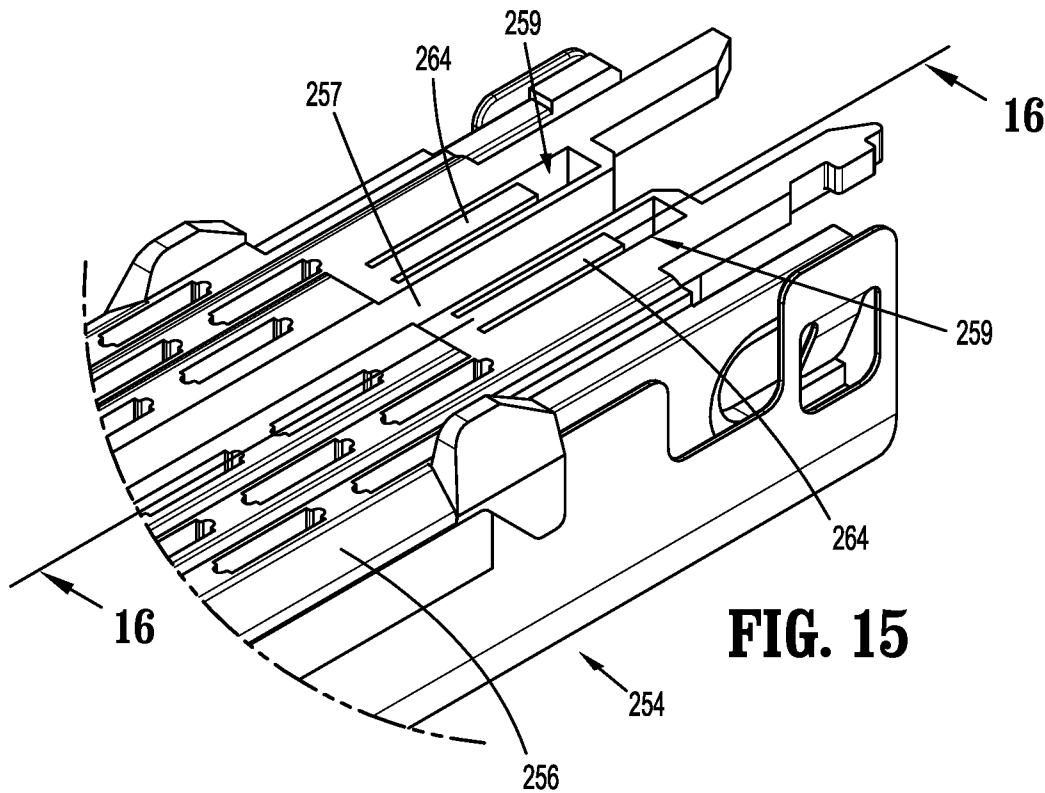
**FIG. 12**

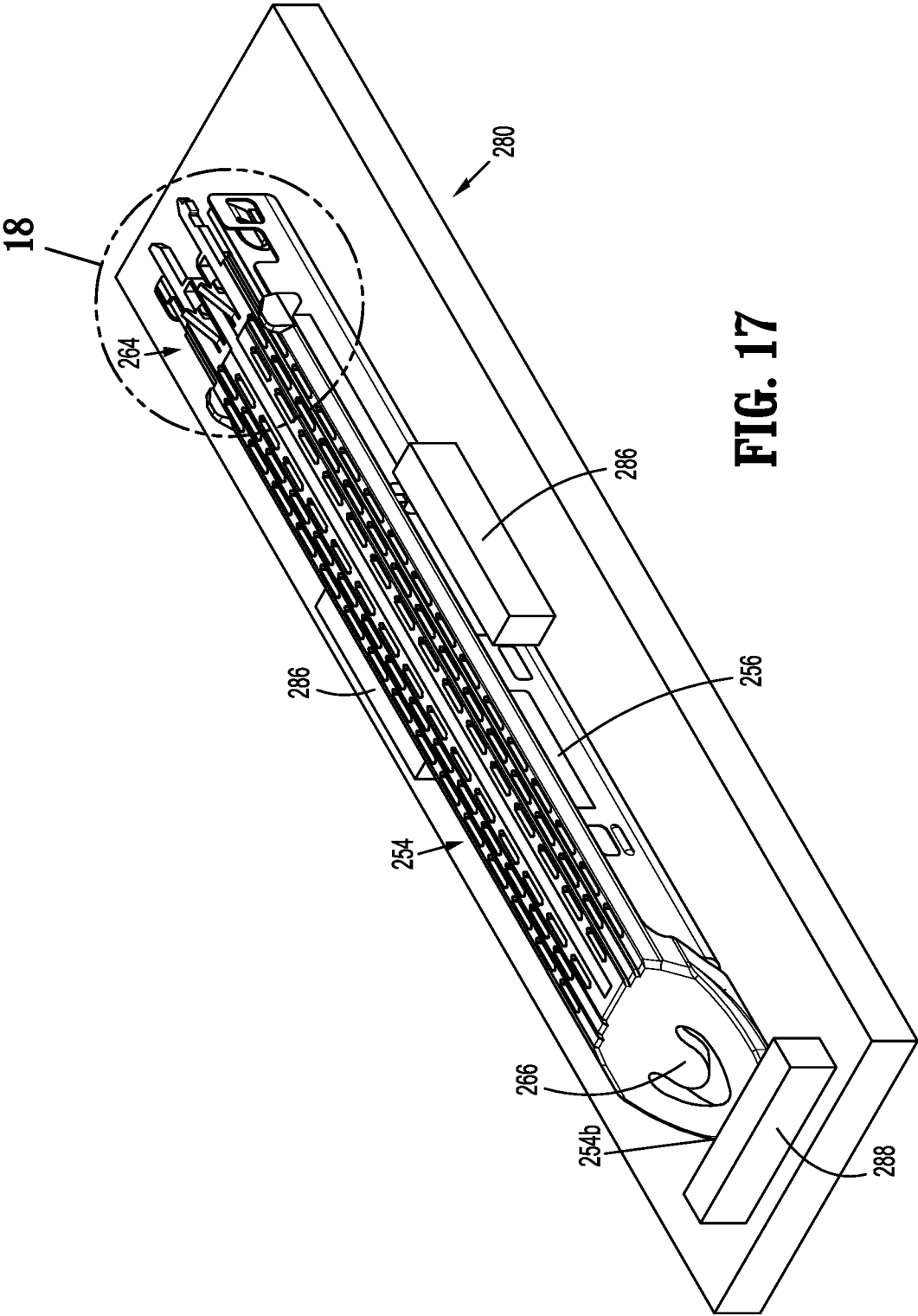


**FIG. 13**

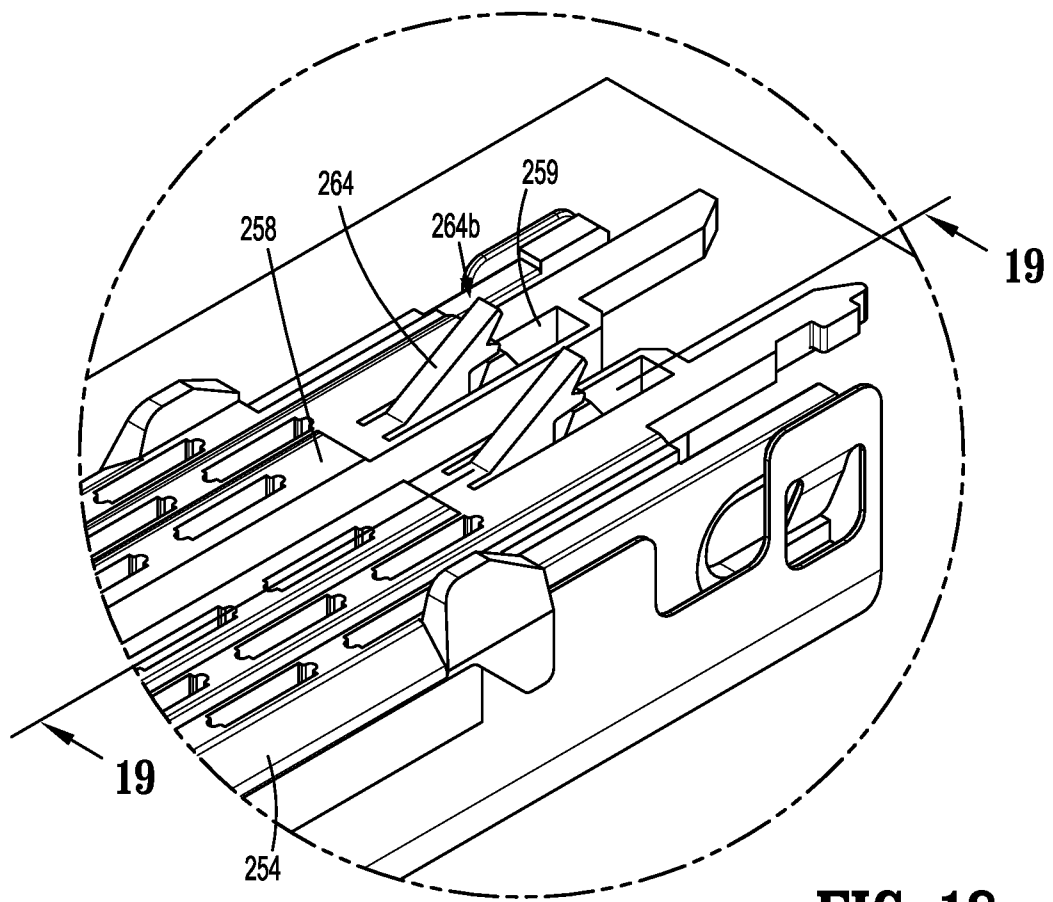


**FIG. 14**

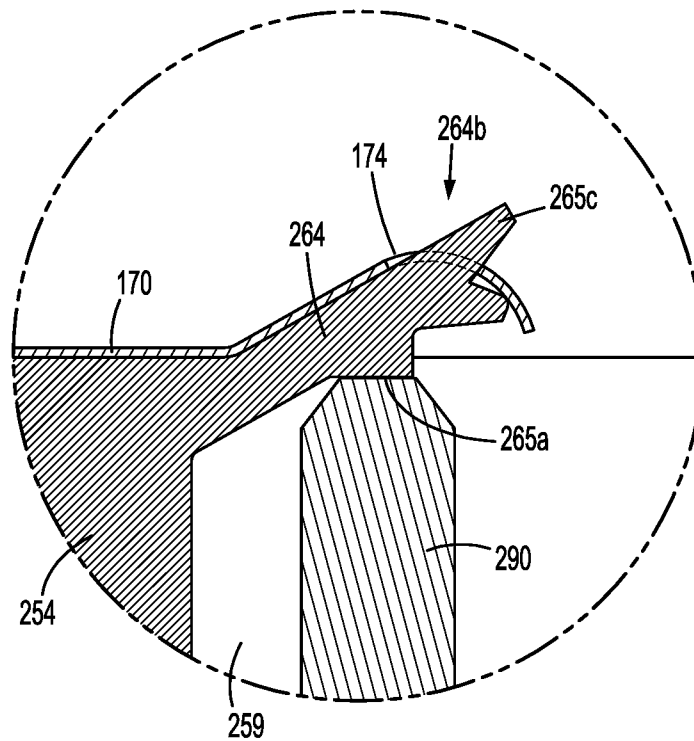








**FIG. 18**



**FIG. 19**

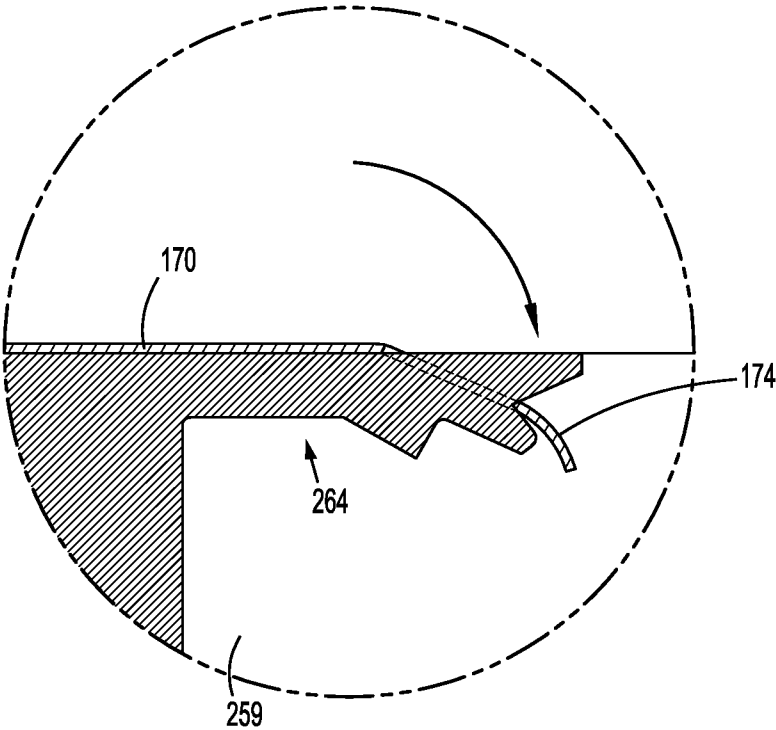


FIG. 20

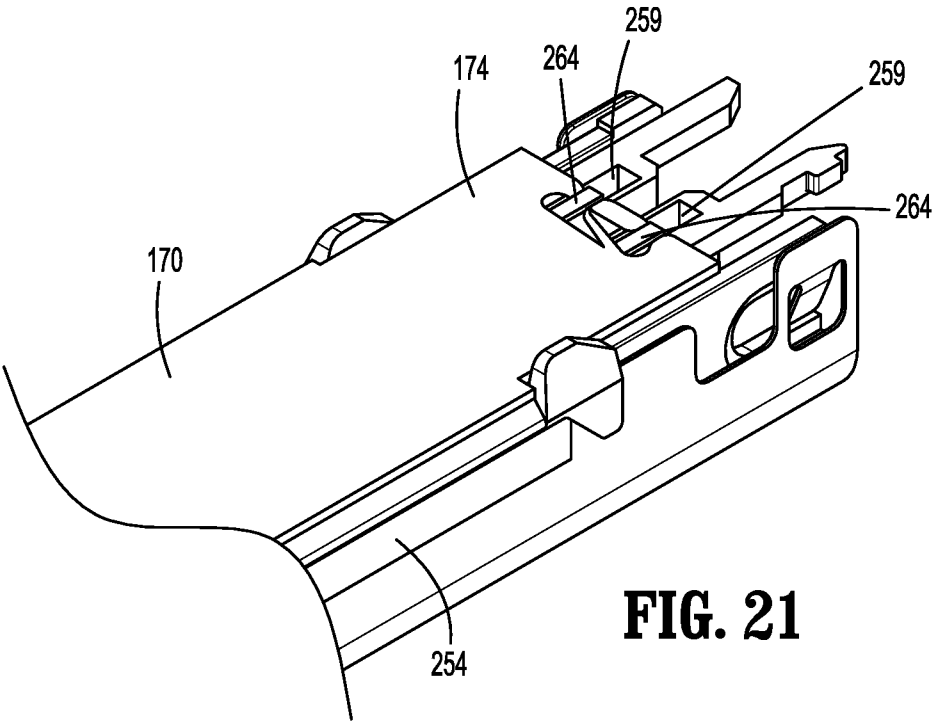


FIG. 21

# INTERNATIONAL SEARCH REPORT

International application No  
**PCT/IB2024/051602**

## A. CLASSIFICATION OF SUBJECT MATTER

**INV. A61B17/00**

**ADD.**

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**A61B**

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-Internal**

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
| <b>X</b>  | <b>US 2010/065606 A1 (STOPEK MEGAN L [US])</b>                                     | <b>1-3, 11</b>        |
| <b>Y</b>  | <b>18 March 2010 (2010-03-18)</b>                                                  |                       |
|           | <b>paragraphs [0003], [0074] - [0079],</b>                                         | <b>8, 10</b>          |
|           | <b>[0082]; figures 1, 9, 10</b>                                                    |                       |
|           | -----                                                                              |                       |
| <b>X</b>  | <b>US 2022/409201 A1 (BARIL JACOB C [US] ET</b>                                    | <b>13-15</b>          |
|           | <b>AL) 29 December 2022 (2022-12-29)</b>                                           |                       |
| <b>Y</b>  | <b>paragraphs [0001], [0042] - [0046];</b>                                         | <b>16</b>             |
| <b>A</b>  | <b>figures 1-3, 9, 16-20</b>                                                       | <b>18-20</b>          |
|           | -----                                                                              |                       |
| <b>Y</b>  | <b>WO 2023/275780 A1 (COVIDIEN LP [US])</b>                                        | <b>8, 10, 16</b>      |
|           | <b>5 January 2023 (2023-01-05)</b>                                                 |                       |
|           | <b>paragraphs [0052], [0054]; figures 14-16</b>                                    |                       |
|           | -----                                                                              |                       |
| <b>Y</b>  | <b>US 2023/040425 A1 (BANERJEE SAUMYA [US] ET</b>                                  | <b>8, 16</b>          |
|           | <b>AL) 9 February 2023 (2023-02-09)</b>                                            |                       |
|           | <b>paragraphs [0041] - [0043], [0046];</b>                                         |                       |
|           | <b>figures 5, 7</b>                                                                |                       |
|           | -----                                                                              |                       |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents :

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

**13 March 2024**

Date of mailing of the international search report

**21/03/2024**

Name and mailing address of the ISA/

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Authorized officer

**Hornung, Alexander**

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No  
PCT/IB2024/051602

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| US 2010065606 A1                          | 18-03-2010          | AU 2007318091 A1           | 15-05-2008          |
|                                           |                     | CA 2665206 A1              | 15-05-2008          |
|                                           |                     | EP 2073719 A2              | 01-07-2009          |
|                                           |                     | ES 2627615 T3              | 28-07-2017          |
|                                           |                     | JP 5528112 B2              | 25-06-2014          |
|                                           |                     | JP 5795564 B2              | 14-10-2015          |
|                                           |                     | JP 2010508068 A            | 18-03-2010          |
|                                           |                     | JP 2012254334 A            | 27-12-2012          |
|                                           |                     | JP 2013252442 A            | 19-12-2013          |
|                                           |                     | US 2010065606 A1           | 18-03-2010          |
|                                           |                     | US 2011315740 A1           | 29-12-2011          |
|                                           |                     | US 2012305626 A1           | 06-12-2012          |
|                                           |                     | US 2013240602 A1           | 19-09-2013          |
|                                           |                     | WO 2008057281 A2           | 15-05-2008          |
| US 2022409201 A1                          | 29-12-2022          | CN 117500443 A             | 02-02-2024          |
|                                           |                     | US 2022409201 A1           | 29-12-2022          |
|                                           |                     | WO 2022269420 A1           | 29-12-2022          |
| WO 2023275780 A1                          | 05-01-2023          | CN 117580517 A             | 20-02-2024          |
|                                           |                     | US 2023000489 A1           | 05-01-2023          |
|                                           |                     | US 2023309995 A1           | 05-10-2023          |
|                                           |                     | WO 2023275780 A1           | 05-01-2023          |
| US 2023040425 A1                          | 09-02-2023          | US 2023040425 A1           | 09-02-2023          |
|                                           |                     | WO 2023012605 A1           | 09-02-2023          |