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(54) **LATCH ASSEMBLIES AND SURGICAL INSTRUMENTS INCLUDING THE SAME**

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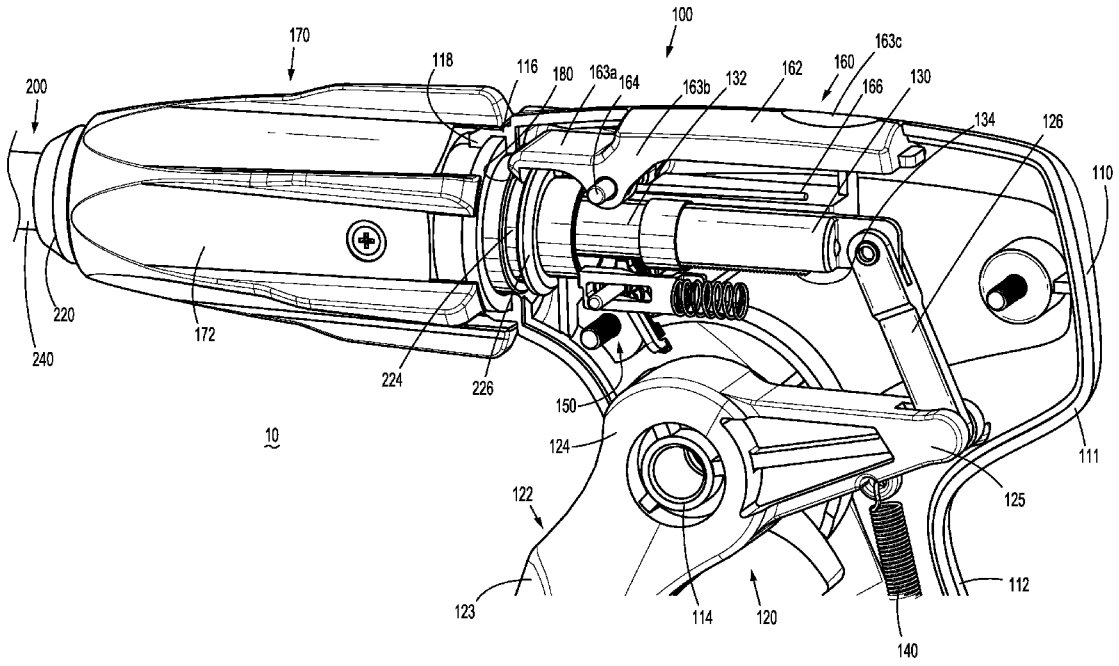
(57) **ABSTRACT**

A latch assembly for a surgical instrument, a handle assembly of a surgical instrument including the latch assembly, and a surgical instrument including the latch assembly are provided. The latch assembly includes a lever having a distal engagement section, an intermediate section, and a proximal manipulatable section. The distal engagement section of the lever includes a base and an engagement tooth depending from the base. The engagement tooth is configured to releasably engage first and second components of a surgical instrument with one another and defines a first surface having a concave portion defining a varied radius of curvature.



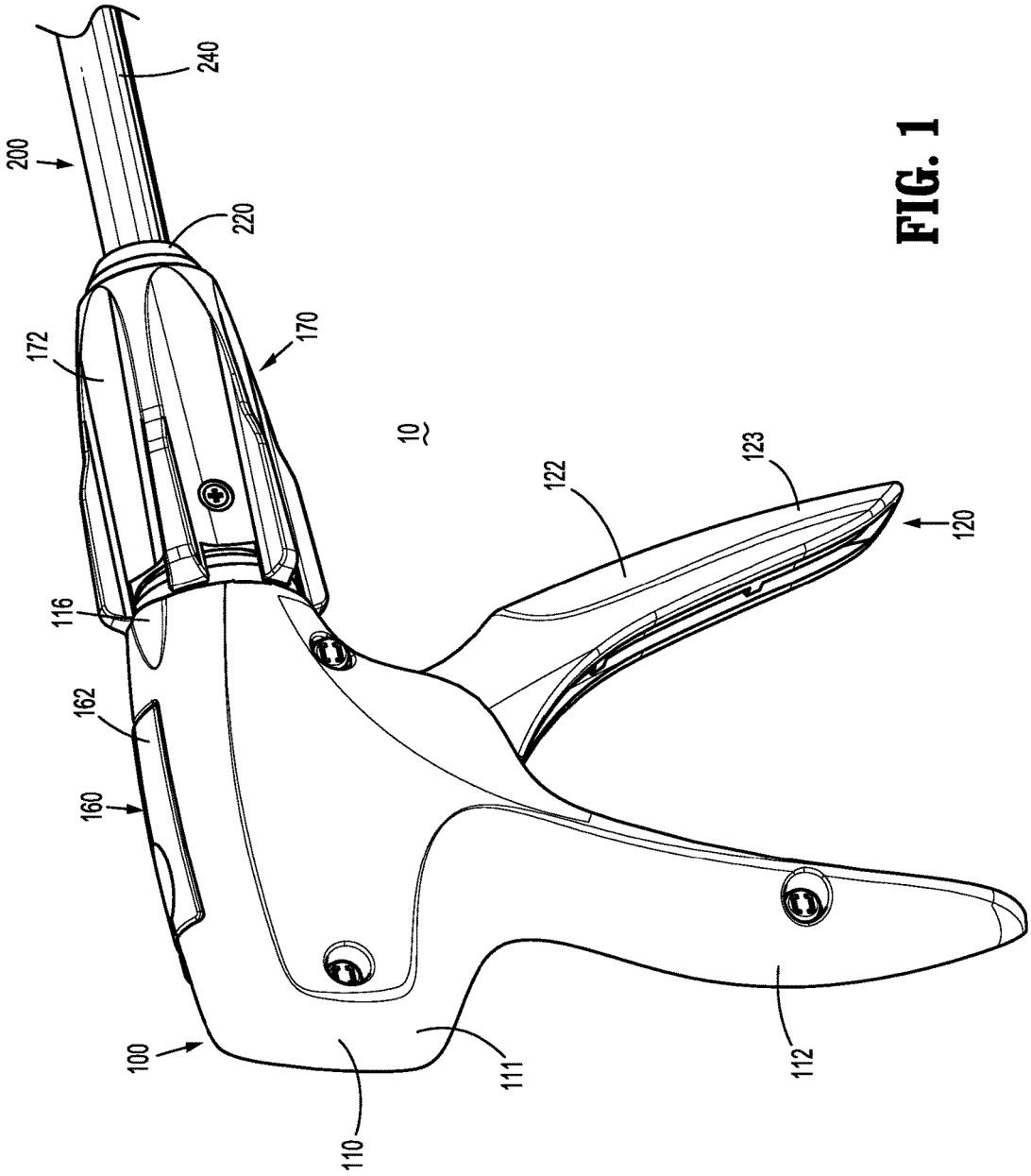


FIG. 1

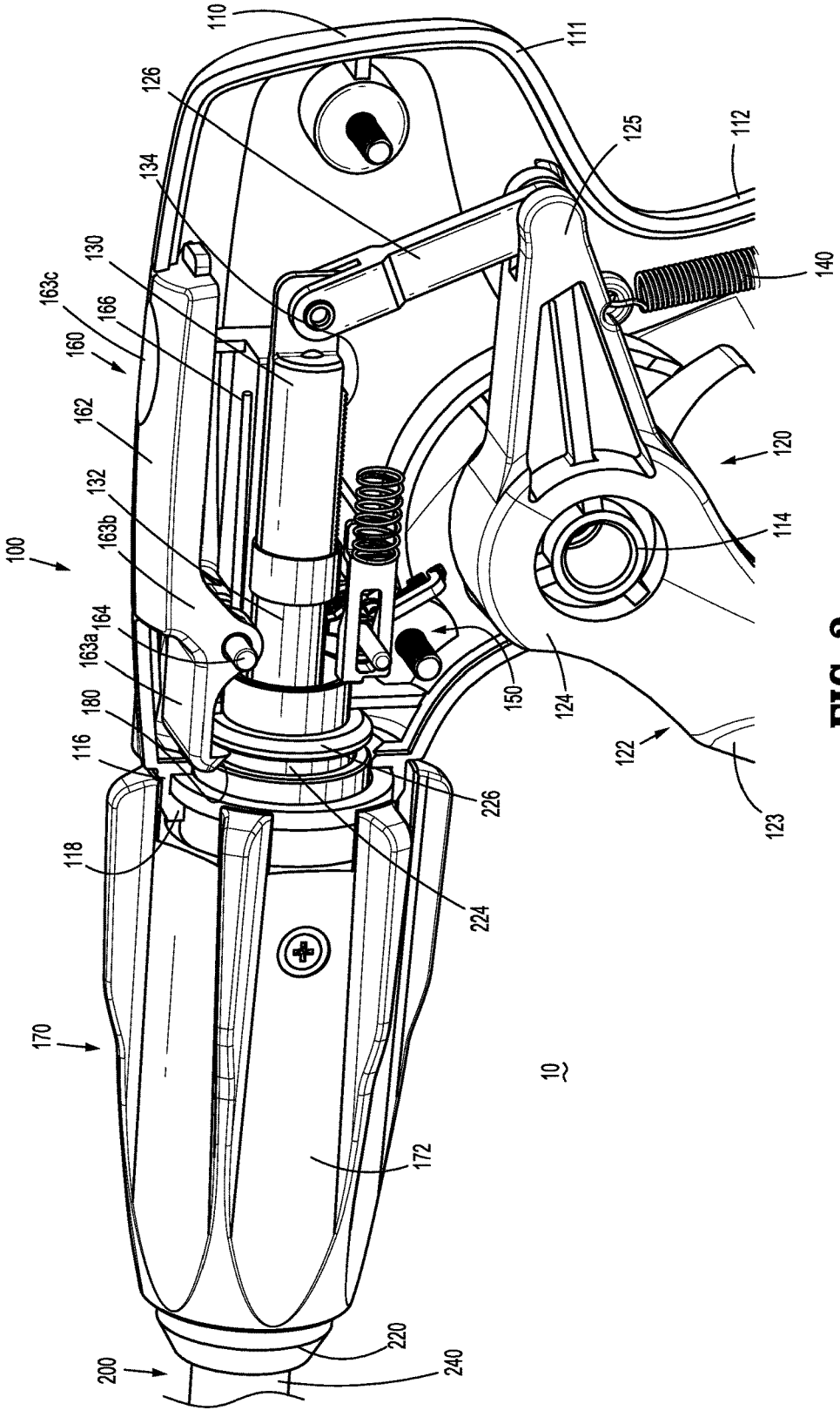
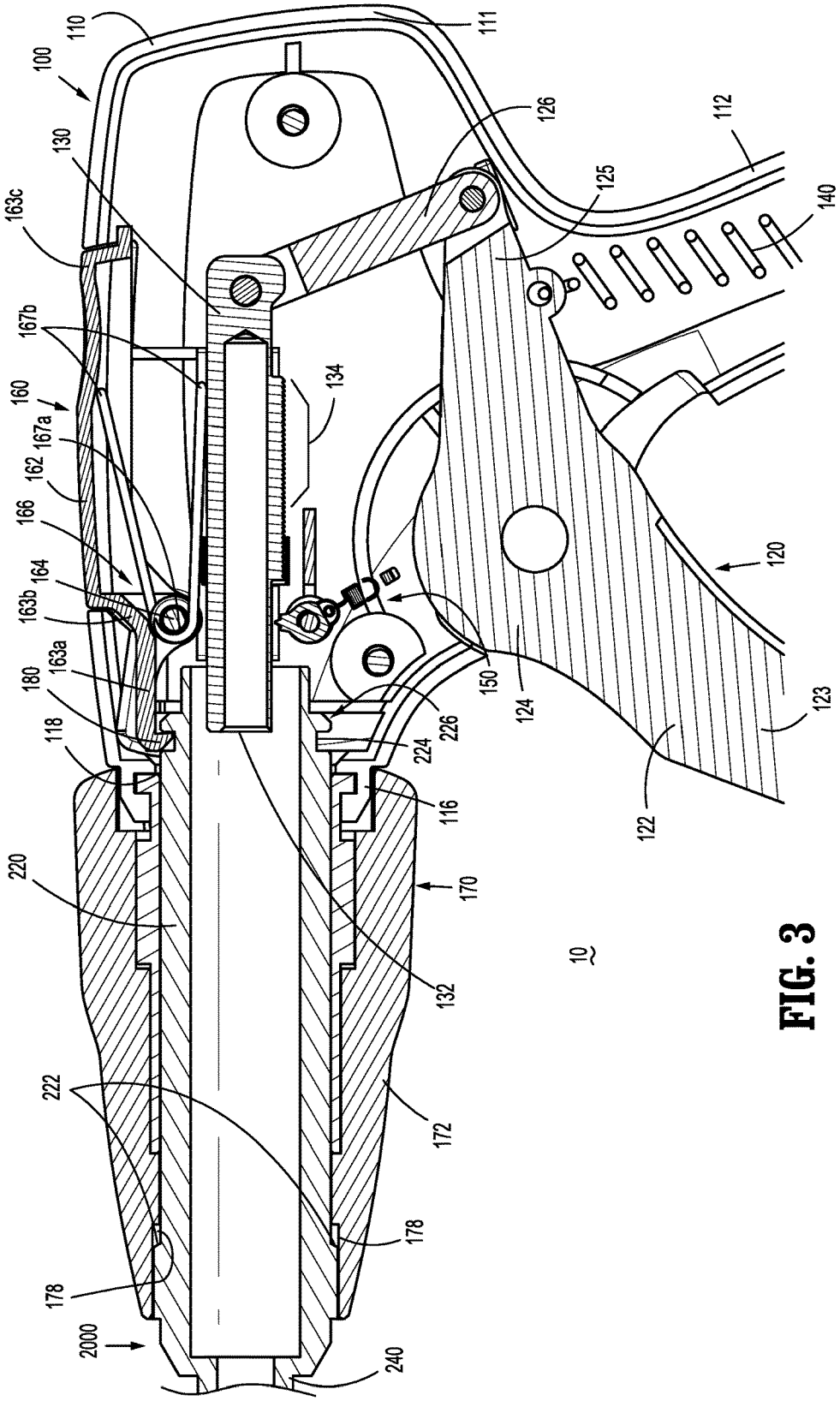

110
111
126
125
112
134
130
140
163c
166
160
162
120
132
114
163b
100
164
163a
150
124
180
122
116
226
123
118
224
170
10
172
220
200
240

FIG. 2


110
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112
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167b
160
134
167a
162
166
164
120
163b
163a
180
150
124
123
118
226
224
116
122
220
170
10
132
222
172
178
178
2000
240

FIG. 3

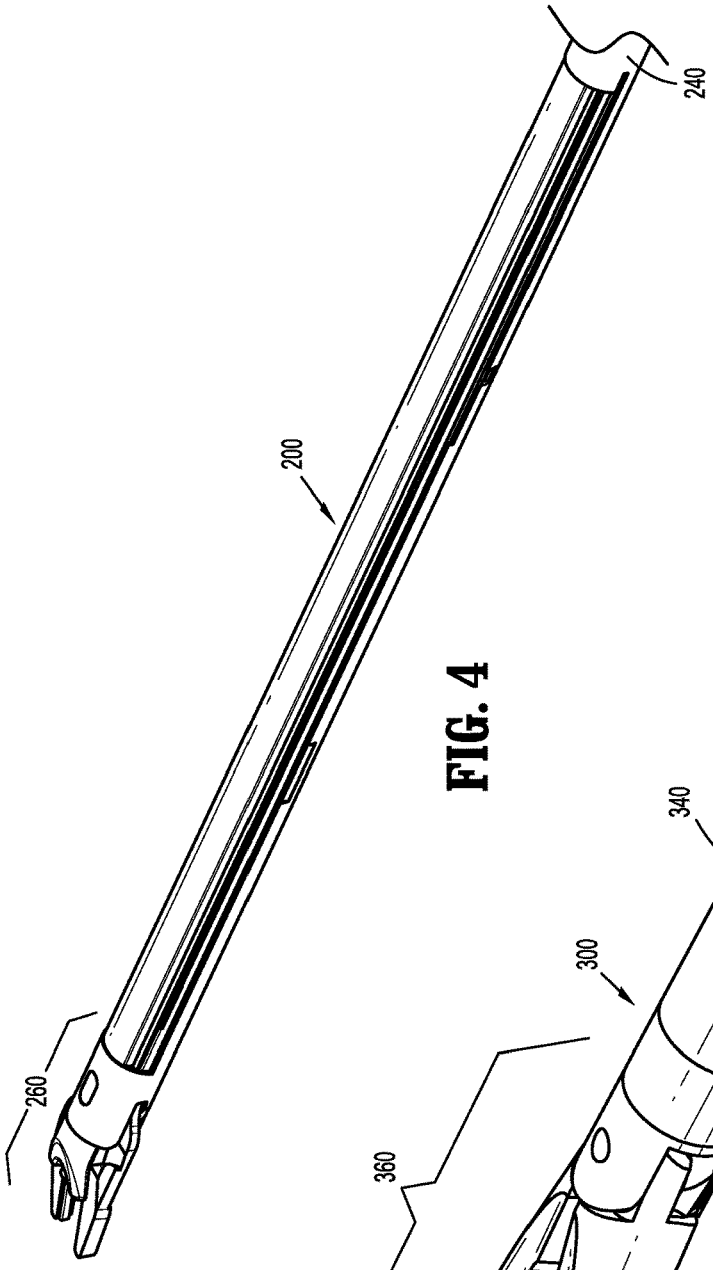

FIG. 4

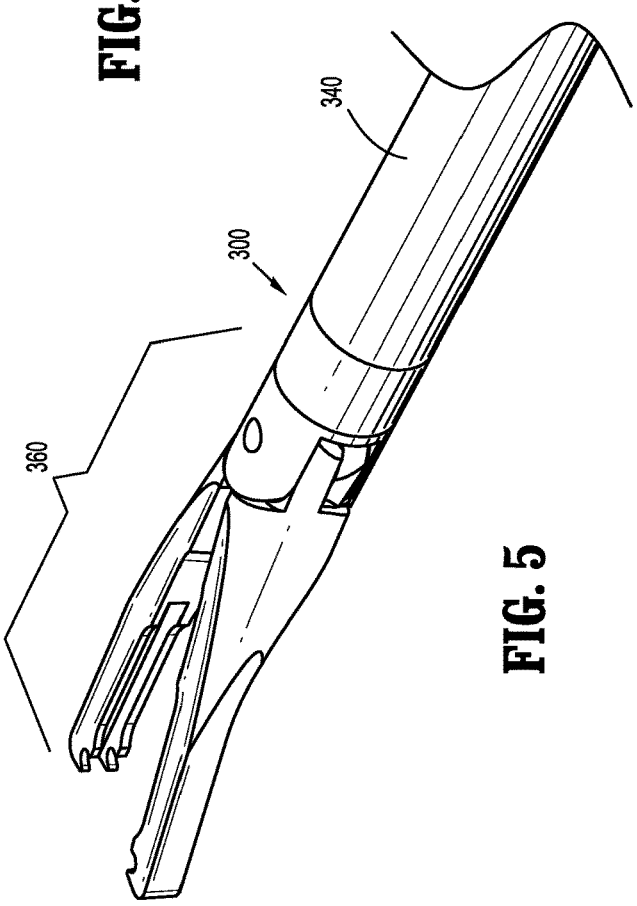

FIG. 5

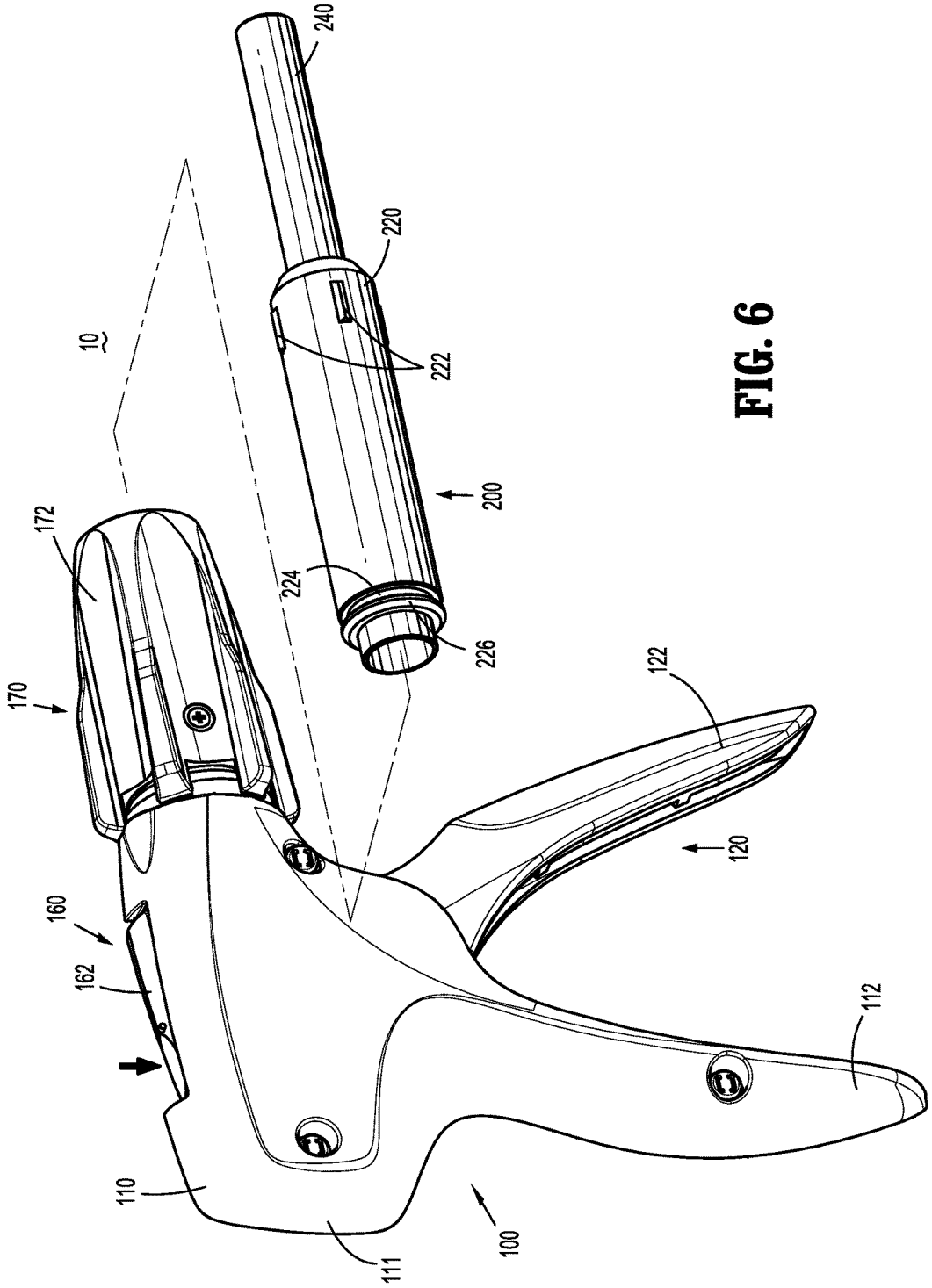
240
220
222
10
200
172
224
226
170
122
120
160
162
112
110
111
100

FIG. 6

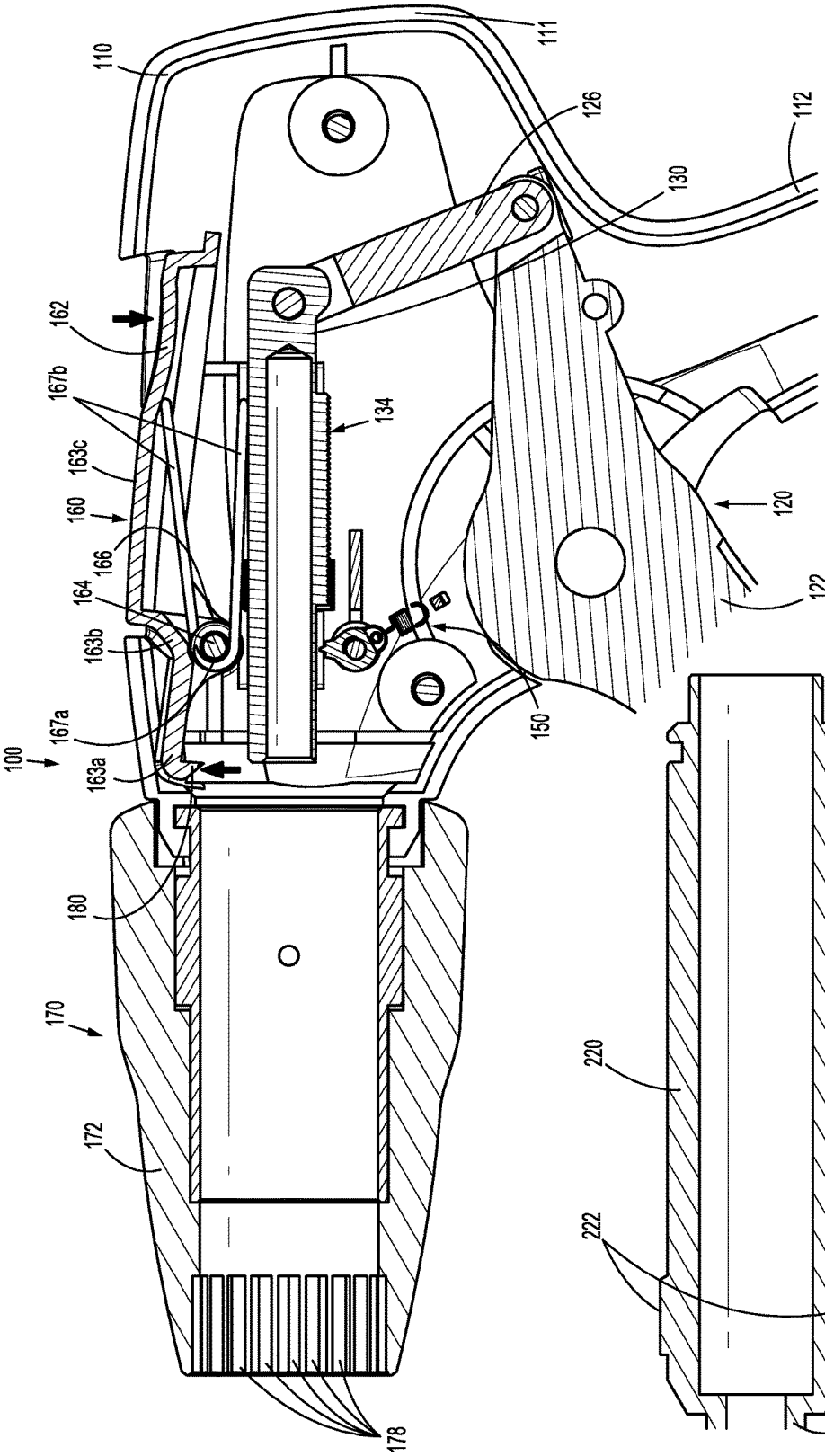
110
111
126
112
130
162
167b
134
163c
160
166
164
163b
167a
163a
100
150
120
122
180
170
172
178

FIG. 7

226
224
200
220
222
240

FIG. 8

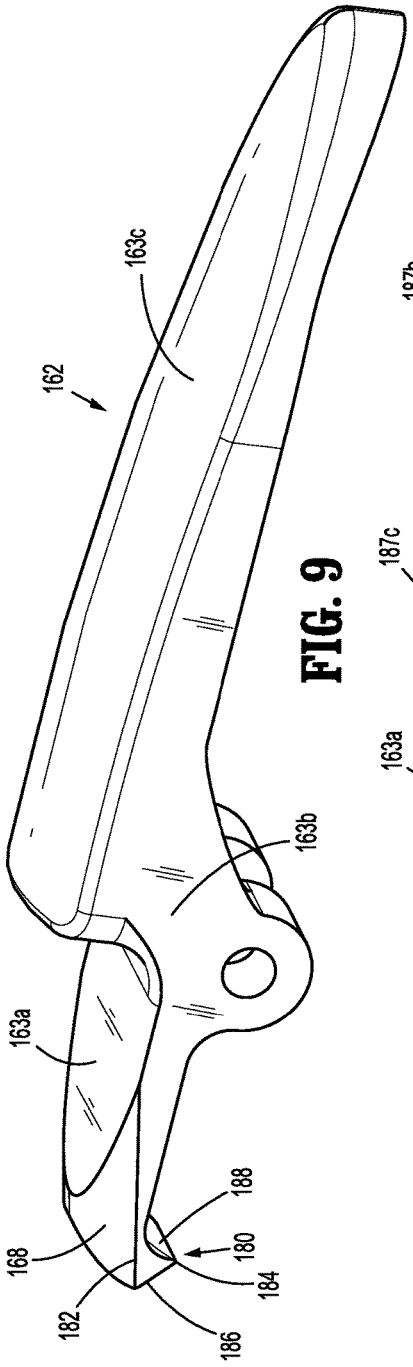
162
163c
163b
163a
168
188
180
184
182
186

FIG. 9

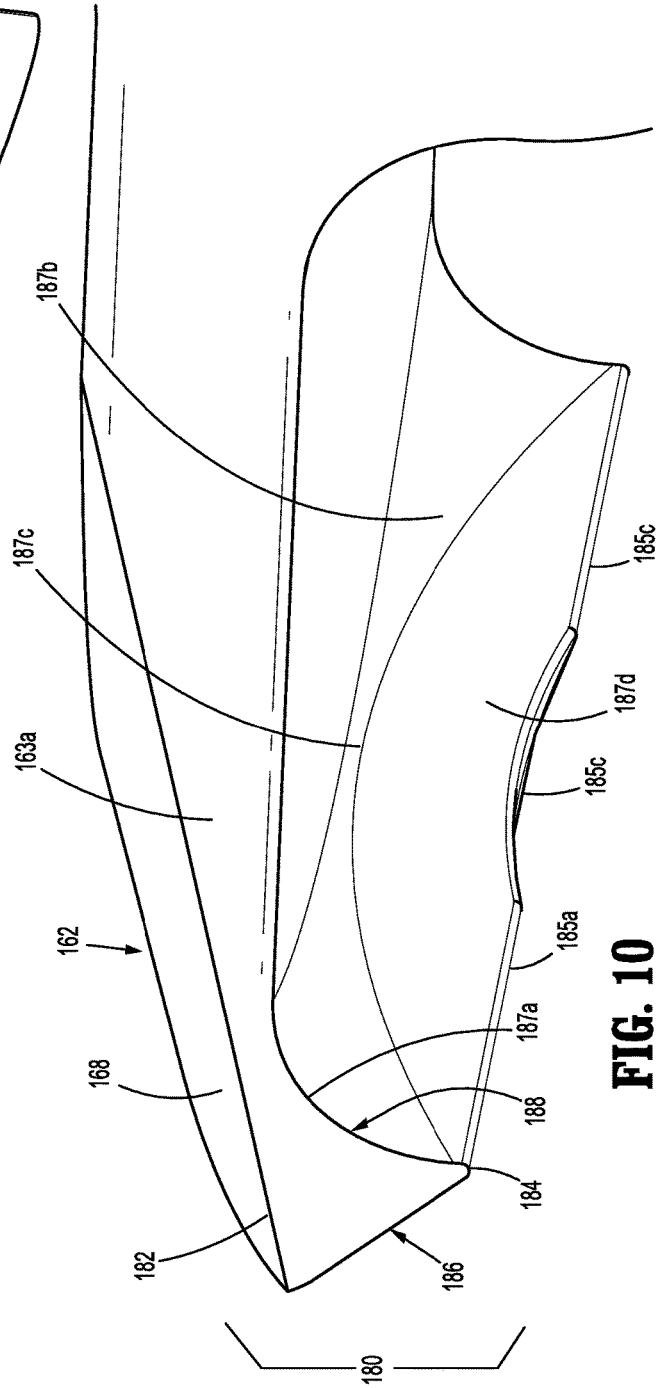
187b
187c
185c
187d
185c
163a
162
185a
187a
168
188
184
182
186
180

FIG. 10

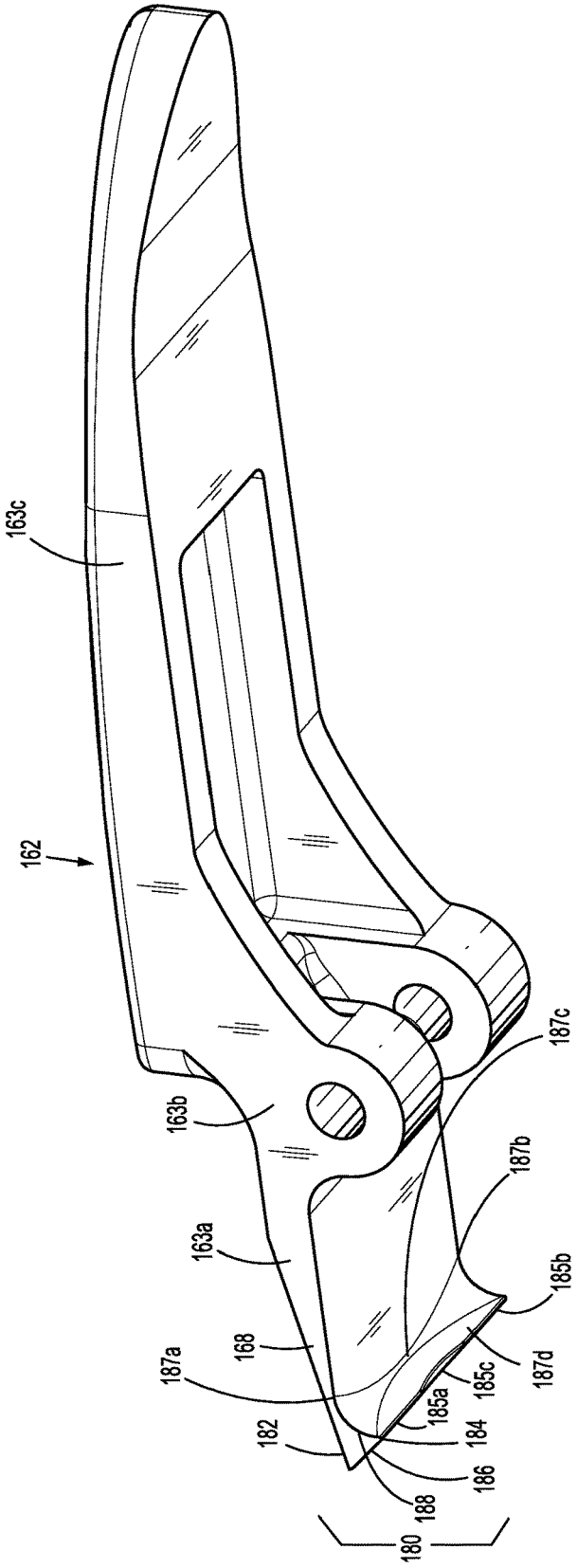
163c
162
187c
163b
187b
163a
185b
168
187a
185c
187d
185a
182
184
186
188
180

FIG. 11

LATCH ASSEMBLIES AND SURGICAL INSTRUMENTS INCLUDING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of and priority to U.S. Provisional Patent Application No. 62/662,269 filed Apr. 25, 2018, the entire disclosure of which is incorporated by reference herein.

BACKGROUND

Technical Field

[0002] The present disclosure relates to surgical instruments such as, for example, surgical clip appliers. More particularly, the present disclosure relates to latch assemblies for surgical clip appliers and surgical clip appliers including the same.

Description of Related Art

[0003] Surgical clip appliers are known in the art and are used for a number of distinct and useful surgical procedures. In the case of a laparoscopic surgical procedure, access to the interior of an abdomen is achieved through narrow tubes or cannulas inserted through a small entrance incision in the skin. Minimally invasive procedures performed elsewhere in the body are often generally referred to as endoscopic procedures.

[0004] Endoscopic surgical clip appliers having various sizes (e.g., diameters), that are configured to apply a variety of diverse surgical clips, are also known in the art, and are capable of applying a single or multiple surgical clips during an entry to the body cavity. Such surgical clips are typically fabricated from a biocompatible material and are usually compressed over tissue. Once applied to tissue, the compressed surgical clip terminates the flow of fluid therethrough.

SUMMARY

[0005] As detailed herein and shown in the drawing figures, as is traditional when referring to relative positioning on a surgical instrument, the term "proximal" refers to the end of the apparatus or component thereof which is closer to the user and the term "distal" refers to the end of the apparatus or component thereof which is further away from the user. Further, to the extent consistent, any or all of the aspects and features detailed herein may be used in conjunction with any or all of the other aspects and features detailed herein.

[0006] Provided in accordance with aspects of the present disclosure is a latch assembly for a surgical instrument including a lever having a distal engagement section, an intermediate section, and a proximal manipulatable section. The distal engagement section of the lever includes a base and an engagement tooth depending from the base. The engagement tooth is configured to releasably engage first and second components of a surgical instrument with one another and defines a first surface having a concave portion defining a varied radius of curvature.

[0007] In an aspect of the present disclosure, the latch assembly further includes a pivot pin pivotably supporting the intermediate section of the lever thereon.

[0008] In another aspect of the present disclosure, the latch assembly further includes a biasing member operably coupled to the pivot pin.

[0009] In yet another aspect of the present disclosure, the radius of curvature of the concave portion varies between a maximum radius of curvature towards ends of the first surface and a minimum radius of curvature towards an intermediate location of the first surface.

[0010] In still another aspect of the present disclosure, a ratio of the maximum radius of curvature to the minimum radius of curvature is between 5:1 and 20:1. The ratio of the maximum radius of curvature to the minimum radius of curvature may be between 10:1 and 15:1.

[0011] In still yet another aspect of the present disclosure, the engagement tooth defines a generally triangular-shaped configuration including a distal-facing surface extending from the base to an apex. The first surface, in such aspects, is proximally-facing and extends from the base to the apex.

[0012] A handle assembly of a surgical instrument provided in accordance with aspects of the present disclosure includes a housing defining a body portion, a fixed handle portion depending from the body portion, and a distal nose extending distally from the body portion, a drive assembly disposed within the housing, and a trigger pivotably connected to the housing and operably associated with the drive assembly. The trigger is movable relative to the fixed handle portion of the housing from an un-actuated position to an actuated position to actuate the drive assembly. The handle assembly further includes a latch assembly operably coupled to the body potion of the housing. The latch assembly is configured to releasably engage an elongated assembly inserted through the distal nose of the housing and may be configured similar to any of the above-detailed aspects or other aspects described herein.

[0013] A surgical instrument provided in accordance with aspects of the present disclosure includes an elongated assembly including a proximal hub, a shaft extending distally from the proximal hub, and an end effector extending distally from the shaft. The surgical instrument further includes a handle assembly configured to releasably receive the elongated assembly. The handle assembly includes a housing defining a body portion, a fixed handle portion depending from the body portion, and a distal nose extending distally from the body portion. The handle assembly further includes a drive assembly disposed within the housing and a trigger pivotably connected to the housing and operably associated with the drive assembly. The trigger is movable relative to the fixed handle portion of the housing from an un-actuated position to an actuated position to actuate the drive assembly. The handle assembly further includes a latch assembly operably coupled to the body potion of the housing and configured to releasably engage the elongated assembly upon insertion of the proximal hub of the elongated assembly through the distal nose of the housing. The latch assembly may be configured similar to any of the above-detailed aspects or other aspects described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Aspects and features of the presently-disclosed latch assemblies for surgical clip appliers and surgical clip appliers including the same are described in detail with

reference to the drawing figures wherein like reference numerals identify similar or identical structural elements and:

[0015] FIG. **1** is a first side, perspective view of an endoscopic surgical clip applier provided in accordance with the present disclosure including a handle assembly having an elongated assembly engaged therewith;

[0016] FIG. **2** is a second, opposite side, perspective view of a proximal portion of the endoscopic surgical clip applier of FIG. **1** with a portion of the housing removed from the handle assembly to illustrate the internal components therein;

[0017] FIG. **3** is a longitudinal, cross-sectional view of the proximal portion of the endoscopic surgical clip applier of FIG. **1**;

[0018] FIG. **4** is a perspective view of a distal portion of the elongated assembly of the endoscopic surgical clip applier of FIG. **1**;

[0019] FIG. **5** is a perspective view of a distal portion of another elongated assembly configured for use with the endoscopic surgical clip applier of FIG. **1**;

[0020] FIG. **6** is a perspective of the endoscopic surgical clip applier of FIG. **1** with the elongated assembly disengaged from the handle assembly;

[0021] FIG. **7** is a longitudinal, cross-sectional view of the proximal portion of the endoscopic surgical clip applier of FIG. **1** with the elongated assembly removed;

[0022] FIG. **8** is longitudinal, cross-sectional view of a proximal portion of the elongated assembly of FIG. **4**, with internal components removed;

[0023] FIG. **9** is a top, perspective view of the lever of the latch assembly of the endoscopic surgical clip applier of FIG. **1**;

[0024] FIG. **10** is an enlarged, perspective view of the distal portion of the lever of FIG. **9**; and

[0025] FIG. **11** is bottom, perspective view of the lever of FIG. **9**.

DETAILED DESCRIPTION

[0026] The present disclosure provides latch assemblies for surgical instruments and surgical instruments including the same. Although detailed herein as incorporated into a surgical clip applier, the latch assemblies of the present disclosure may alternatively be incorporated into any suitable surgical instrument.

[0027] Turning to FIGS. **1-3**, an endoscopic surgical clip applier embodying the aspects and features of the present disclosure is shown generally identified by reference numeral **10**. Surgical clip applier **10** generally includes a handle assembly **100** and a plurality of elongated assemblies **200** (FIGS. **1-4**), **300** (FIG. **5**) selectively connectable to handle assembly **100**. Handle assembly **100** is configured to operate each of the plurality of elongated assemblies **200**, **300** upon connection thereto, and may be configured as a sterilizable, reusable component such that handle assembly **100** may be repeatedly used with different and/or additional elongated assemblies **200**, **300** during the course of one or more surgical procedures. The elongated assemblies **200**, **300** may be configured as single-use disposable components, limited-use disposable components, or reusable components, depending upon a particular purpose and/or the configuration of the particular elongated assembly. In either configuration, the need for multiple handle assemblies **100** is obviated and, instead, the surgeon need only select an appropriate elongated assembly **200**, **300** and connect that elongated assembly to handle assembly **100** in preparation for use.

[0028] Handle assembly **100** generally includes a housing **110**, an actuation mechanism **120** operably associated with housing **110**, a ratchet mechanism **150** operably disposed within housing **110**, and a rotation knob assembly **170** operably coupled to a distal portion of housing **110**. A latch assembly **160**, provided in accordance with the present disclosure, is also operably associated with housing **110**, as detailed below. Housing **110** supports and/or encloses the operating components of handle assembly **100**. Actuation mechanism **120** is configured to enable selective firing of one or more surgical clips (not shown) from the end effector of the attached elongated assembly. Ratchet mechanical **150** enables ratcheting advancement of drive bar **130** of actuation mechanism **120**, when an elongated assembly configured for ratcheting actuation is connected to handle assembly **100**. Latch assembly **160** is configured to facilitate releasable locking engagement of the elongated assembly with handle assembly **100**. Rotation knob assembly **170** enables the selective rotation of the attached elongated assembly relative to housing **110**.

[0029] With additional reference to FIGS. **4** and **5**, as noted above, handle assembly **100** is configured for use with different elongated assemblies such as, for example, elongated assembly **200** (FIG. **4**) and elongated assembly **300** (FIG. **5**). Handle assembly **100**, more specifically, is configured for both ratcheting use, e.g., in connection with elongated assembly **200** (FIG. **4**), and non-ratcheting use, e.g., in connection with elongated assembly **300** (FIG. **5**). Elongated assemblies **200**, **300** are described briefly below. A more detailed discussion of elongated assemblies, e.g., elongated assemblies **200**, **300**, configured for use with handle assembly **100** can be found in International Application No. PCT/CN2016/096666, filed on Aug. 26, 2016, International Application No. PCT/CN2016/071178, filed on Jan. 18, 2016, and/or International Application No. PCT/CN2015/091603, filed on Oct. 10, 2015, the entire contents of each of which is hereby incorporated herein by reference.

[0030] Referring to FIGS. **4**, **6**, and **8**, in conjunction with FIGS. **1-3**, elongated assembly **200** is configured for ratcheting use and generally includes a proximal hub **220**, an elongated shaft **240** extending distally from proximal hub **220**, an end effector assembly **260** disposed towards a distal end portion of elongated shaft **240**, and an inner drive assembly (not shown) operably coupled between handle assembly **100** and end effector assembly **260** when elongated assembly **200** is engaged with handle assembly **100** to enable the sequential firing of at least one surgical clip (not shown) about tissue. End effector assembly **260** of elongated assembly **200** may be configured to fire surgical clips similar to those shown and described in U.S. Pat. Nos. 7,819,886 or 7,905,890, the entire contents of each of which is hereby incorporated herein by reference.

[0031] Proximal hub **220** of elongated assembly **200** defines a plurality of indexing protrusions **222** annularly disposed thereabout towards a distal end portion thereof (see FIG. **6**). Indexing protrusions **222** are configured for slidable receipt within longitudinally-extending grooves **178** defined within outer knob **172** of rotation knob assembly **170** to rotationally fix proximal hub **220** of elongated assembly **200** relative to rotation knob assembly **170** upon insertion of

proximal hub **220** therethrough. As such, in use, rotation of outer knob **172** of rotation knob assembly **170** relative to housing **110** effects corresponding rotation of elongated assembly **200** relative to housing **110**.

[0032] Proximal hub **220** further defines an annular channel **224** towards the proximal end thereof and a chamfered proximal edge **226**. As detailed below, upon insertion of proximal hub **220** through rotation knob assembly **170** and into body portion **111** of housing **110**, chamfered proximal edge **226** cams engagement tooth **180** of lever **162** of latch assembly **160** over the outer surface of proximal hub **220** until engagement tooth **180** is disposed in alignment with annular channel **224**, whereby engagement tooth **180** falls into engagement within annular recess **224** to engage proximal hub **220** and, thus, elongated assembly **200**, with handle assembly **100**.

[0033] Referring to FIG. **5**, elongated assembly **300** is configured for non-ratcheting use and generally includes a proximal hub (not shown), an elongated shaft **340** extending distally from the proximal hub, an end effector assembly **360** disposed towards a distal end portion of elongated shaft **340**, and an inner drive assembly (not shown) operably coupled between handle assembly **100** and end effector assembly **360** when elongated assembly **300** is engaged with handle assembly **100** (FIG. **1**) to enable grasping and/or manipulation of tissue, retrieval of a surgical clip, and firing of the surgical clip about tissue. It is contemplated that end effector assembly **360** of elongated assembly **300** may be configured to fire surgical clips similar to those shown and described in U.S. Pat. No. 4,834,096, the entire contents of which is hereby incorporated herein by reference.

[0034] With additional reference to FIGS. **1-3**, the proximal hub (not shown) of elongated assembly **300**, similarly as with proximal hub **220** of elongated assembly **200**, may also include indexing protrusions to rotationally fix elongated assembly **300** relative to rotation knob assembly **170** upon insertion of the proximal hub therethrough and/or an annular channel and chamfered proximal edge to facilitate engagement of engagement tooth **180** of lever **162** of latch assembly **160** with elongated assembly **300** to engage elongated assembly with handle assembly **100**.

[0035] Although exemplary elongated assemblies **200**, **300** configured for ratcheting and non-ratcheting use, respectively, are detailed above, it is contemplated that various other elongated assemblies for performing various different surgical tasks and/or having various different configurations suitable for ratcheting or non-ratcheting use may likewise be utilized with handle assembly **100**.

[0036] Turning back to FIGS. **1-3**, housing **110** of handle assembly **100** may be formed from first and second housing halves that cooperate to define a body portion **111** and a fixed handle portion **112** depending from body portion **111**. Body portion **111** of housing **110** includes an internal pivot post **114** extending transversely within body portion **111**, and a distal nose **116** defining a distal opening **118** therethrough. A proximal end portion of a proximal hub of an elongated assembly, e.g., proximal hub **220** of elongated assembly **200** or the proximal hub (not shown) of elongated assembly **300** (FIG. **5**), is configured to extend at least partially through distal opening **118** of distal nose **116** of housing **110** when the elongated assembly is engaged with handle assembly **100**.

[0037] Actuation mechanism **120** is operably supported by housing **110** and includes a trigger **122**, a linkage **126**, a drive bar **130**, and a biasing member **140**. Trigger **122** includes a grasping portion **123**, an intermediate pivot portion **124**, and a proximal extension **125**. Grasping portion **123** of trigger **122** extends downwardly from body portion **111** of housing **110** in opposed relation relative to fixed handle portion **112** of housing **110**. Grasping portion **123** is configured to facilitate grasping and manipulation of trigger **122**. Intermediate pivot portion **124** of trigger **122** is at least partially disposed within housing **110** and defines a pivot aperture configured to receive pivot post **114** of housing **110** so as to enable pivoting of trigger **122** about pivot post **114** and relative to housing **110**, e.g., between an un-actuated position, wherein grasping portion **123** of trigger **122** is spaced-apart relative to fixed handle portion **112**, and an actuated position, wherein grasping portion **123** of trigger **122** is approximated relative to fixed handle portion **112**.

[0038] Proximal extension **125** of trigger **122** is disposed on an opposite side of intermediate pivot portion **124** and, thus, pivot post **114**, as compared to grasping portion **123** of trigger **122**. As such, pivoting of grasping portion **123** to rotate in one direction, e.g., proximally towards fixed handle portion **112**, pivots proximal extension **125** to rotate in the opposite direction, e.g., distally. Proximal extension **125** of trigger **122** is pivotably coupled to the proximal end of linkage **126**. Biasing member **140** is secured at either end and extends between proximal extension portion **125** of trigger **122** and a support (not shown) disposed within fixed handle portion **112** of housing **110**. Pivoting of grasping portion **123** towards the actuated position elongates biasing member **140** storing energy therein such that, upon release of grasping portion **123**, grasping portion **123** is returned towards the un-actuated position under the bias of biasing member **140**. Although illustrated as an extension coil spring, biasing member **140** may define any suitable configuration for biasing grasping portion **123** of trigger **122** towards the un-actuated position.

[0039] As noted above, linkage **126** is coupled at its proximal end to proximal extension portion **125** of trigger **122**. Linkage **126** is also pivotably coupled at its distal end to a proximal end of drive bar **130**. As a result of this configuration, pivoting of grasping portion **123** of trigger **122** towards the actuated position urges proximal extension portion **125** of trigger **122** distally which, in turn, urges linkage **126** distally to, in turn, urge drive bar **130** distally.

[0040] Drive bar **130** is slidable through body portion **111** of housing **110**, in response to actuation of trigger **122**, to urge a distal end portion **132** of drive bar **130** into contact with a proximal actuator of an inner drive assembly (not shown) of an elongated assembly, e.g., elongated assembly **200** or elongated assembly **300** (FIG. **5**), engaged with handle assembly **100** to fire a surgical clip supported at the end effector assembly of the elongated assembly. Drive bar **130**, more specifically, is slidable from an un-actuated, proximal position, corresponding to the un-actuated position of grasping portion **123** of trigger **122**, to an actuated, distal position, corresponding to the actuated position of grasping portion **123** of trigger **122**, in order to urge the proximal actuator of the inner drive assembly (not shown) of the elongated assembly distally to fire a surgical clip supported at the end effector assembly of the elongated assembly.

[0041] Drive bar **130** may further include a ratchet rack **134** extending along at least a portion of an underside surface thereof. Ratchet rack **134** is configured to selectively interface with ratchet mechanism **150** to enable advance-

ment of drive bar **130** in either a ratcheting condition or a non-ratcheting condition. Ratchet rack **134** and ratchet mechanism **150** may be configured similarly as described in, for example, International Application No. PCT/CN2016/096666 or International Application No. PCT/CN2016/071178, each of which was previously incorporated by reference herein.

[0042] Continuing with reference to FIGS. **1-3**, rotation knob assembly **170** is rotatably coupled to distal nose **116** of body portion **111** of housing **110** and is configured to receive the proximal hub of the elongated assembly, e.g., proximal hub **220** of elongated assembly **200**, coupled to handle assembly **100** in fixed rotational engagement therewith, e.g., via receipt of indexing protrusions **222** within grooves **178** (see FIG. **3**), to enable selective rotation of elongated assembly **200** relative to housing **110** upon rotation of outer knob **172** of rotation knob assembly **170** relative to housing **110**.

[0043] Referring now to FIGS. **1-3**, **6**, and **7**, latch assembly **160** of the present disclosure includes a lever **162**, a pivot pin **164**, and a biasing member **166**. Lever **162** is at least partially disposed within a cut-out defined without housing **110** of handle assembly **100** to enable manual manipulation thereof and defines a distal engagement section **163***a*, an intermediate section **163***b*, and a proximal manipulatable section **163***c*. Distal engagement section **163***a* of lever **162** includes an engagement tooth **180** extending therefrom. Engagement tooth **180** is configured to engage an elongated assembly, e.g., elongated assembly **200**, inserted into handle assembly **100**. More specifically, as noted above with respect to elongated assembly **200**, for example, upon insertion of proximal hub **220** of elongated assembly **200** into handle assembly **100**, engagement tooth **180** is configured to cam over chamfered proximal edge **226** of proximal hub **220** and into engagement within annular channel **224** to thereby lock elongated assembly **200** in engagement with handle assembly **100**. Lever **162** and, in particular, distal engagement section **163***a* thereof, is described in greater detail below with reference to FIGS. **9-11**.

[0044] Pivot pin **164** of latch assembly **160** pivotably couples intermediate section **163***b* of lever **162** with housing **110** of handle assembly **100** such that urging of proximal manipulation section **163***c* of lever **162** in a first direction into housing **110**, urges distal engagement section **163***a* of lever **162** in a second, opposite direction out of engagement with annular channel **224** of proximal hub **220** of elongated assembly **200**. Biasing member **166** is configured as a torsion spring having a body **167***a* disposed about pivot pin **164** and first and second legs **167***b* disposed between housing **110** and proximal manipulation section **163***c* of lever **162** to bias proximal manipulation section **163***c* of lever **162** away from housing **110**, thereby biasing distal engagement section **163***a* towards an engaged position. However, other suitable configurations of biasing member **166** are also contemplated. Proximal manipulation section **163***c* of lever **162** is selectively depressible into housing **110**, as illustrated in FIGS. **6** and **7**, against the bias of biasing member **166** to urge distal engagement section **163***a* towards a disengaged position to disengage engagement tooth **180** from annular channel **224** of proximal hub **220** of elongated assembly **200** and enable withdrawal of elongated assembly **200** from handle assembly **100**.

[0045] Turning now to FIGS. **9-11**, the engagement of engagement tooth **180** of distal engagement section **163***a* of lever **162** of latch assembly **160** within the annular channel of a proximal hub of an elongated assembly, e.g., annular channel **224** of proximal hub **222** of elongated assembly **200** (FIGS. **1-3** and **8**) or the annular channel of any other elongated assembly configured for use with handle assembly **100** (FIGS. **1-3**), retains the elongated assembly in operable engagement with handle assembly **100** (FIGS. **1-3**), which is critical for proper operation. As such, it is a consideration to ensure that lever **162** provides proper retention in all use conditions, with all elongated assemblies, and throughout the entire life of handle assembly **100** FIGS. **1-3**), during which handle assembly **100** may go through a large number of engagement, firing, and disengagement use cycles and a large number of cleaning/autoclaving cycles. It is also a consideration that the space occupied by lever **162** within handle assembly **100** is minimized to maintain the ergonomics of handle assembly **100** and such that lever **162** does not interfere with the other operable components within handle assembly **100**. Distal engagement section **163***a* of lever **162**, detailed below, meets both of these considerations.

[0046] Distal engagement section **163***a* of lever **162** includes a base portion **168** having engagement tooth **180** depending therefrom in generally perpendicular orientation relative thereto. Engagement tooth **180**, more specifically, defines a generally triangular cross-sectional configuration wherein engagement tooth **180** defines a maximum width at a base **182** (positioned adjacent to base portion **168** of distal engagement section **163***a*) and tapers from the maximum width at base **182** to a minimal width at an apex **184**. Engagement tooth **180** further defines a distally-facing, outer surface **186** extending between base **182** and apex **184** on a distal side of engagement tooth **180** and a proximally-facing, inner surface **188** extending between base **182** and apex **184** on a proximal side of engagement tooth **180**. Apex **184** of engagement tooth **180** may define a pair of linear segments **185***a*, **185***b* having an arc-shaped cut-out **185***c* defined therebetween. Arc-shaped cut-out **185***c* may be centrally disposed between the opposed ends of apex **184** of engagement tooth **180** such that linear segments **185***a*, **185***b* define equal lengths, although other configurations are also contemplated.

[0047] Distally-facing, outer surface **186** of engagement tooth **180** is configured to cam over chamfered proximal edge **226** of proximal hub **220** of elongated assembly **200** upon insertion of elongated assembly **200** into handle assembly **100** to facilitate engagement of elongated assembly **200** within handle assembly **100**, as noted above (see FIGS. **3**, **7**, and **8**). To this end, distally-facing, outer surface **186** may define a generally planar configuration (within manufacturing and material tolerances) sloped in a distal-to-proximal direction from base **182** of engagement tooth **180** to apex **184** thereof. In embodiments, the slope of outer surface **186** is equal in magnitude to the slope of chamfered proximal edge **226** of proximal hub **220** of elongated assembly **200** to facilitate camming of engagement tooth **180** about proximal hub **220** and into engagement within annular channel **224** (see FIGS. **3**, **7**, and **8**).

[0048] Proximally-facing, inner surface **188** of engagement tooth **180** defines a concave configuration over a portion thereof; the concave portion having a varied radius of curvature. More specifically, the concave portion of proximally-facing inner surface **188** defines a first, maximum radius of curvature at first and second ends **187***a*, **187***b*, respectively, thereof, wherein the concave portion extends

the entire width of proximally-facing, inner surface **188** at the ends **187***a*, **187***b*. The concave portion of proximally-facing, inner surface **188** further defines a second, minimum radius of curvature at an intermediate location **187***c* such that the concave portion extends only a portion of the width of proximally-facing, inner surface **188** at intermediate location **187***c*. Intermediate location **187***c* may be centrally located between first and second ends **187***a*, **187***b*, respectively, or otherwise disposed therebetween.

[0049] The radius of curvature of the concave portion of proximally-facing inner surface **188** may decrease continuously and smoothly from the ends **187***a*, **187***b* to the intermediate location **187***c*. The radius of curvature at the ends **187***a*, **187***b* and the radius of curvature at the intermediate location **187***c* may define a ratio, in embodiments, of 5:1 to 20:1, in other embodiments, of 10:1 to 15:1, and, in other embodiments, of 12:1 to 13:1. In embodiments, the radii of curvature may define a ratio of 12.5:1, and, in such embodiments, the radius of curvature at the end **187***a*, **187***b* may be about 0.0625 inches (within manufacturing an material tolerances) and the radius of curvature at the intermediate location **187***c* may be about 0.005 inches (within manufacturing and material tolerances).

[0050] Proximally-facing, inner surface **188** further defines a planar portion **187***d* that occupies the remainder of proximally-facing, inner surface **188** (e.g., the portion that is not part of the concave portion), although this remainder portion may also be curved or otherwise configured. Planar portion **187***d* defines an inverse configuration relative to the concave portion. That is, planar portion **187***d* defines a minimum or zero width adjacent ends **187***a*, **187***b* and a maximum width adjacent intermediate portion **187***c*.

[0051] The above-detailed configuration of engagement tooth **180** and, more specifically, proximally-facing, inner surface **188** thereof provides a secure engagement between lever **162** and a proximal hub of an elongated assembly, is capable of withstanding multiple use and cleaning/sterilization cycles, and enables a reduction in the overall thickness of engagement tooth **180** without compromising mechanical stability. More specifically, the thickness of engagement tooth **180** has been shown to provide the same mechanical stability as an engagement tooth without the above-described features of proximally-facing, inner surface **188** that has a 10% greater thickness.

[0052] With general reference back to FIGS. **1-4**, **6**, and **7**, insertion and engagement of an elongated assembly, e.g., elongated assembly **200**, with handle assembly **100** and use of the same are described. In order to engage elongated assembly **200** with handle assembly **100**, proximal hub **220** of elongated assembly **200** is inserted through outer knob **172** of rotation knob assembly **170** and into distal nose **116** of housing **110**, wherein engagement tooth **180** of latch assembly **160** cams over chamfered proximal edge **226** of proximal hub **220** and into engagement within annular channel **224** of proximal hub **220** to thereby rotatably engage proximal hub **220** relative to housing **110**. Upon insertion of proximal hub **220** through rotation knob assembly **170**, indexing protrusions **222** of proximal hub **220** are received within longitudinally-extending grooves **178** of outer knob **172** to rotationally fix proximal hub **220** relative to outer knob **172**.

[0053] With elongated assembly **200** engaged with handle assembly **100** as detailed above, handle assembly **100** may be manipulated and/or outer knob **172** rotated to position end effector **260** (FIG. **4**) of elongated assembly **200** about tissue to be treated. Once end effector **260** is positioned as desired, trigger **122** is pivoted towards fixed handle portion **112** of housing **110** to urge linkage **126** distally which, in turn, urges drive bar **130** distally through housing **110** to drive the inner drive assembly (not shown) of elongated assembly **200** distally through elongated assembly **200** to fire and form a surgical clip from end effector assembly **260** (FIG. **3**A) about tissue. The above may be repeated to fire and form several surgical clips about tissue, as necessary.

[0054] In order to disengage elongated assembly **200** from handle assembly **100**, e.g., for cleaning and/or sterilization, or to replace elongated assembly **200** with another elongated assembly, lever **162** of latch assembly **160** is depressed inwardly into housing **110** to disengage engagement tooth **180** from annular channel **224**, thereby disengaging lever **162** from proximal hub **220** of elongated assembly **200** and enabling proximal hub **220** to be withdrawn distally from housing **110** and rotation knob assembly **170**.

[0055] It should be understood that the foregoing description is only illustrative of the present disclosure. Various alternatives and modifications can be devised by those skilled in the art without departing from the disclosure. Accordingly, the present disclosure is intended to embrace all such alternatives, modifications and variances. The embodiments described with reference to the attached drawing figures are presented only to demonstrate certain examples of the disclosure. Other elements, steps, methods and techniques that are insubstantially different from those described above and/or in the appended claims are also intended to be within the scope of the disclosure.

What is claimed is:

1. A latch assembly for a surgical instrument, comprising:

a lever including a distal engagement section, an intermediate section, and a proximal manipulatable section, the distal engagement section including a base and an engagement tooth depending from the base, the engagement tooth configured to releasably engage first and second components of a surgical instrument with one another, the engagement tooth defining a first surface having a concave portion defining a varied radius of curvature.

2. The latch assembly according to claim **1**, wherein the radius of curvature of the concave portion varies between a maximum radius of curvature towards ends of the first surface and a minimum radius of curvature towards an intermediate location of the first surface.

3. The latch assembly according to claim **2**, wherein a ratio of the maximum radius of curvature to the minimum radius of curvature is between 5:1 and 20:1.

4. The latch assembly according to claim **2**, wherein a ratio of the maximum radius of curvature to the minimum radius of curvature is between 10:1 and 15:1.

5. The latch assembly according to claim **2**, further comprising a pivot pin pivotably supporting the intermediate section of the lever thereon.

6. The latch assembly according to claim **5**, further comprising a biasing member operably coupled to the pivot pin.

7. The latch assembly according to claim **1**, wherein the engagement tooth defines a generally triangular-shaped configuration including a distal-facing surface extending from the base to an apex, and wherein the first surface is proximally-facing extending from the base to the apex

8. A handle assembly of a surgical instrument, comprising:

a housing defining a body portion, a fixed handle portion depending from the body portion, and a distal nose extending distally from the body portion;

a drive assembly disposed within the housing;

a trigger pivotably connected to the housing and operably associated with the drive assembly, the trigger movable relative to the fixed handle portion of the housing from an un-actuated position to an actuated position to actuate the drive assembly; and

a latch assembly operably coupled to the body potion of the housing, the latch assembly configured to releasably engage an elongated assembly inserted through the distal nose of the housing, the latch assembly including:

a lever including a distal engagement section, an intermediate section, and a proximal manipulatable section, the distal engagement section including a base and an engagement tooth depending from the base, the engagement tooth configured to releasably engage the elongated assembly, the engagement tooth defining a first surface having a concave portion defining a varied radius of curvature.

9. The handle assembly according to claim **8**, wherein the radius of curvature of the concave portion varies between a maximum radius of curvature towards ends of the first surface and a minimum radius of curvature towards an intermediate location of the first surface.

10. The handle assembly according to claim **9**, wherein a ratio of the maximum radius of curvature to the minimum radius of curvature is between 5:1 and 20:1.

11. The handle assembly according to claim **9**, wherein a ratio of the maximum radius of curvature to the minimum radius of curvature is between 10:1 and 15:1.

12. The handle assembly according to claim **9**, wherein the latch assembly further includes a pivot pin pivotably coupling the intermediate section of the lever with the housing.

13. The handle assembly according to claim **12**, wherein the latch assembly further includes a biasing member operably coupled to the pivot pin and configured to bias the latch towards an engaged position.

14. The handle assembly according to claim **8**, wherein the engagement tooth defines a generally triangular-shaped configuration including a distal-facing surface extending from the base to an apex, and wherein the first surface is proximally-facing extending from the base to the apex

15. A surgical instrument, comprising:

an elongated assembly including a proximal hub, a shaft extending distally from the proximal hub, and an end effector extending distally from the shaft; and

a handle assembly, including:

a housing defining a body portion, a fixed handle portion depending from the body portion, and a distal nose extending distally from the body portion;

a drive assembly disposed within the housing;

a trigger pivotably connected to the housing and operably associated with the drive assembly, the trigger movable relative to the fixed handle portion of the housing from an un-actuated position to an actuated position to actuate the drive assembly; and

a latch assembly operably coupled to the body potion of the housing, the latch assembly configured to releasably engage the elongated assembly upon insertion of the proximal hub of the elongated assembly through the distal nose of the housing, the latch assembly including:

a lever including a distal engagement section, an intermediate section, and a proximal manipulatable section, the distal engagement section including a base and an engagement tooth depending from the base, the engagement tooth configured to releasably engage a channel defined within the proximal hub of the elongated assembly, the engagement tooth defining a first surface having a concave portion defining a varied radius of curvature.

16. The surgical instrument according to claim **15**, wherein the radius of curvature of the concave portion varies between a maximum radius of curvature towards ends of the first surface and a minimum radius of curvature towards an intermediate location of the first surface.

17. The surgical instrument according to claim **16**, wherein a ratio of the maximum radius of curvature to the minimum radius of curvature is between 5:1 and 20:1.

18. The surgical instrument according to claim **16**, wherein a ratio of the maximum radius of curvature to the minimum radius of curvature is between 10:1 and 15:1.

19. The surgical instrument according to claim **15**, wherein the engagement tooth defines a generally triangular-shaped configuration including a distal-facing surface extending from the base to an apex, and wherein the first surface is proximally-facing extending from the base to the apex

20. The surgical instrument according to claim **15**, wherein the latch assembly further comprises:

a pivot pin pivotably coupling the intermediate section of the lever with the housing; and

a biasing member operably coupled to the pivot pin and configured to bias the latch towards an engaged position.

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