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(54) **APPARATUS FOR APPLYING SURGICAL CLIPS**

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CPC ***A61B 17/1285*** (2013.01); ***A61B 17/12*** (2013.01); ***A61B 17/128*** (2013.01); *A61B 2017/12004* (2013.01)

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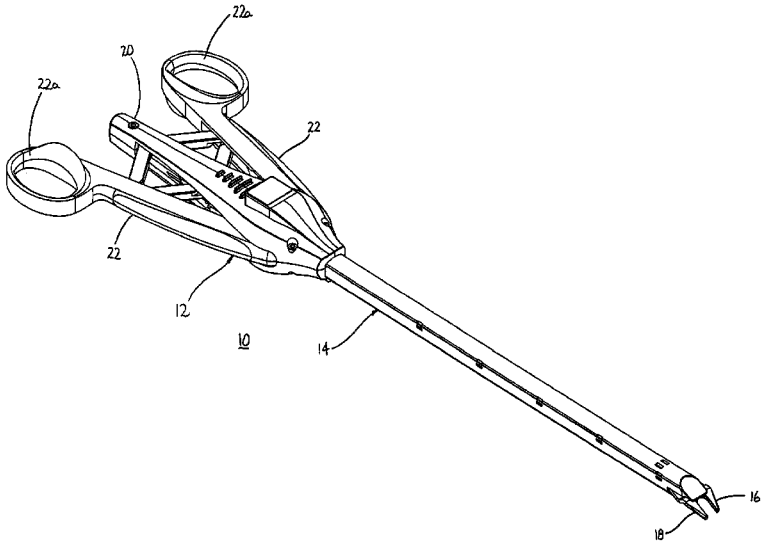
(57) **ABSTRACT**

A clip applying apparatus is described for applying clips seriatim to tissue. The apparatus includes a lockout member for limiting distal movement of the camming member after the proximal-most clip has been applied to tissue. In one embodiment, the apparatus includes a jaw locking member for preventing approximation of the jaw members of the apparatus. In one embodiment, a latch assembly is provided to releasably engage a clip pusher of the apparatus to the camming member of the apparatus.

21 Claims, 32 Drawing Sheets



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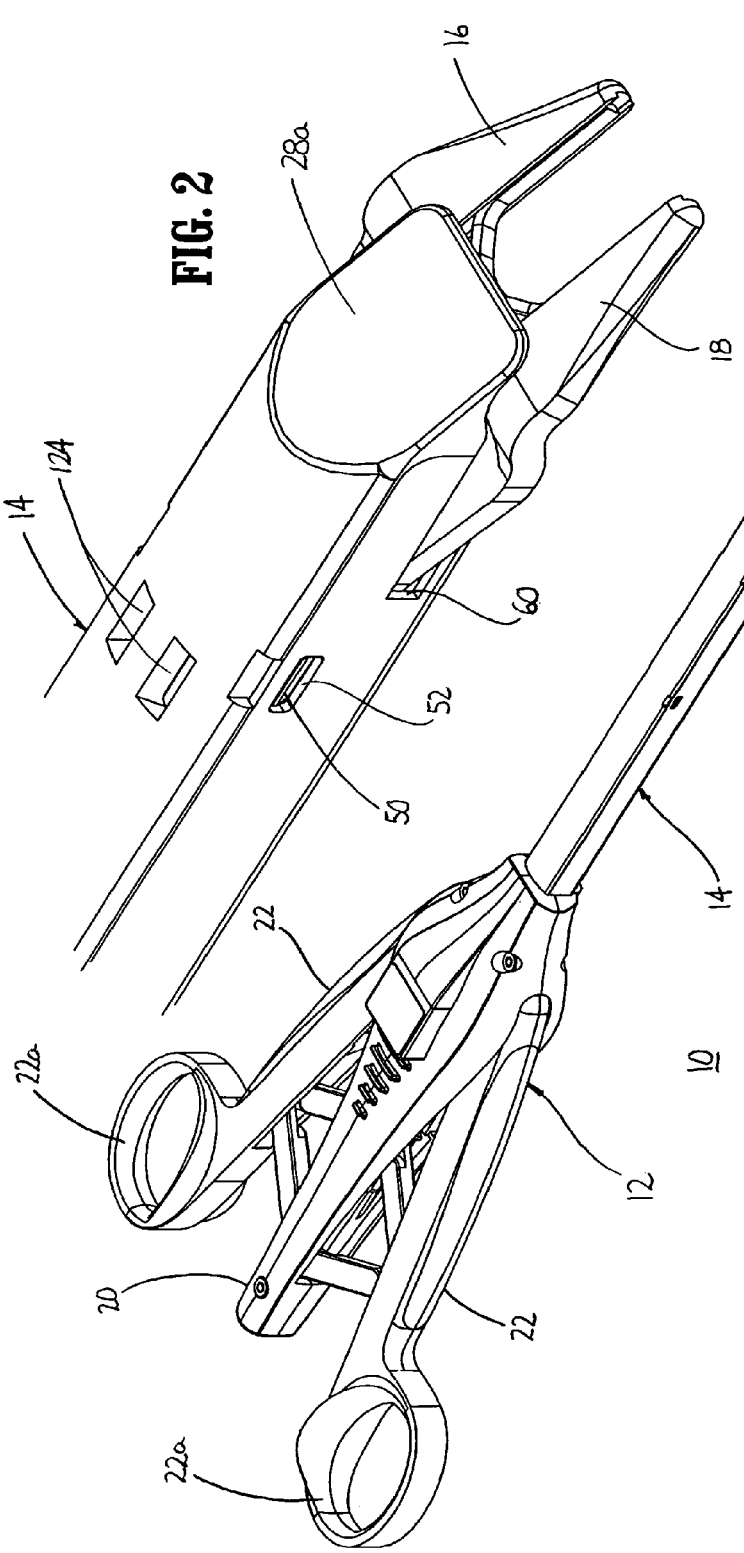
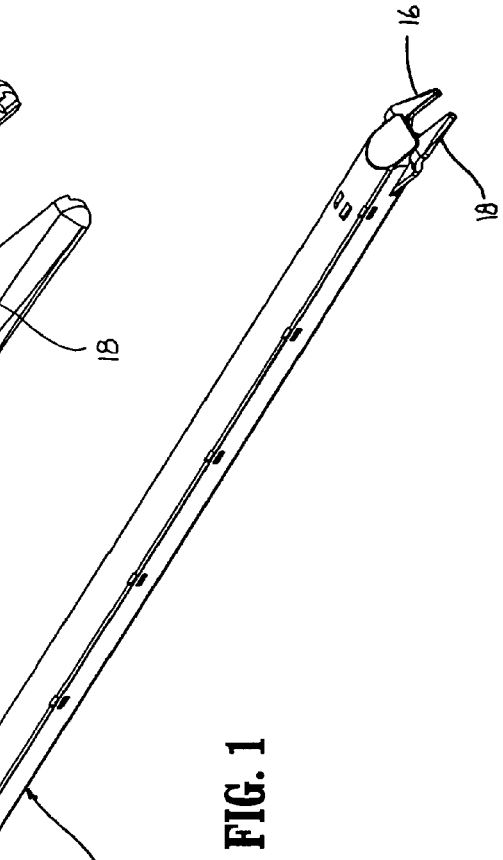


FIG. 2



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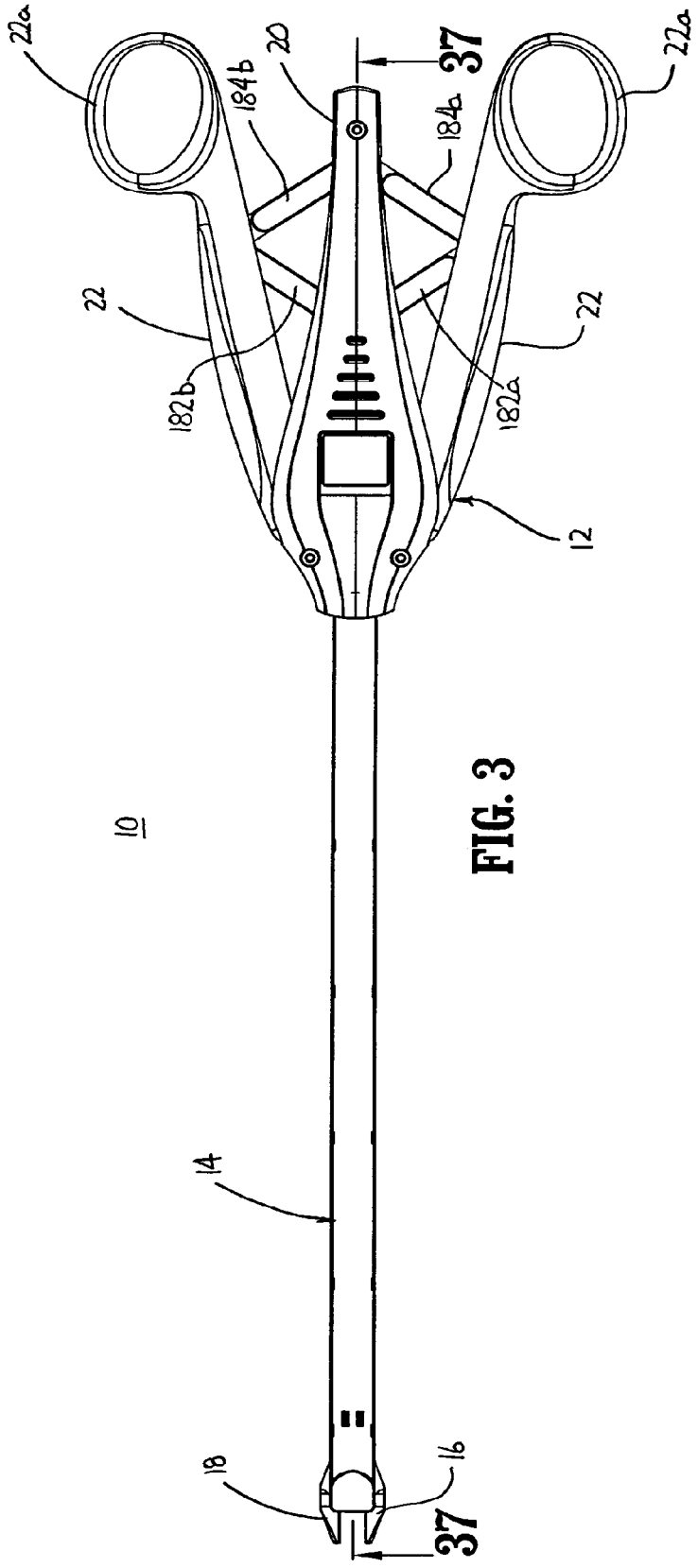
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FIG. 3

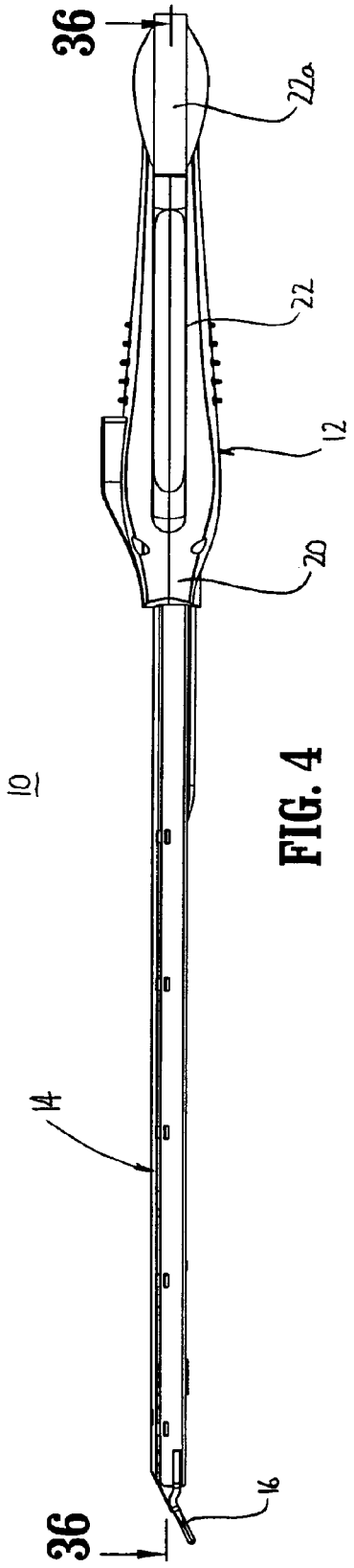
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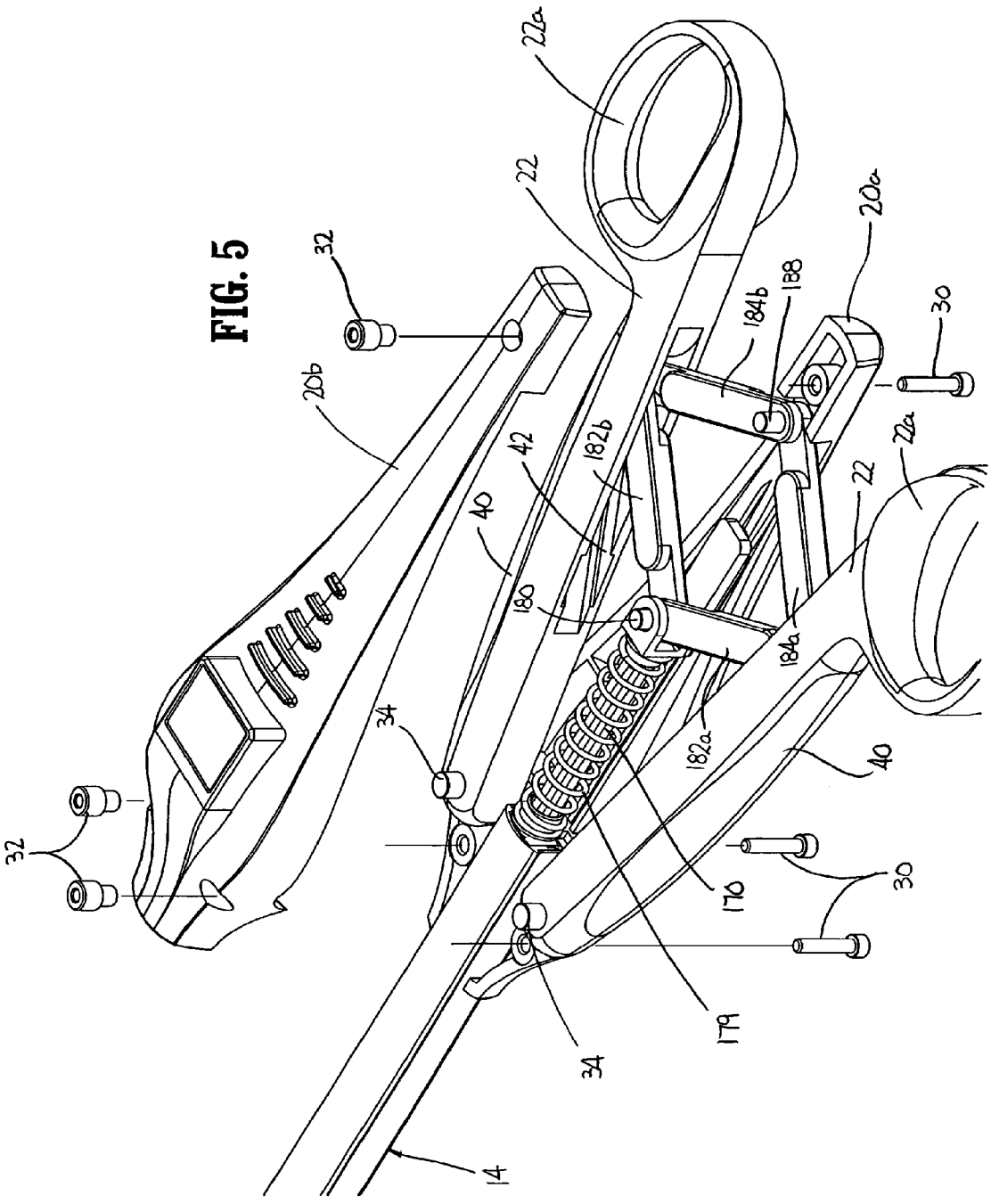
FIG. 4

FIG. 5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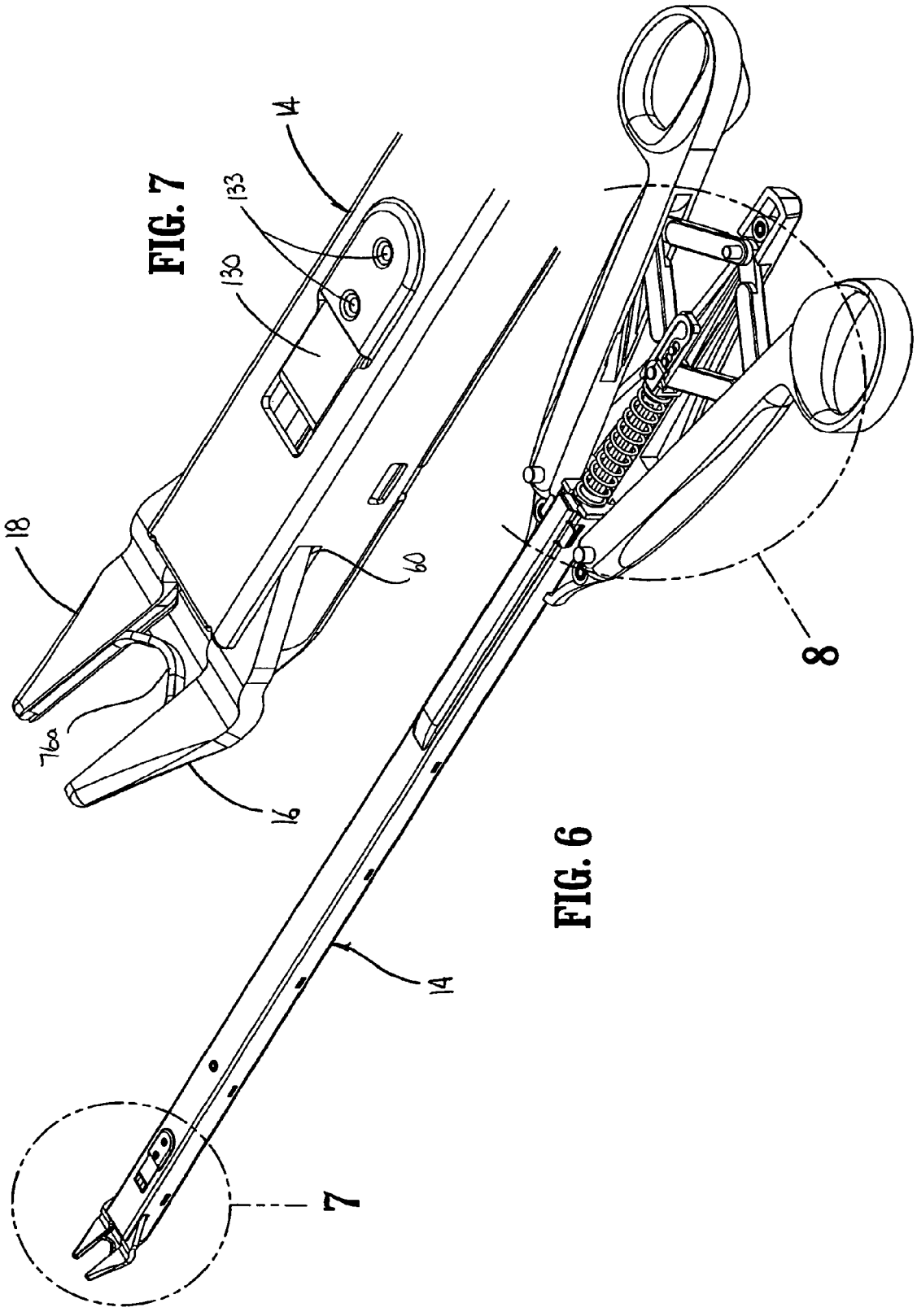

FIG. 7

FIG. 6

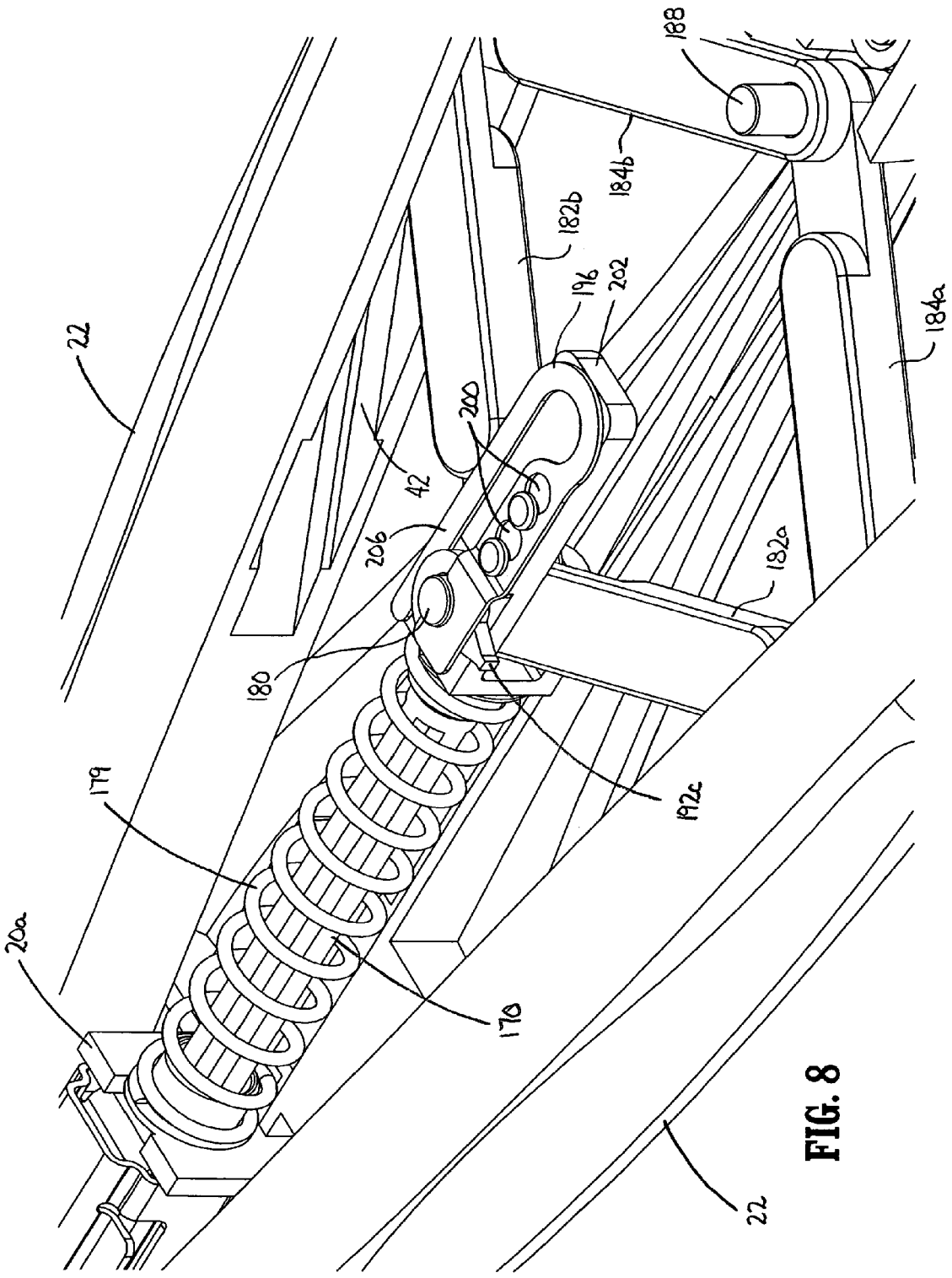
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FIG. 8

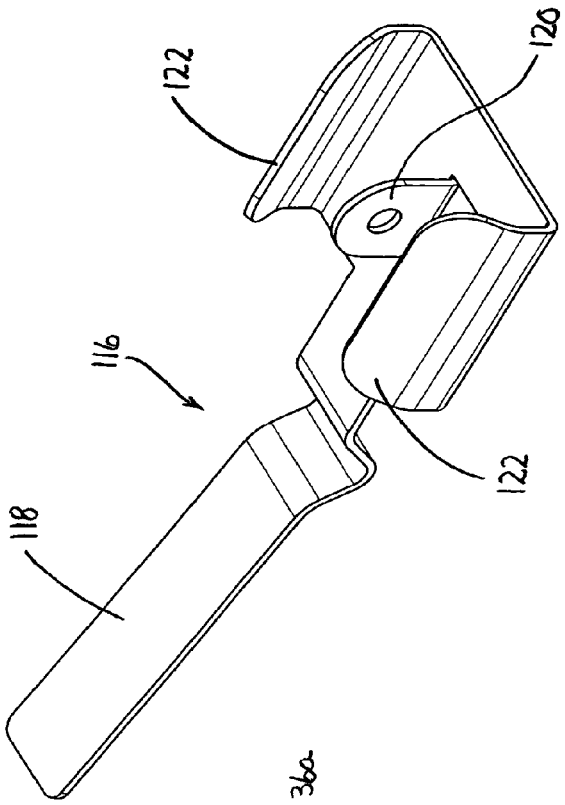

FIG. 11

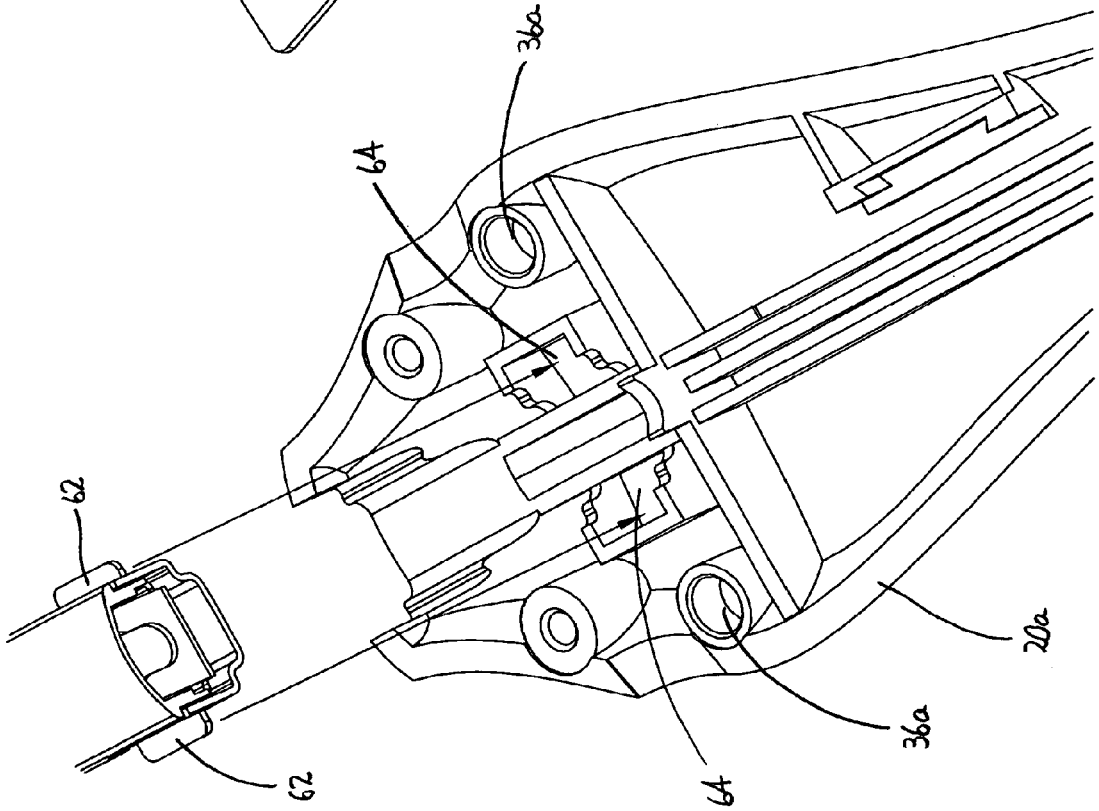

FIG. 9

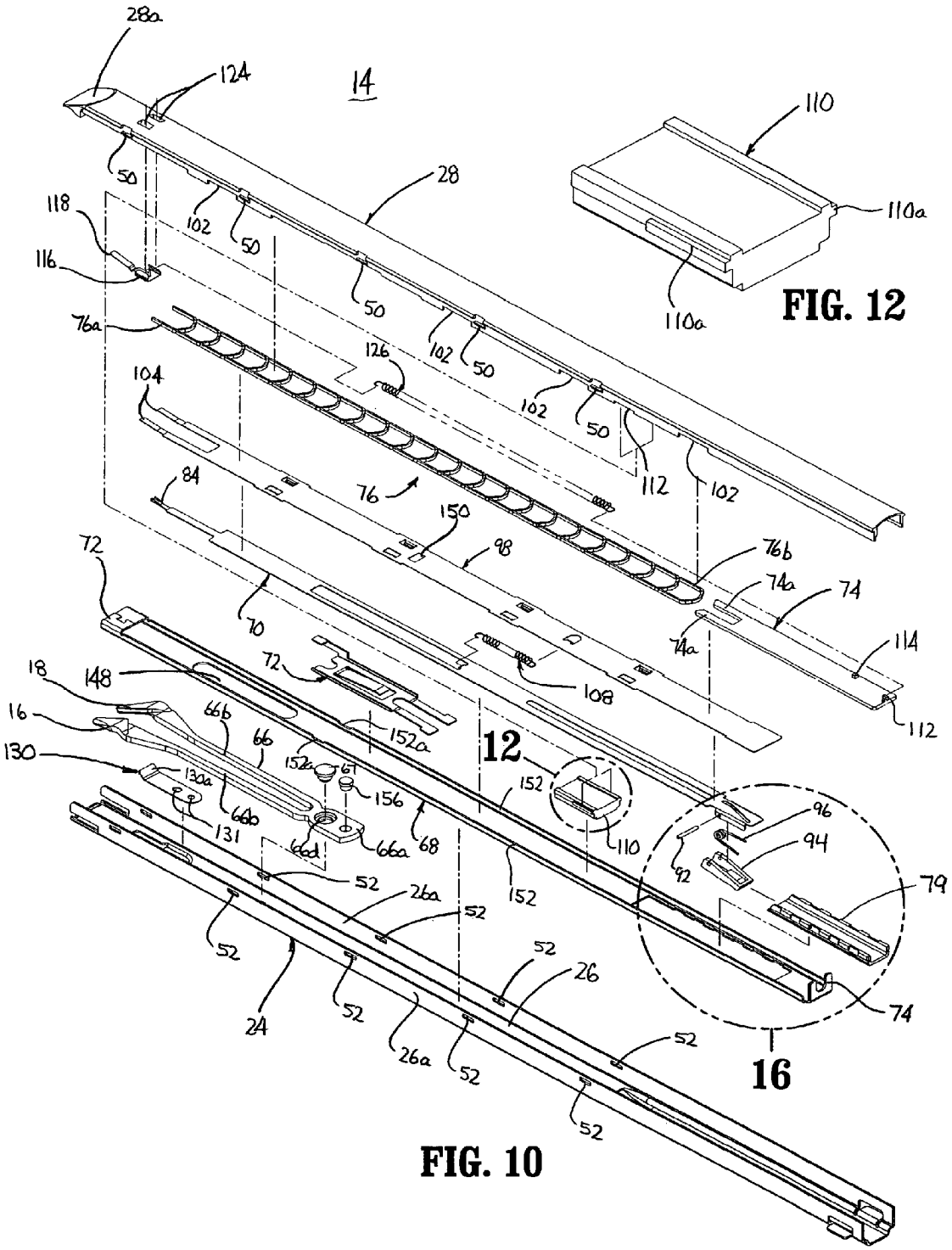
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FIG. 12
FIG. 10

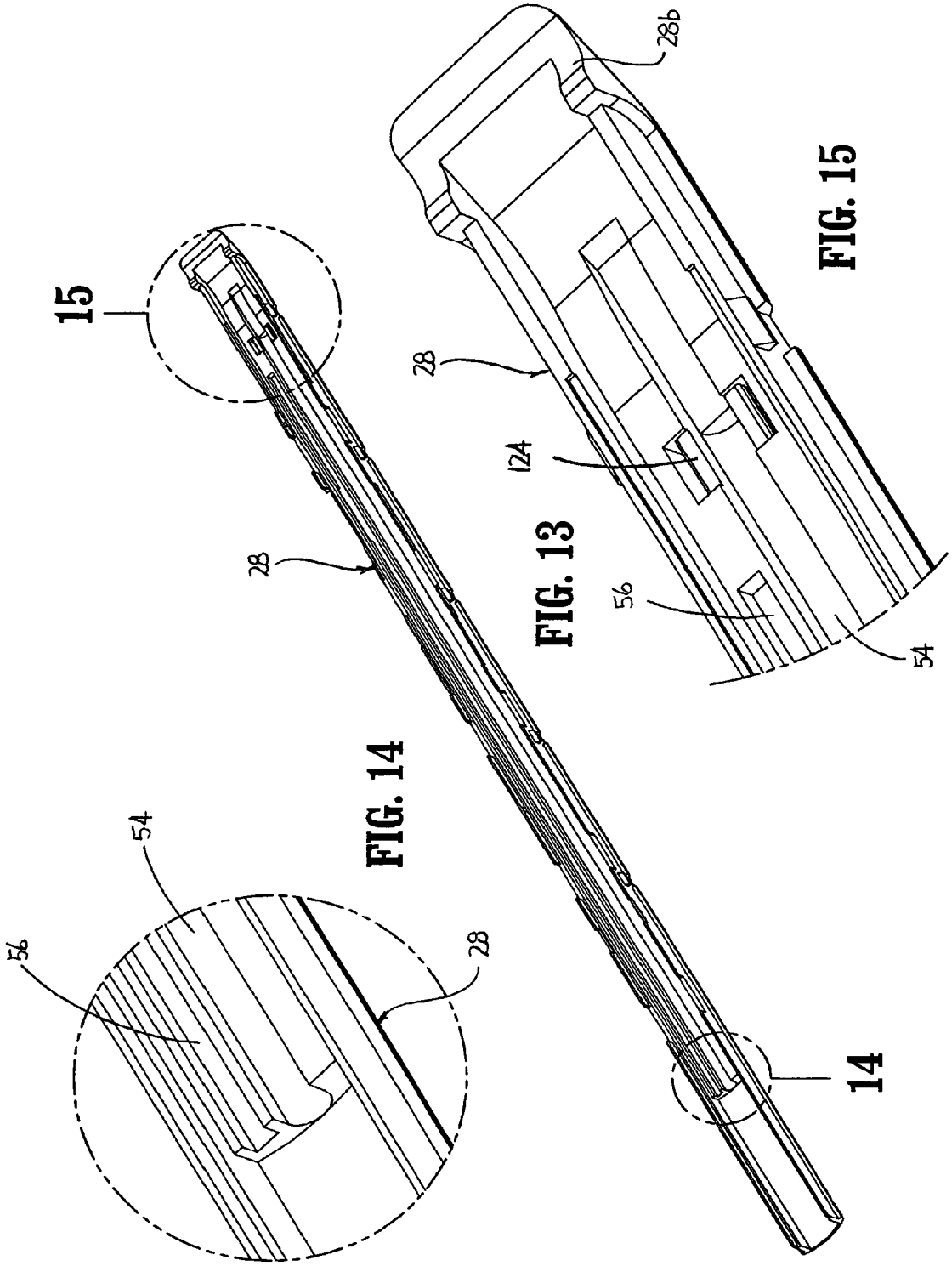
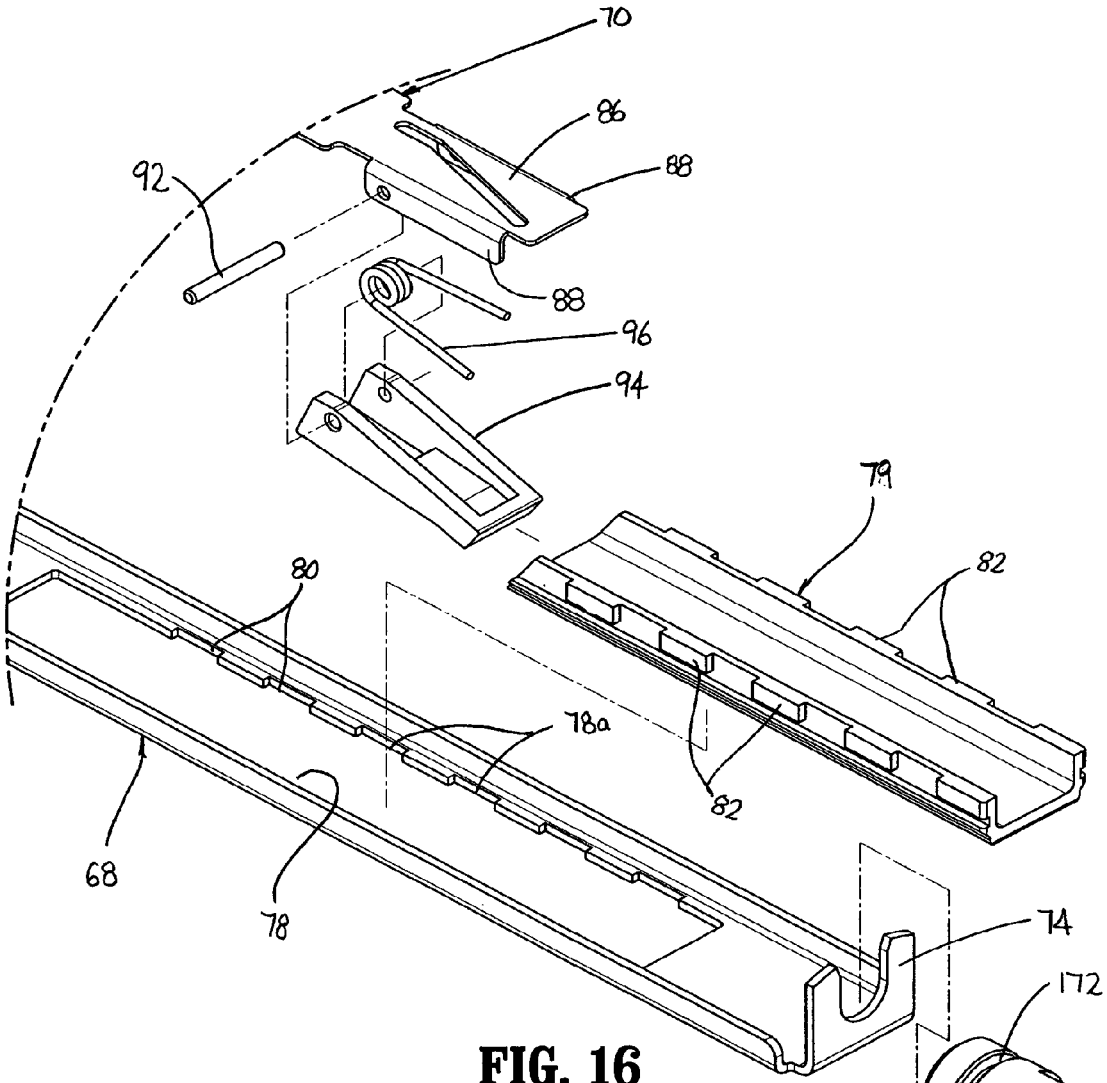


FIG. 13

FIG. 14

FIG. 15



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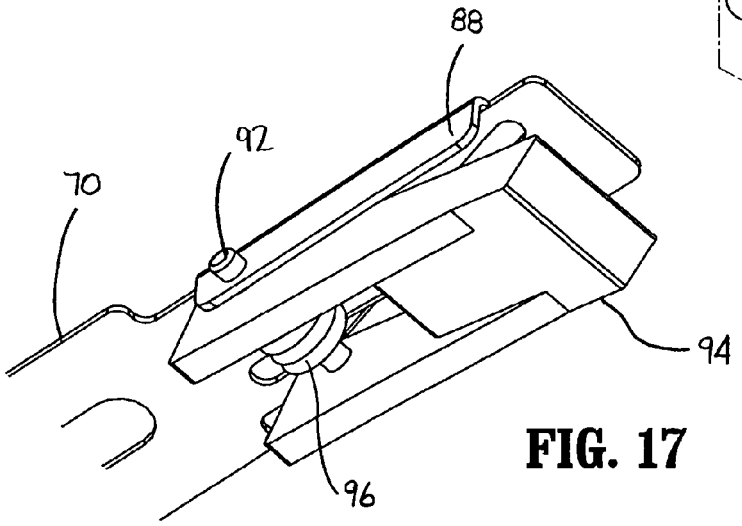

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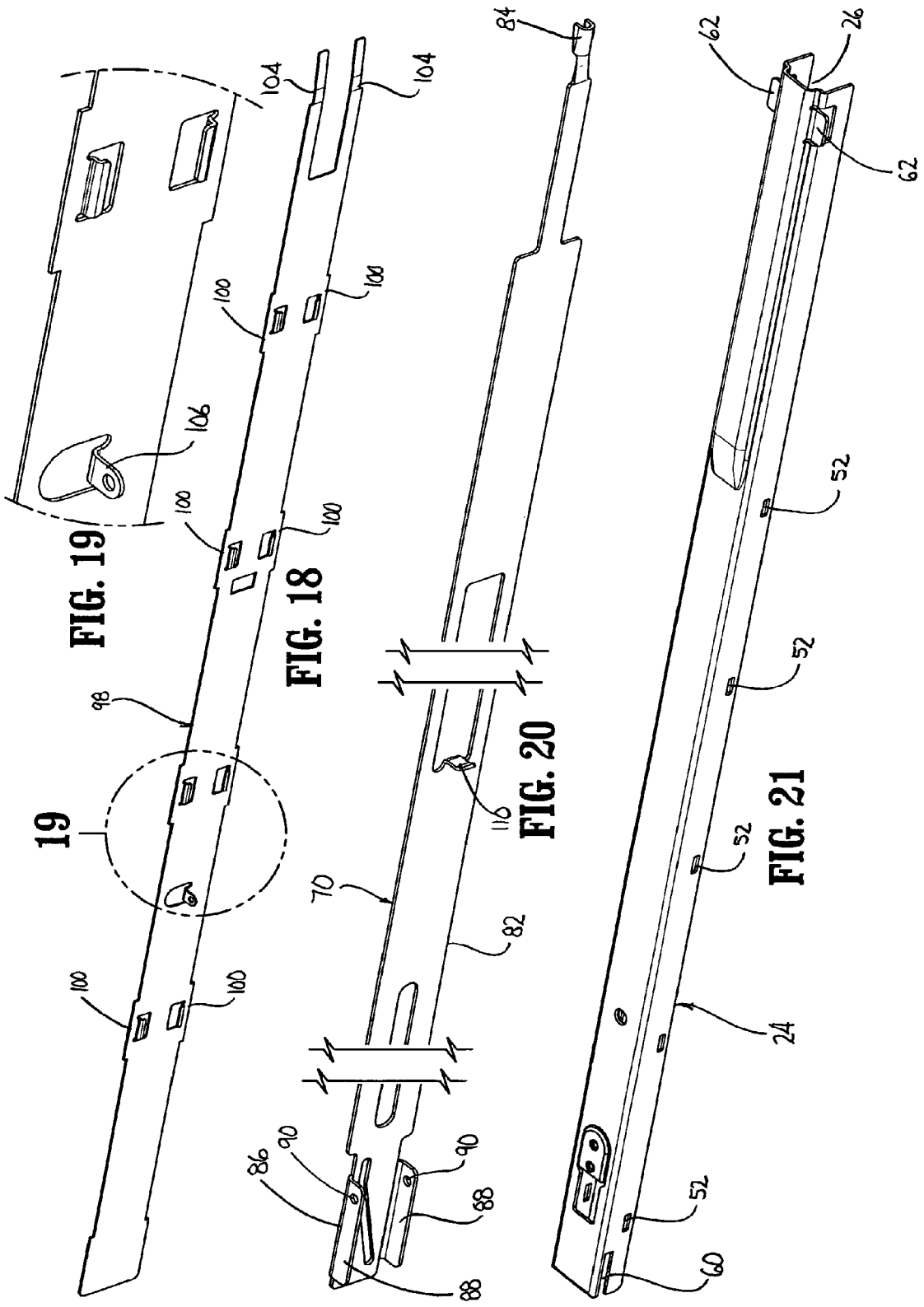


FIG. 19

FIG. 18

FIG. 20

FIG. 21

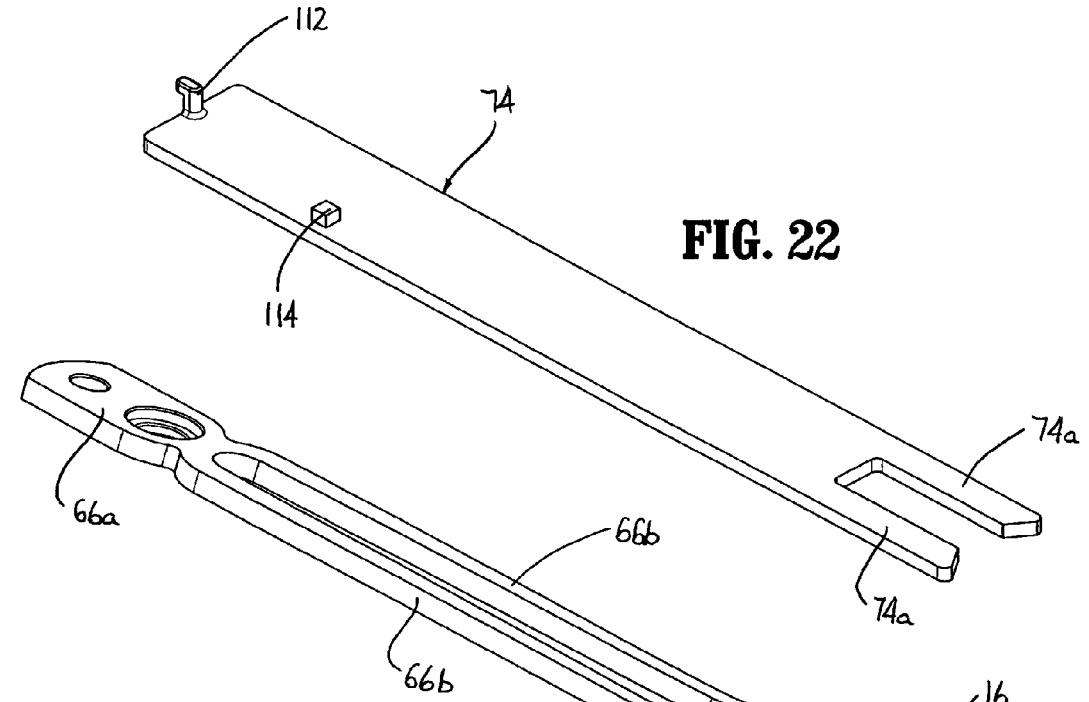
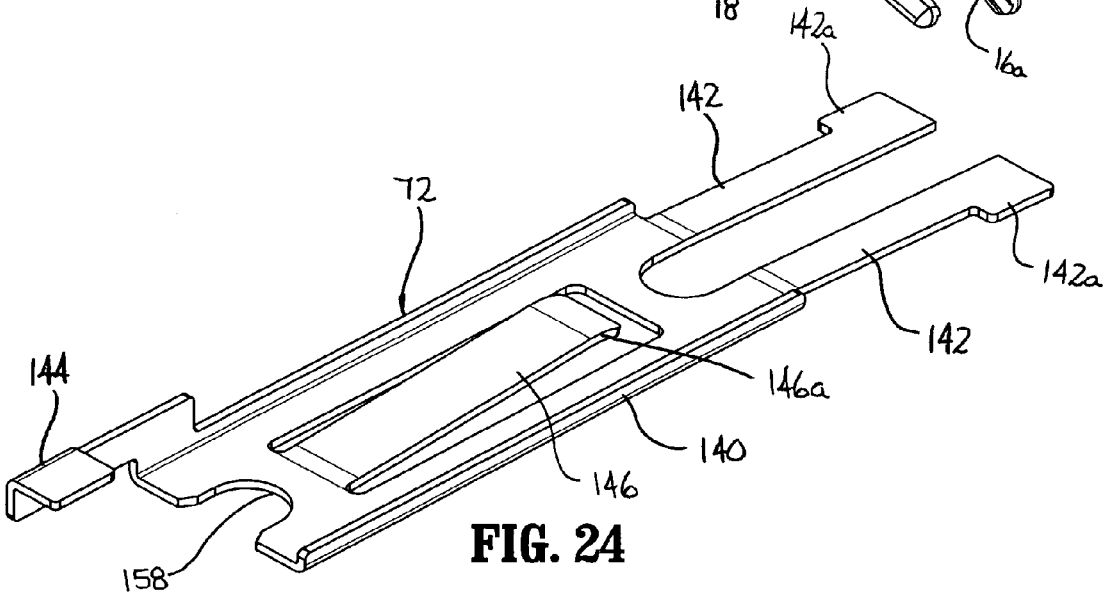


FIG. 22

FIG. 23



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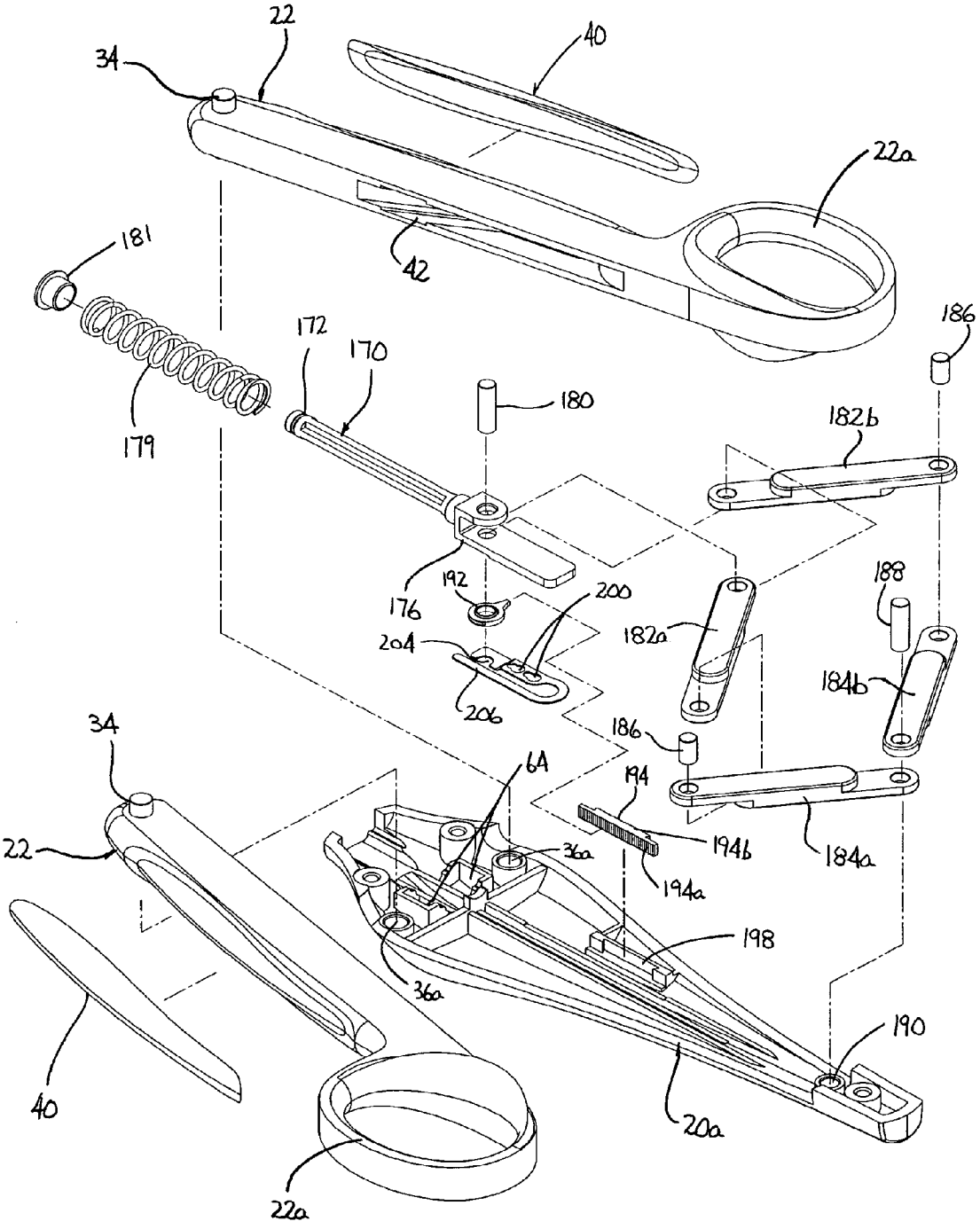
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FIG. 25

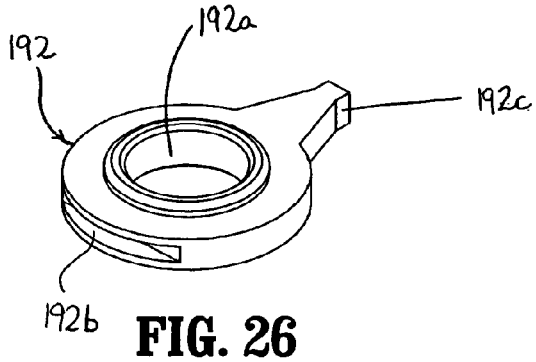
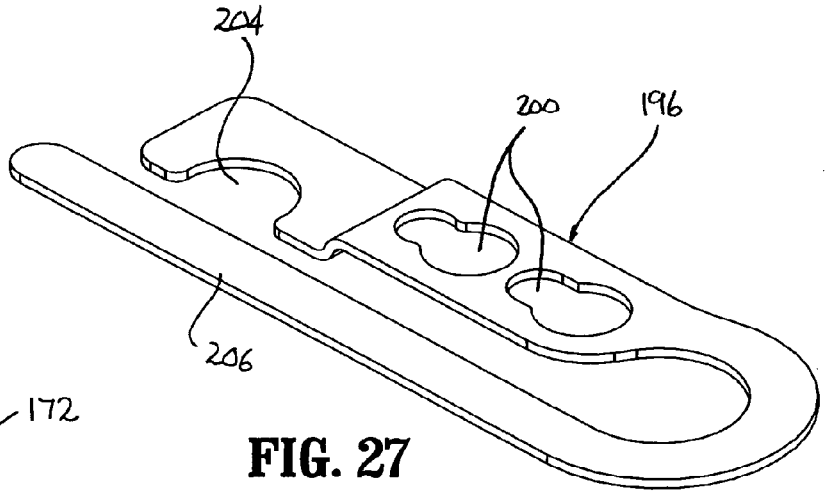


FIG. 26



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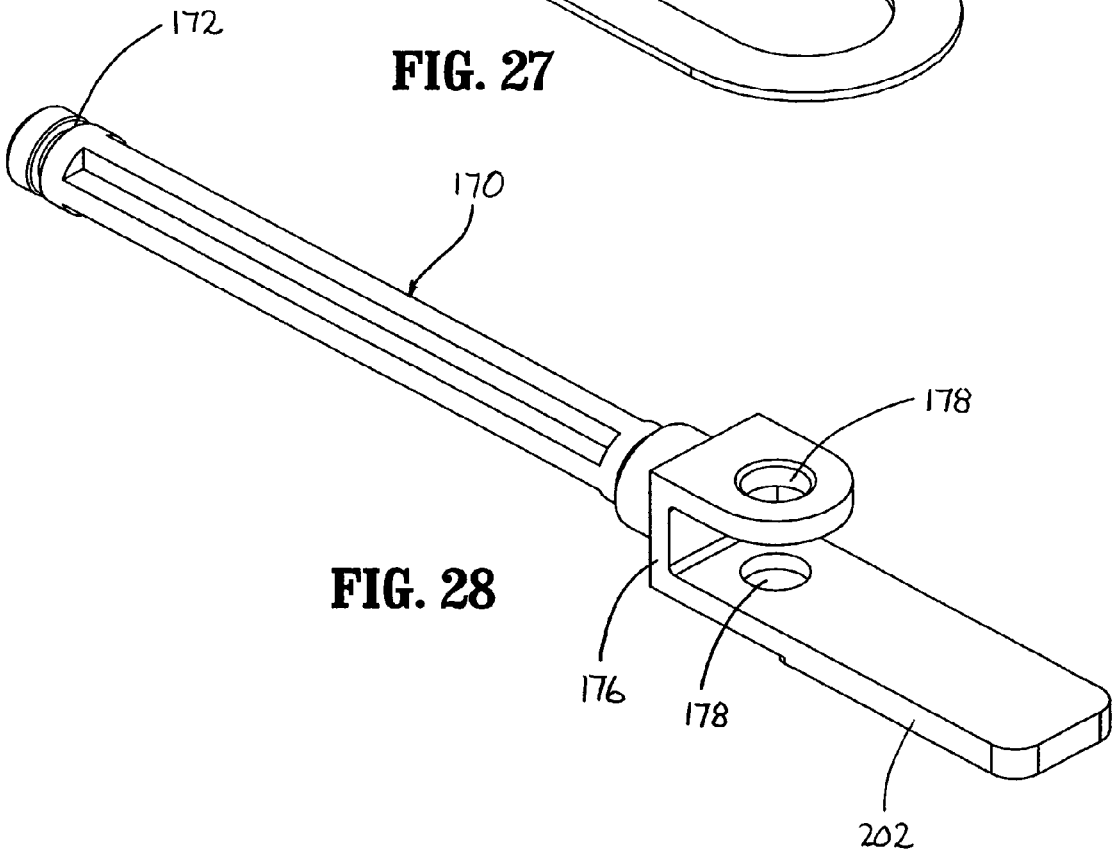

FIG. 28

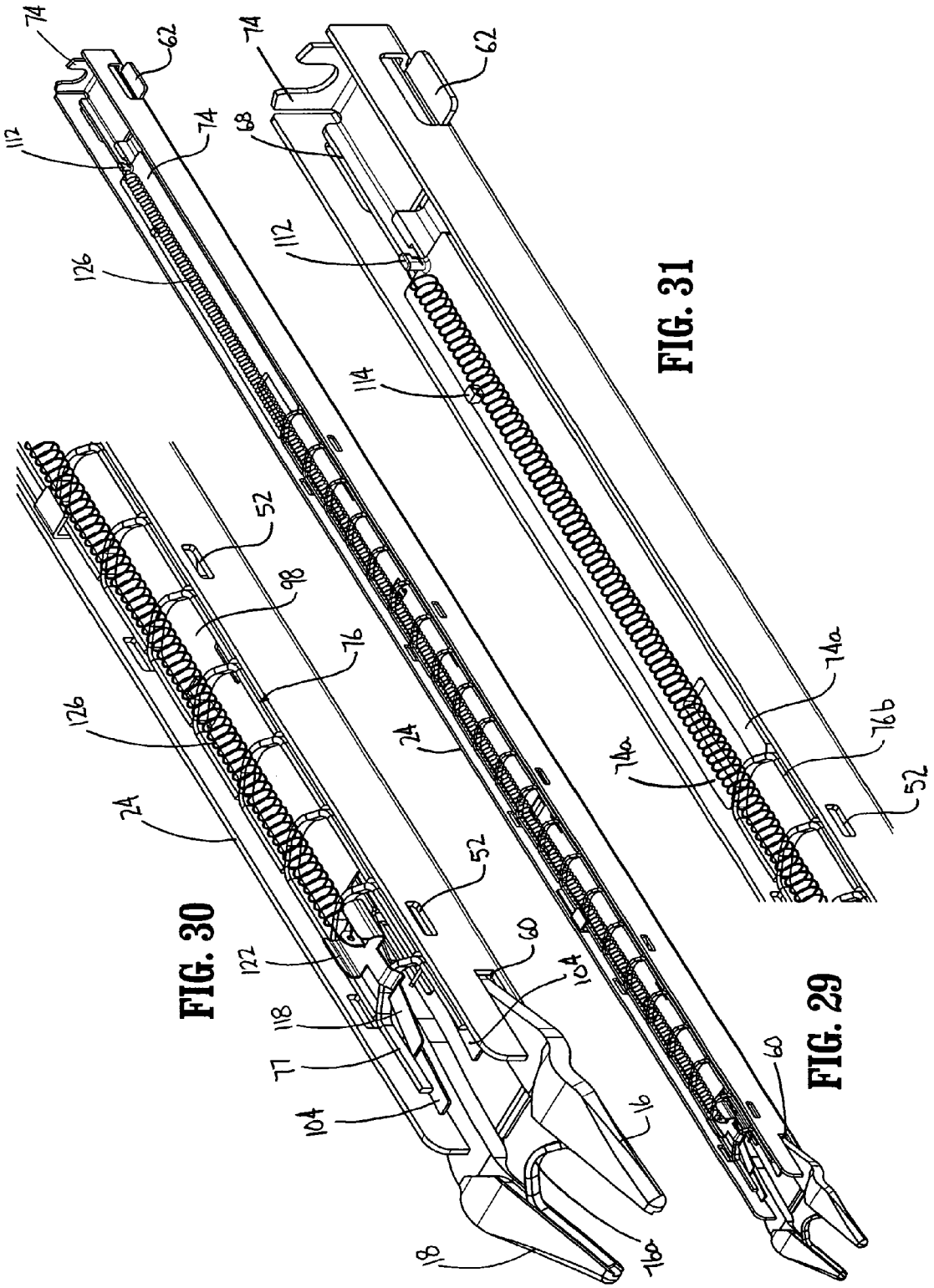

FIG. 30

FIG. 31

FIG. 29

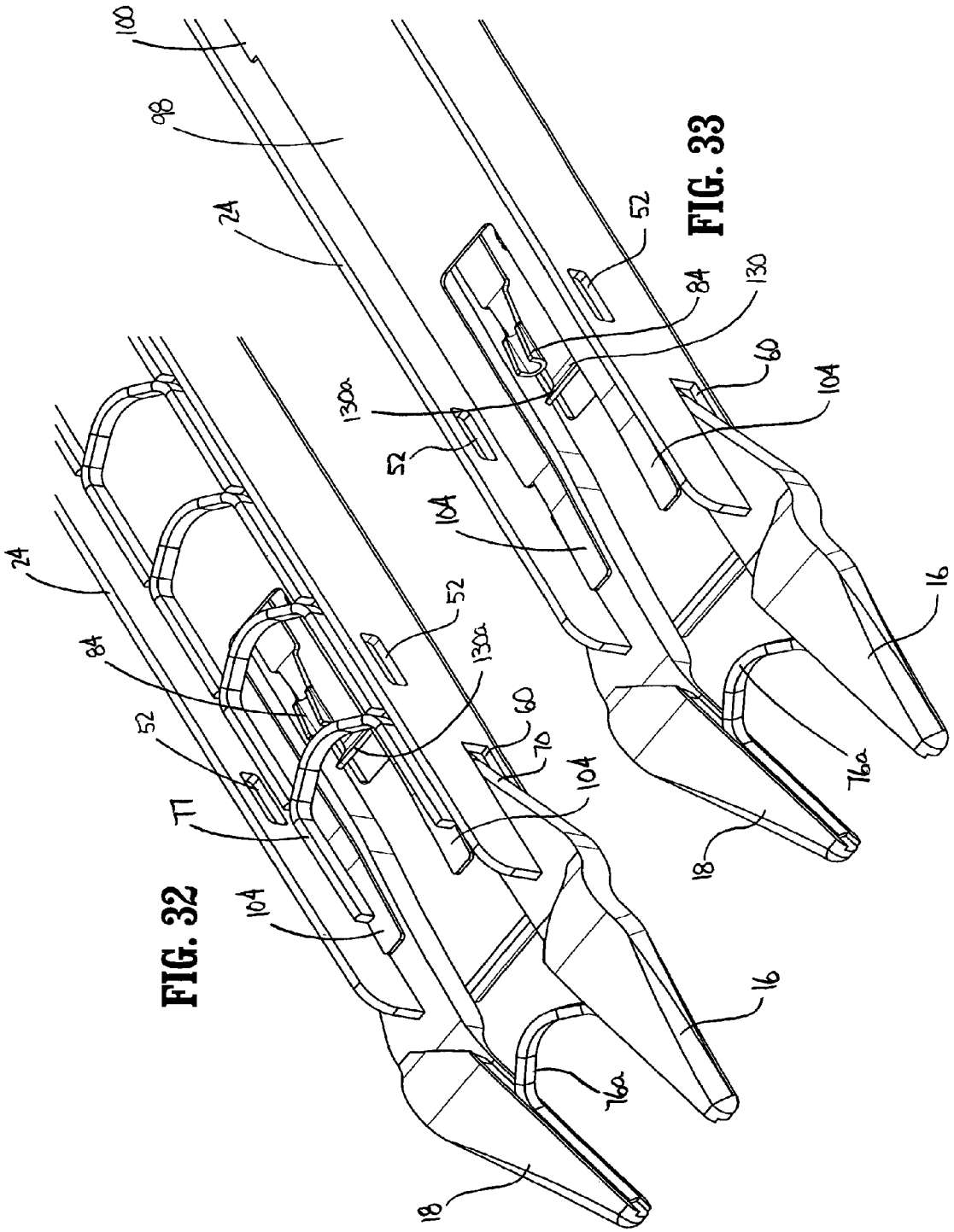
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FIG. 32

FIG. 33

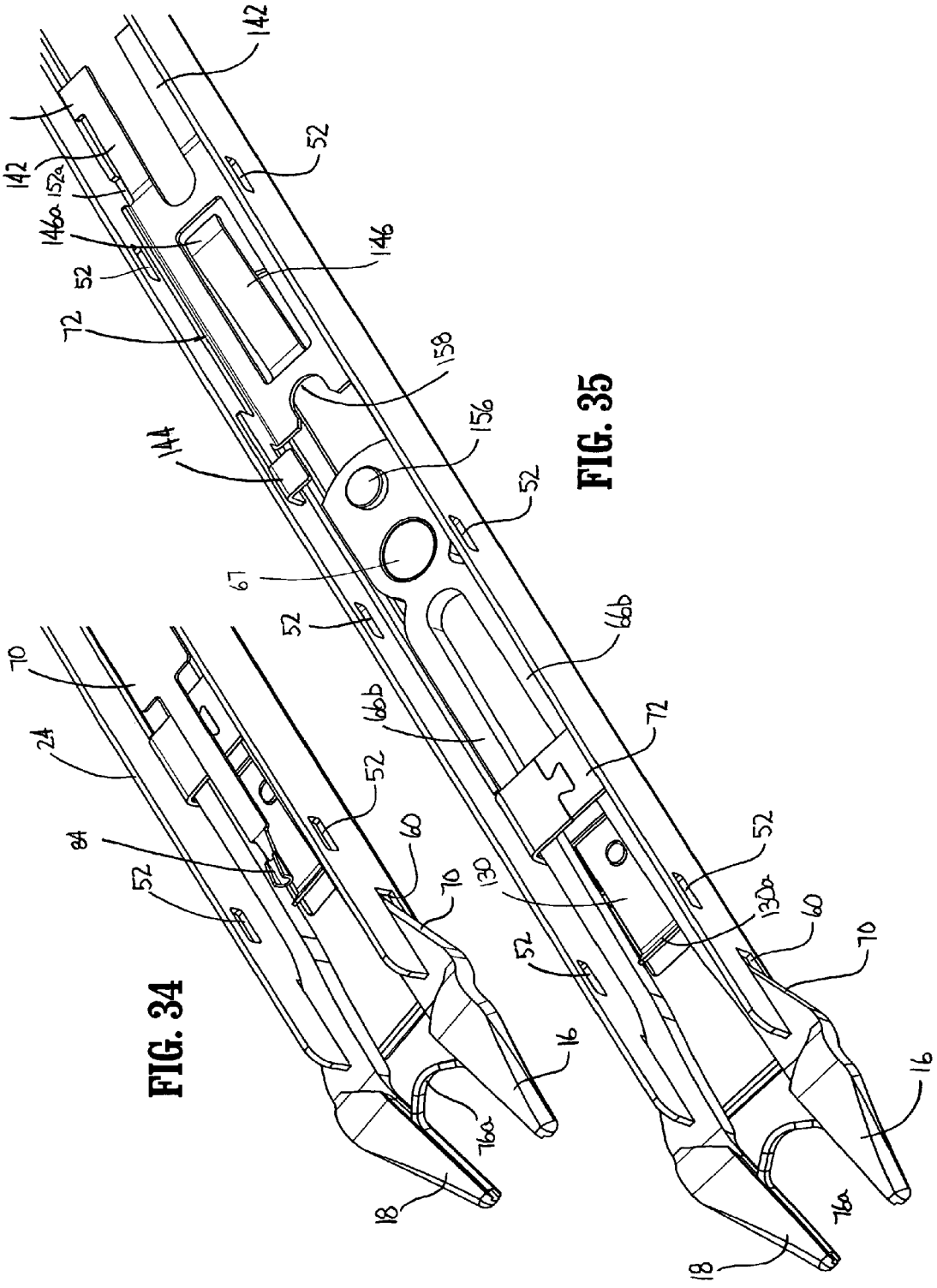
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FIG. 34

FIG. 35

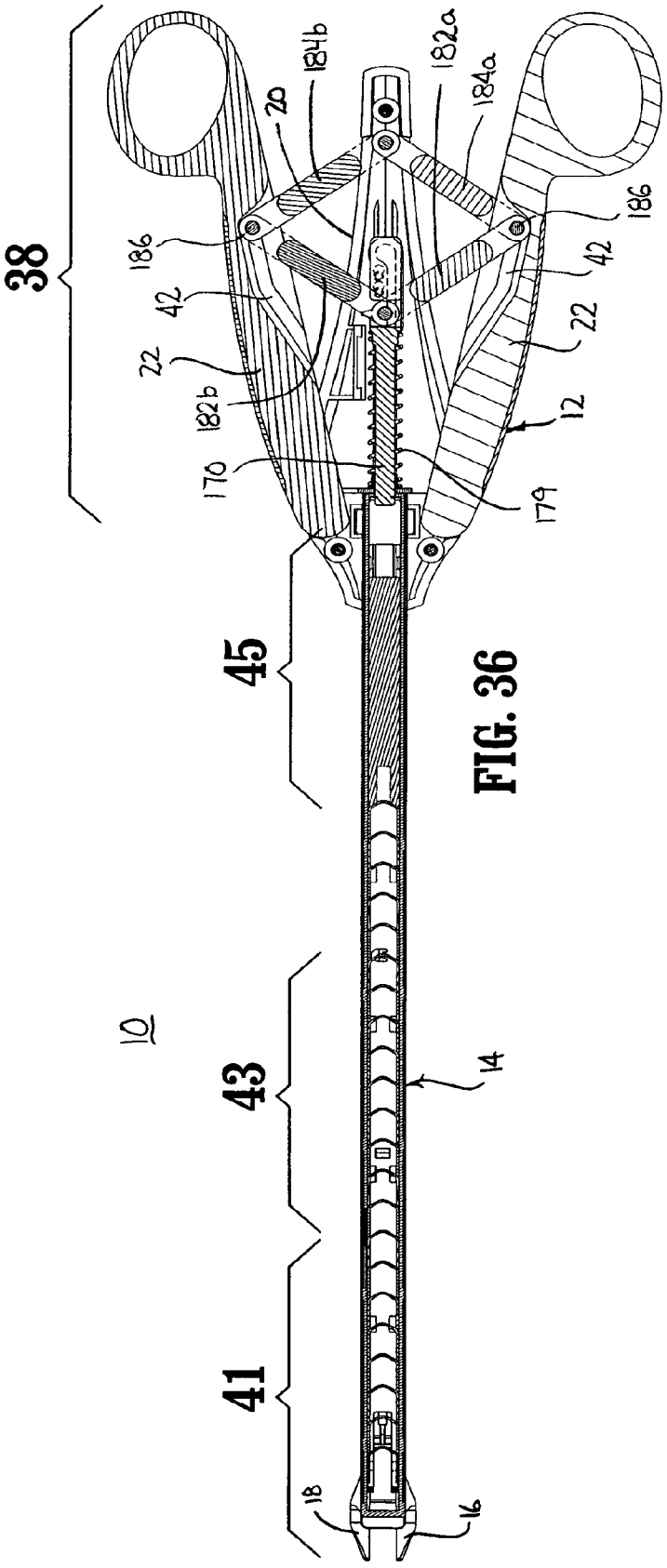
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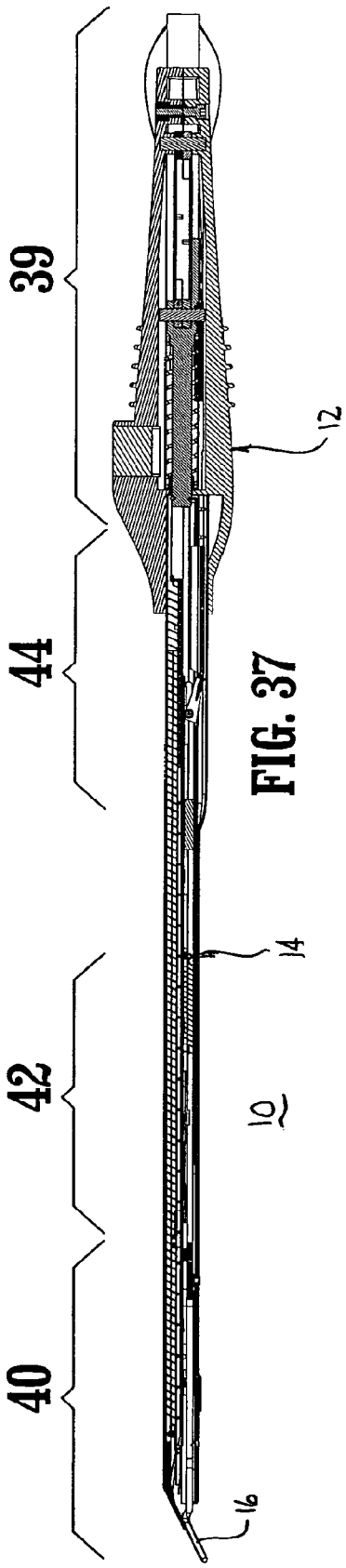
FIG. 36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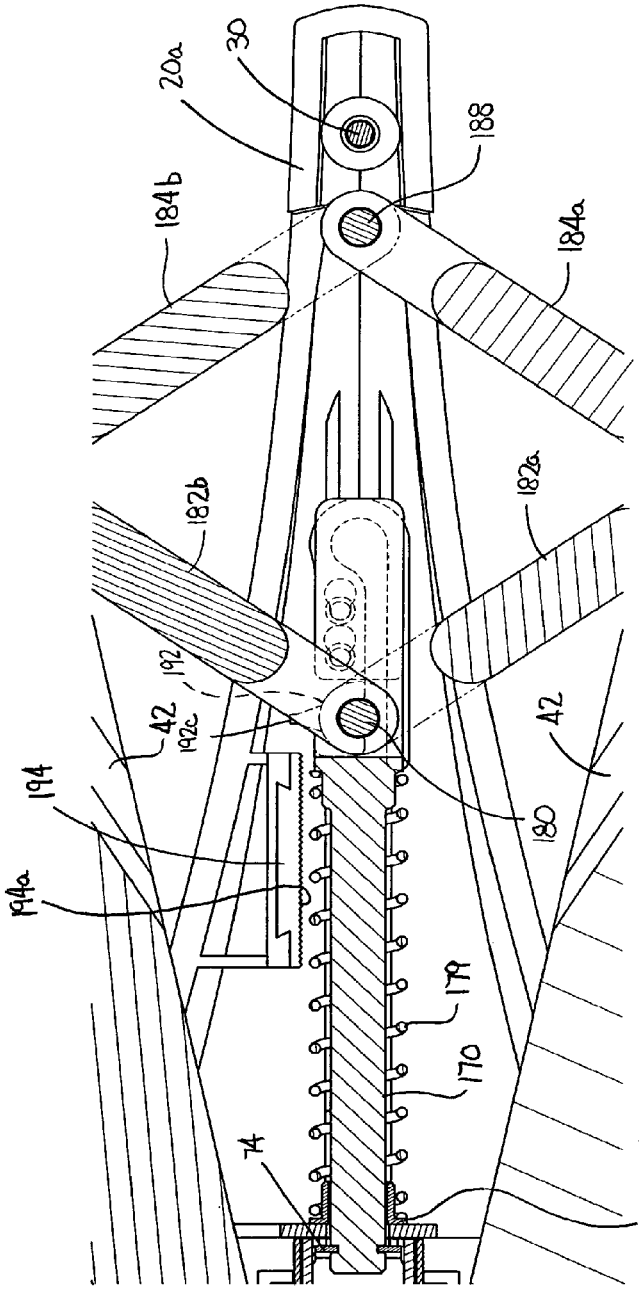
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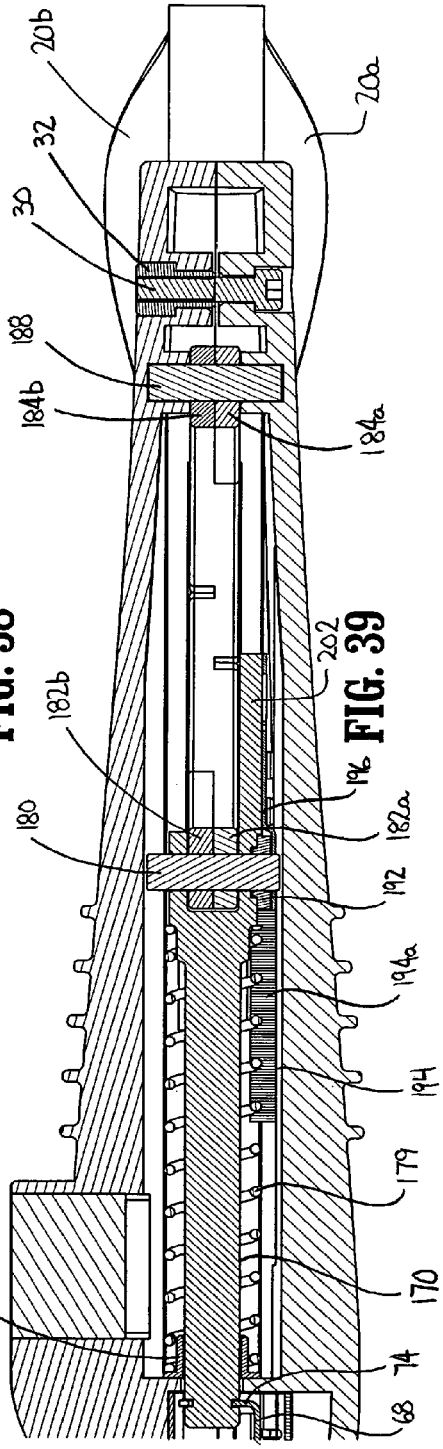
FIG. 38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68

FIG. 39

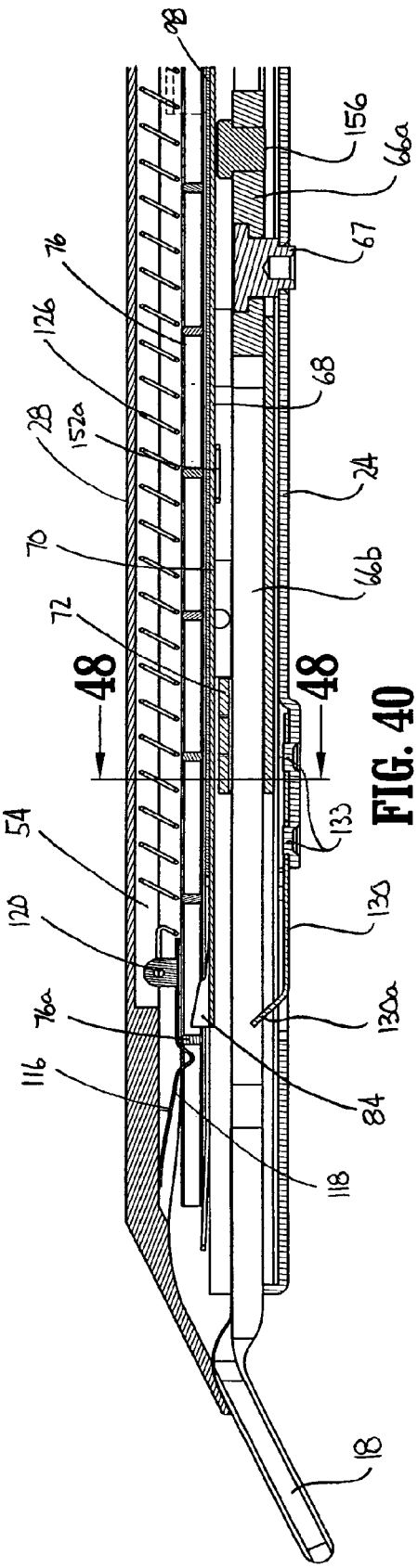

98
156
66a
67
76
126
68
28
152a
24
70
66b
72
48
48
54
133
120
130
130a
76a
84
116
118
18

FIG. 40

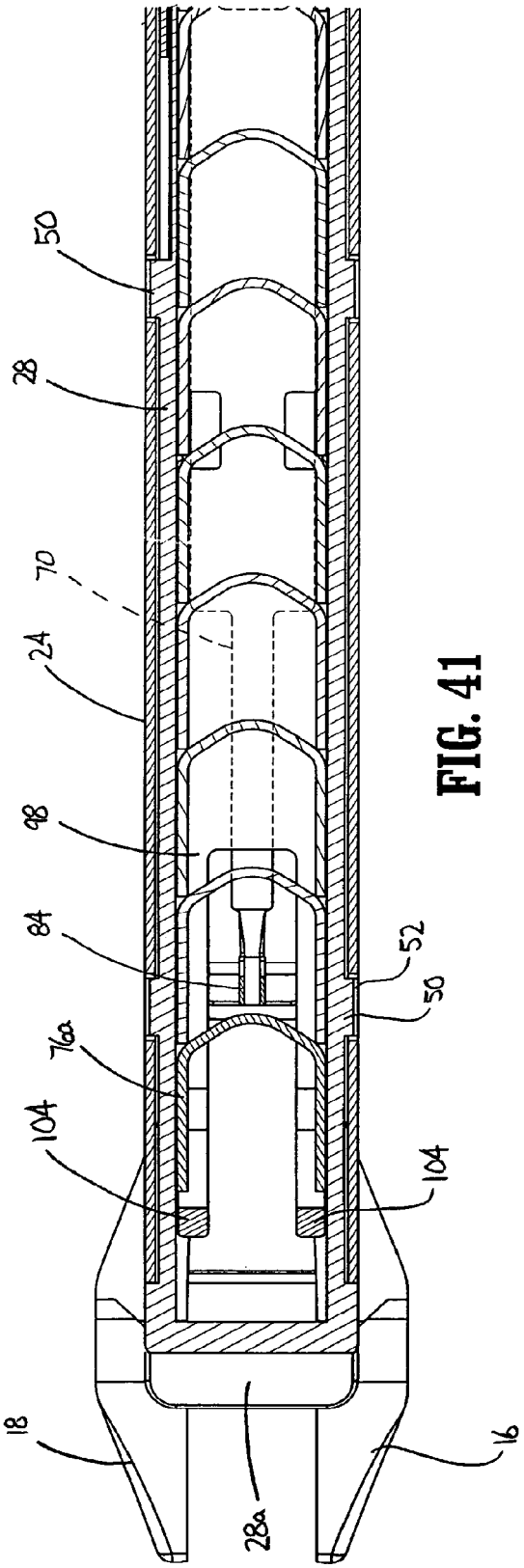

50
28
70
24
98
84
52
50
76a
104
104
18
28a
16

FIG. 41

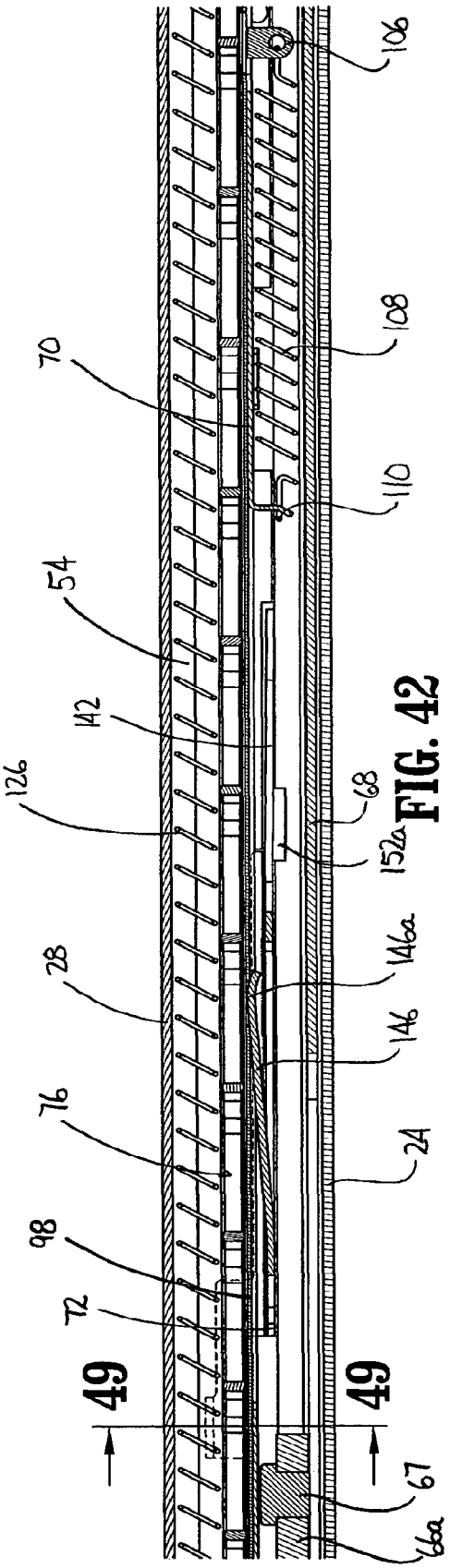

106
108
70
110
54
142
126
68
152a
146a
28
146
76
24
98
72
49
49
67
66a

FIG. 42

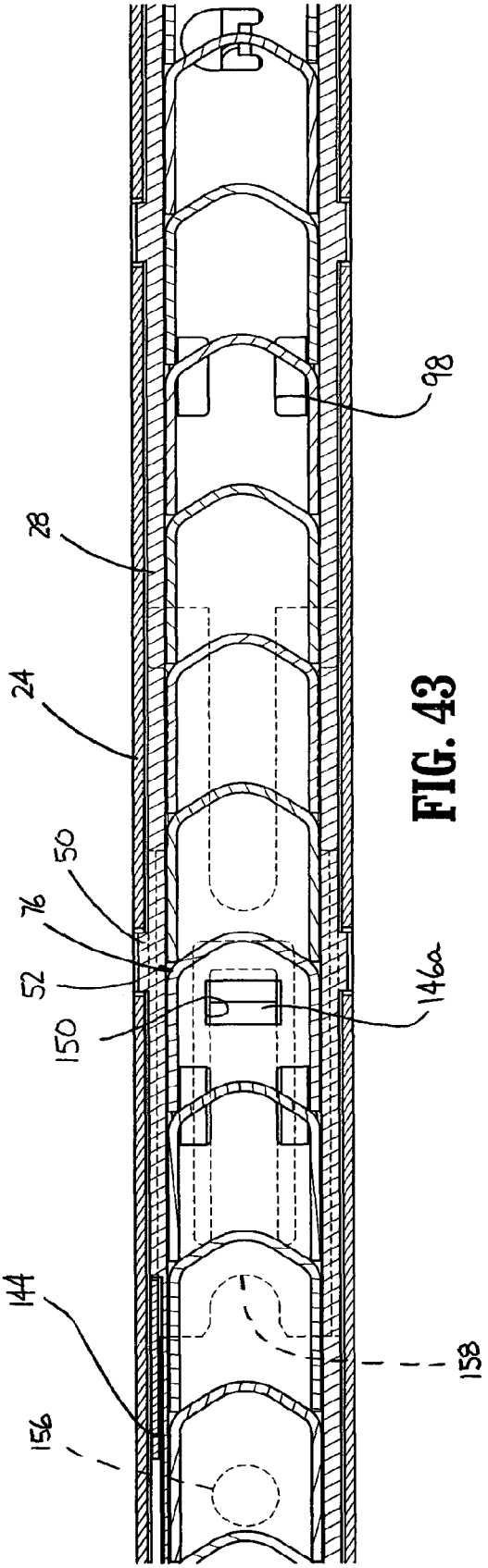

98
28
24
50
76
52
150
146a
144
158
156

FIG. 43

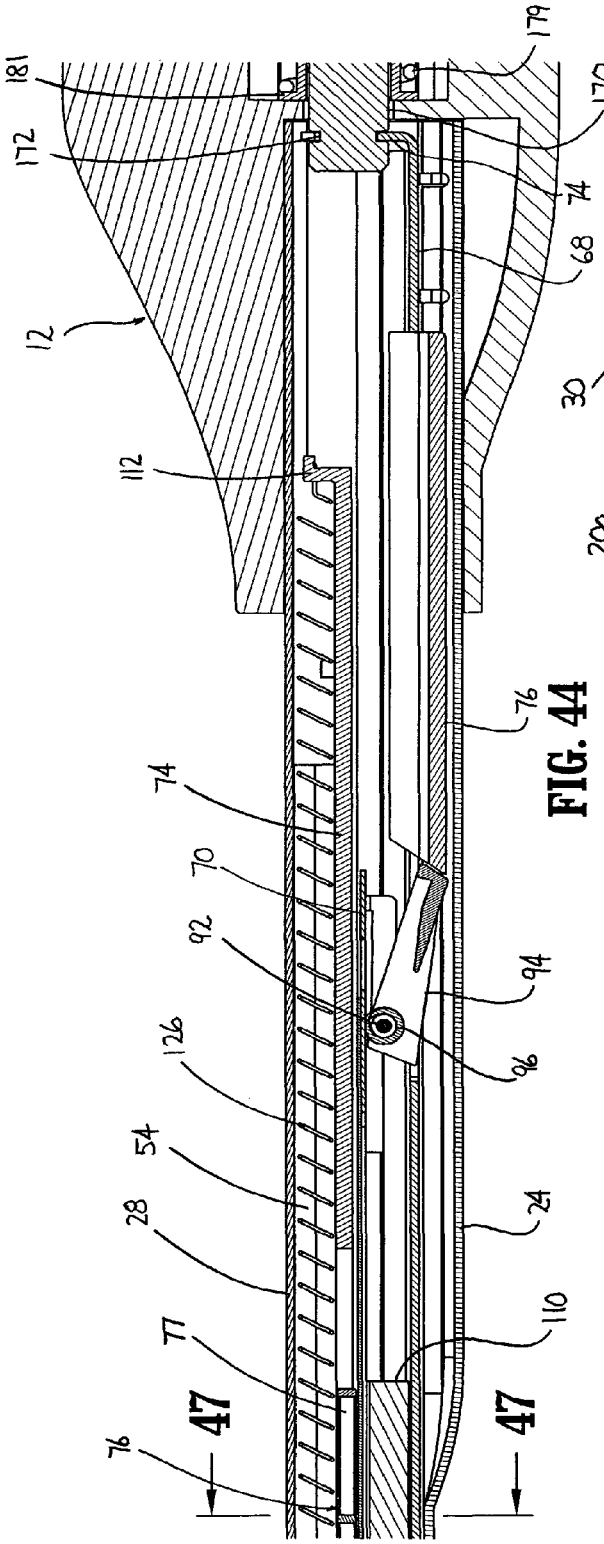

181
172
179
170
74
62
68
12
112
76
74
70
92
94
96
126
54
28
24
77
110
47
47
76

FIG. 44

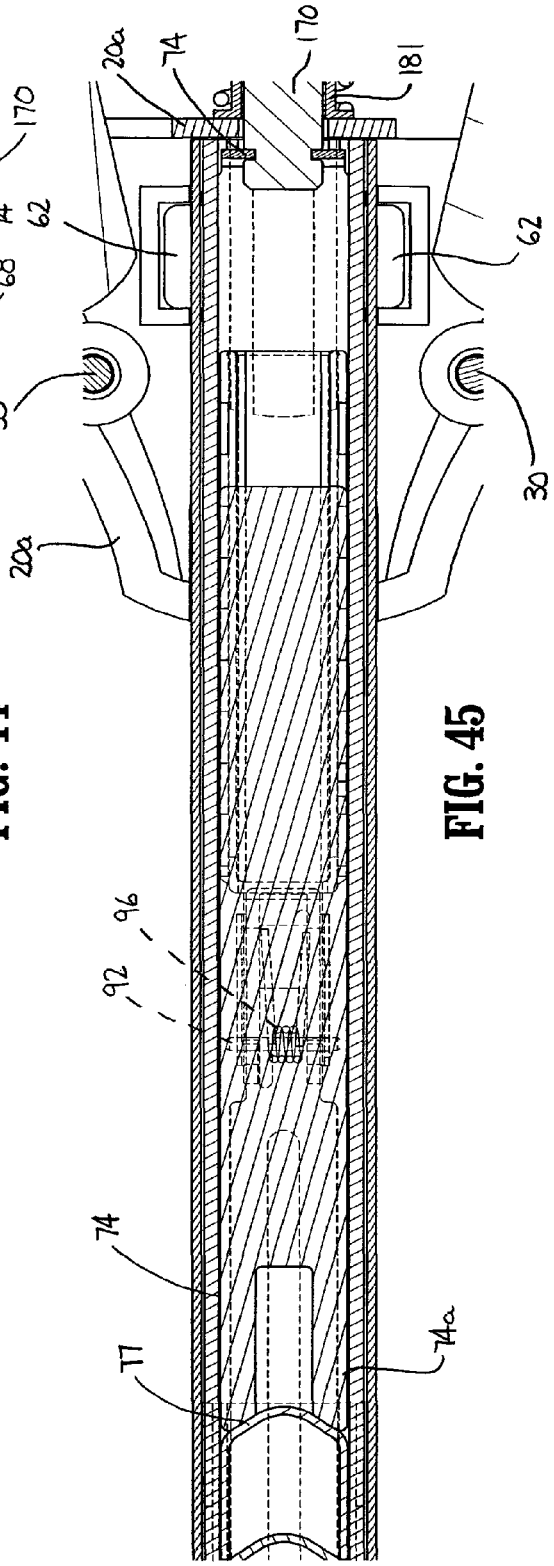

20a
74
170
181
62
30
30
20a
96
92
74
77
74a

FIG. 45

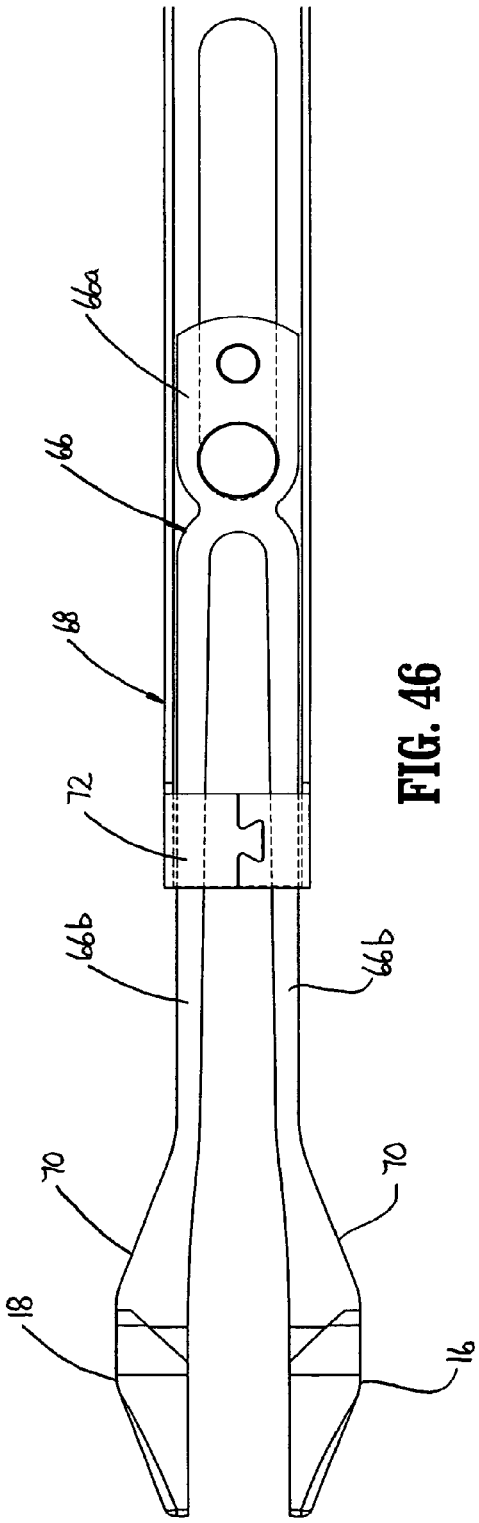


FIG. 46

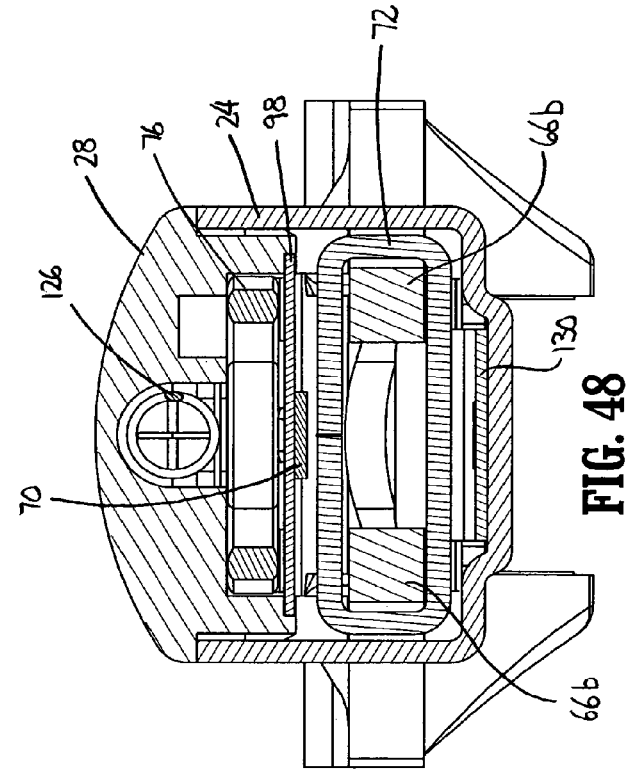


FIG. 48

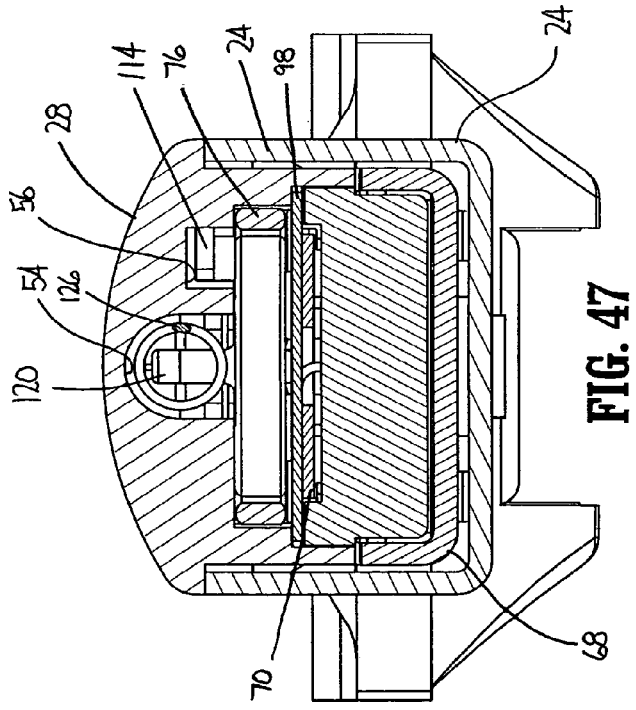


FIG. 47

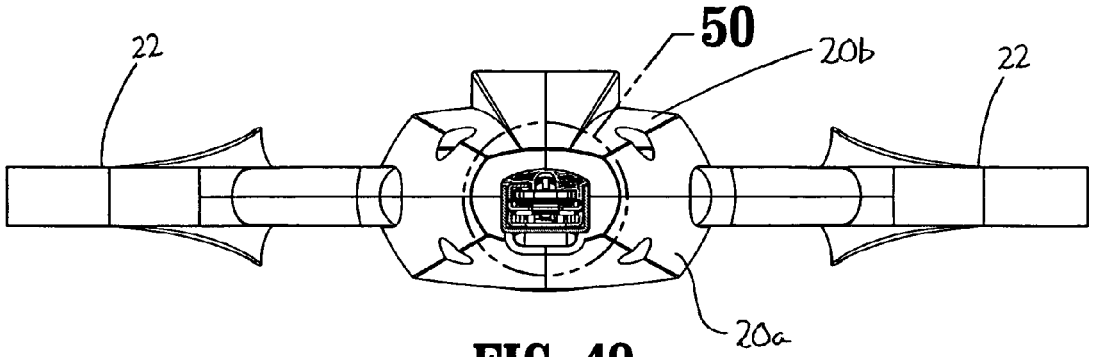


FIG. 49

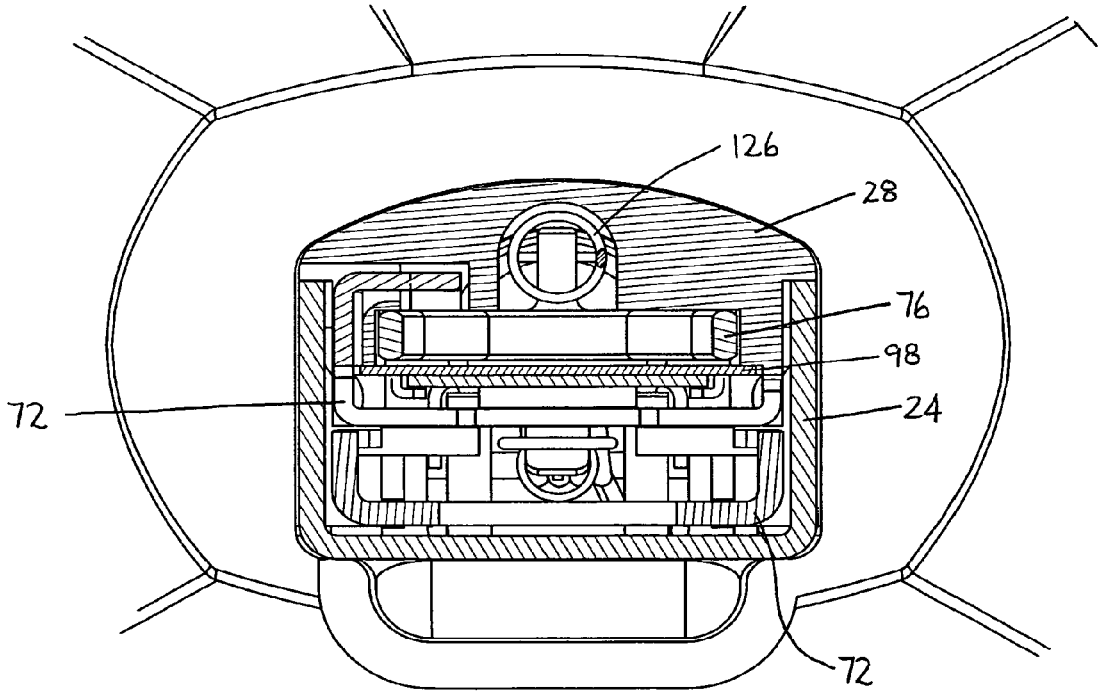


FIG. 50

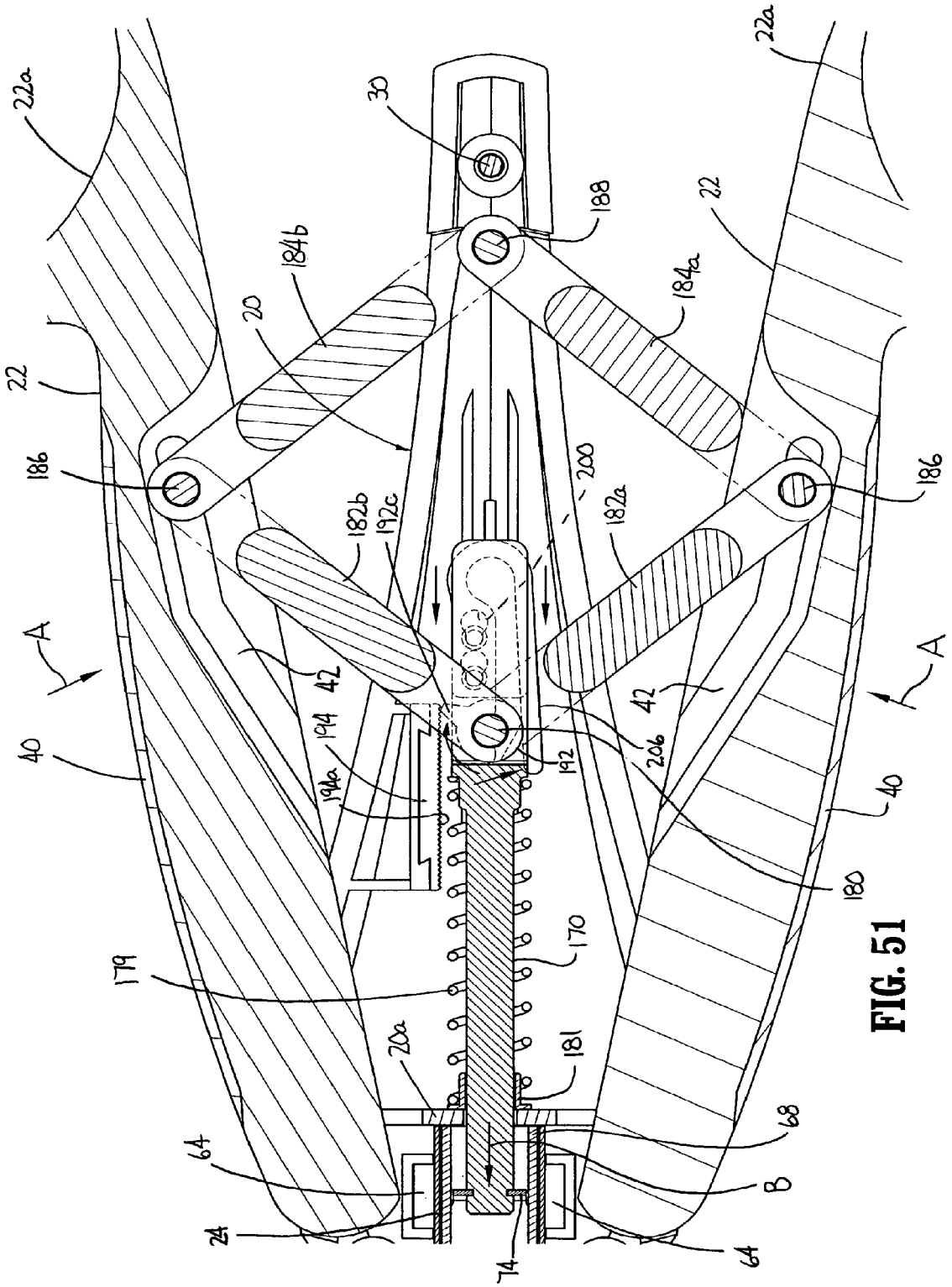

22a
30
188
22
184b
184a
20
22
186
186
182b
192c
182a
200
A
A
42
42
40
194
194a
192
206
40
180
170
179
20a
181
68
64
B
24
74
64

FIG. 51

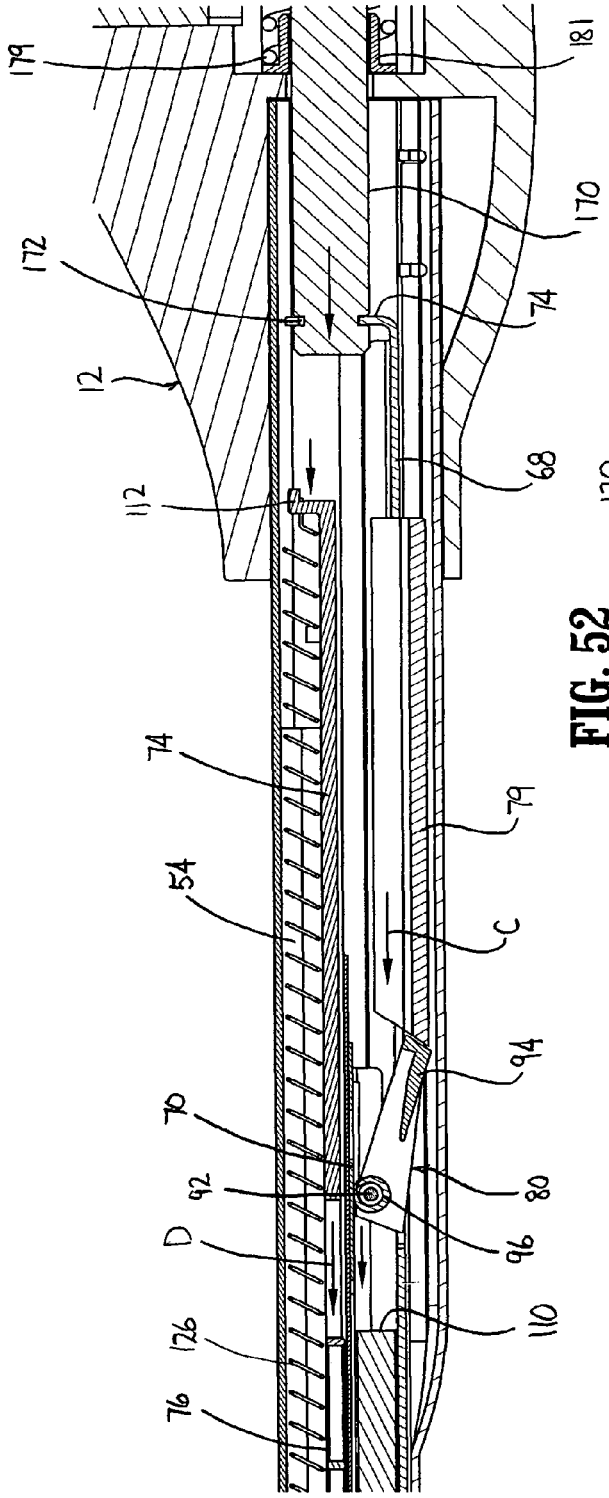

179
181
170
172
74
12
68
112
74
79
54
C
94
70
92
80
D
96
110
126
76

FIG. 52

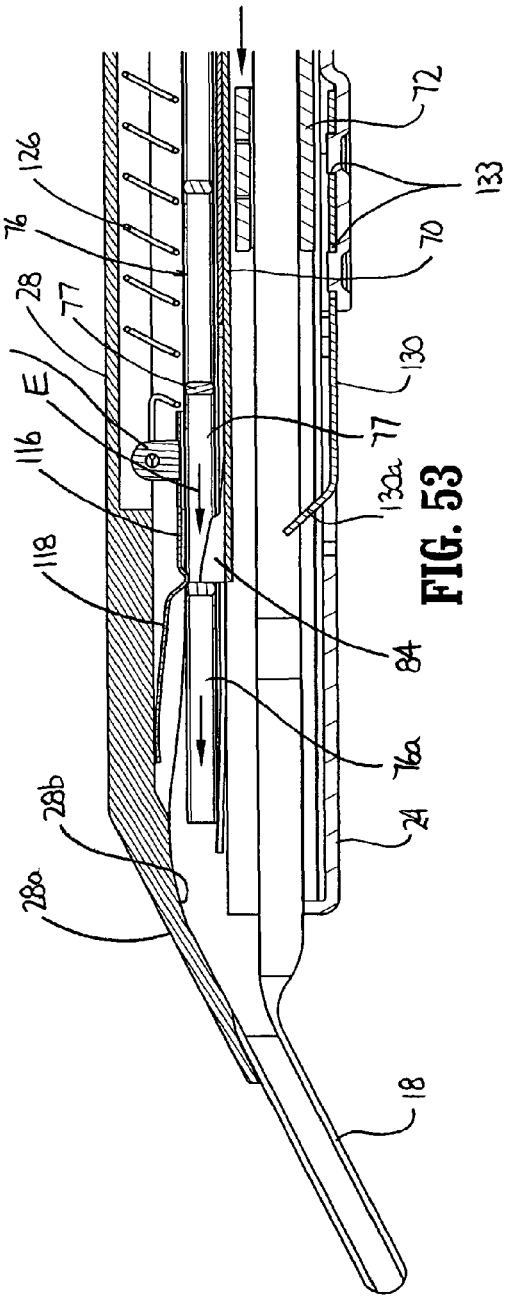
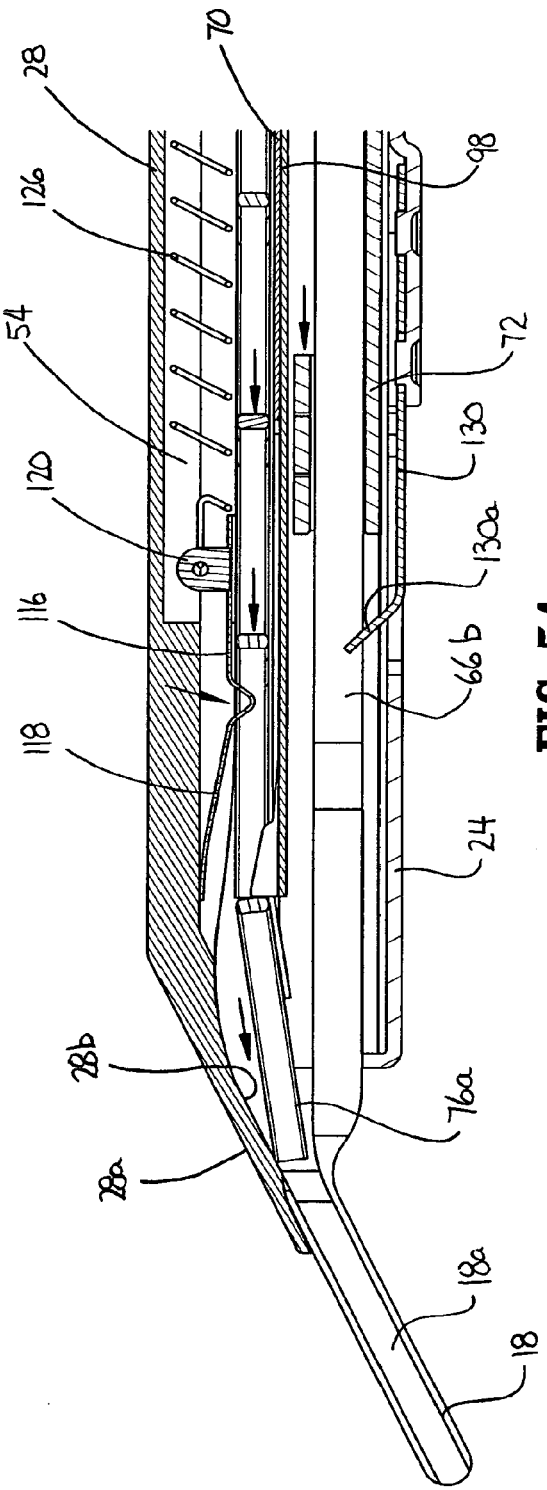

72
126
133
76
70
28
77
120
E
130
116
77
132a
118
84
76a
28b
24
28a
18

FIG. 53


28
70
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130a
116
66b
118
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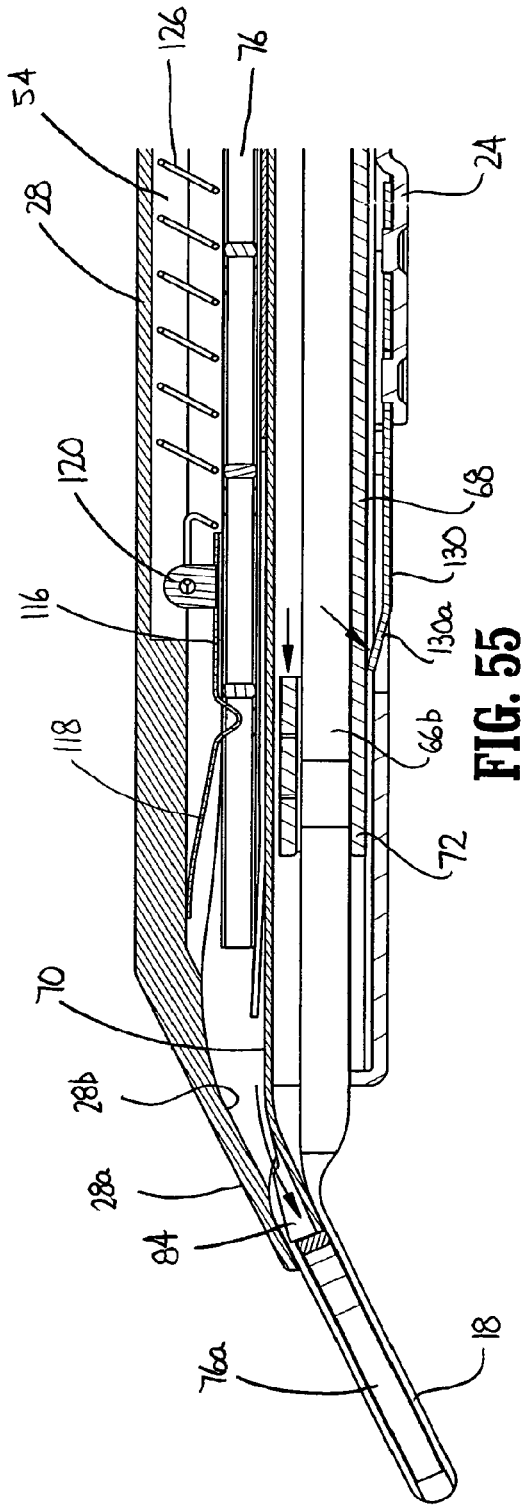
28b
76a
28a
18a
18

FIG. 54


126
76
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118
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28b
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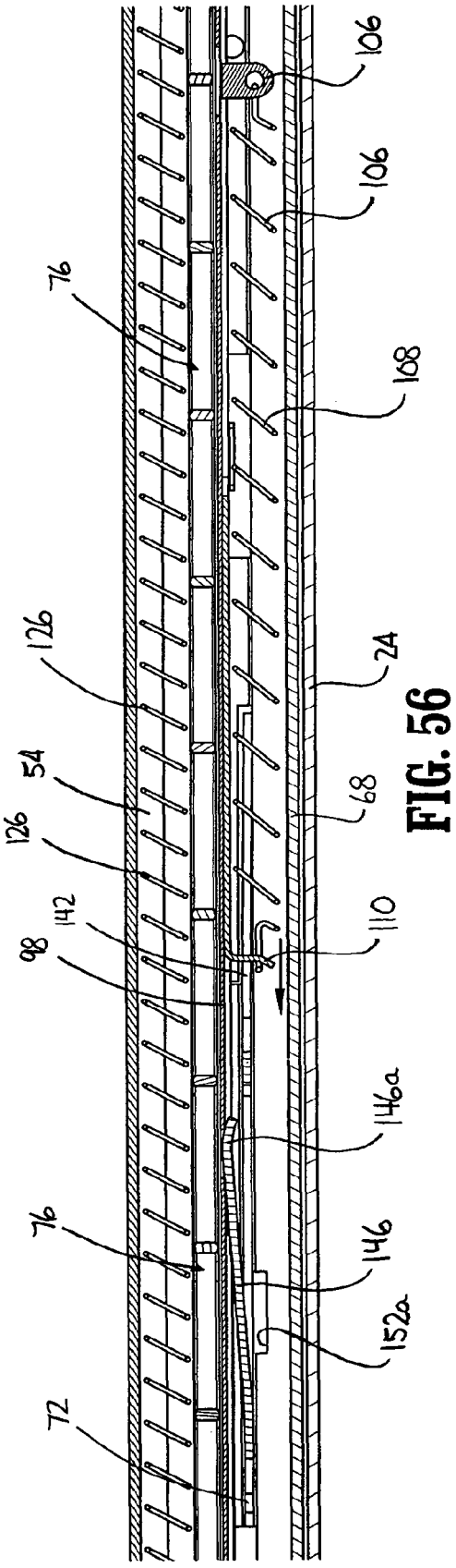
18
76a

FIG. 55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106
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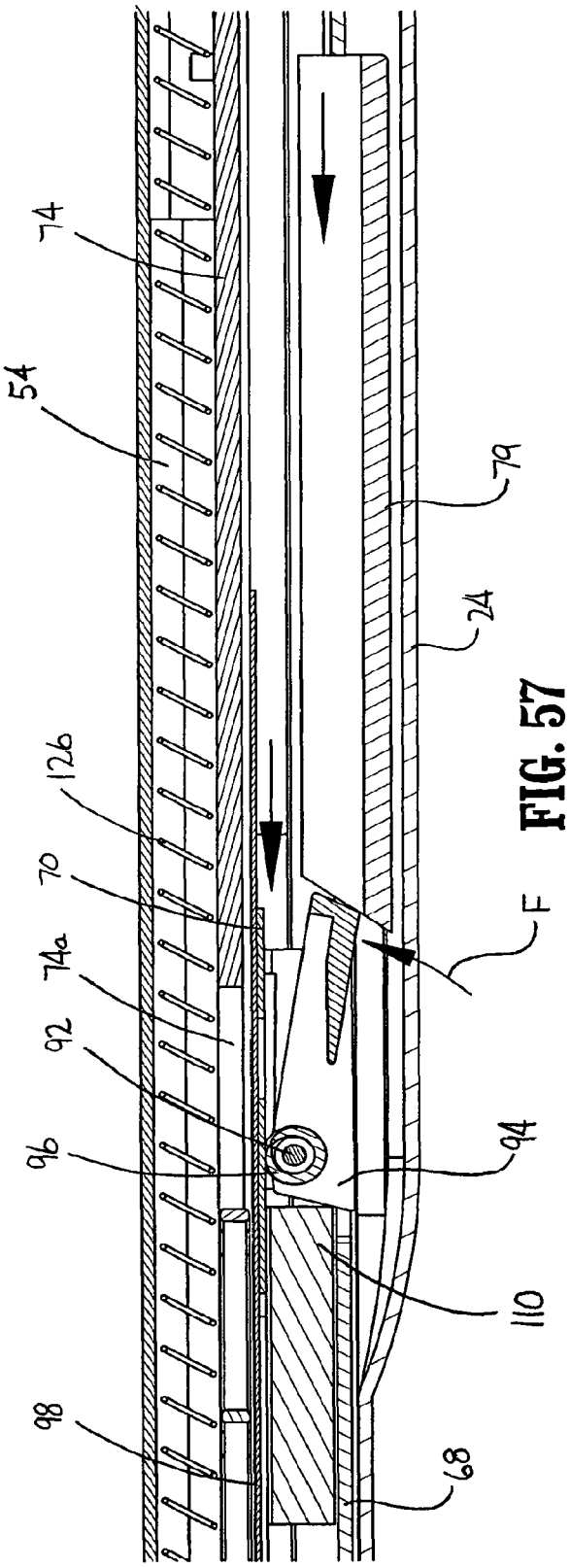
108
126
24
54
68
126
142
98
110
146a
76
146
152a
72

FIG. 56


74
54
79
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126
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F
74a
92
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110
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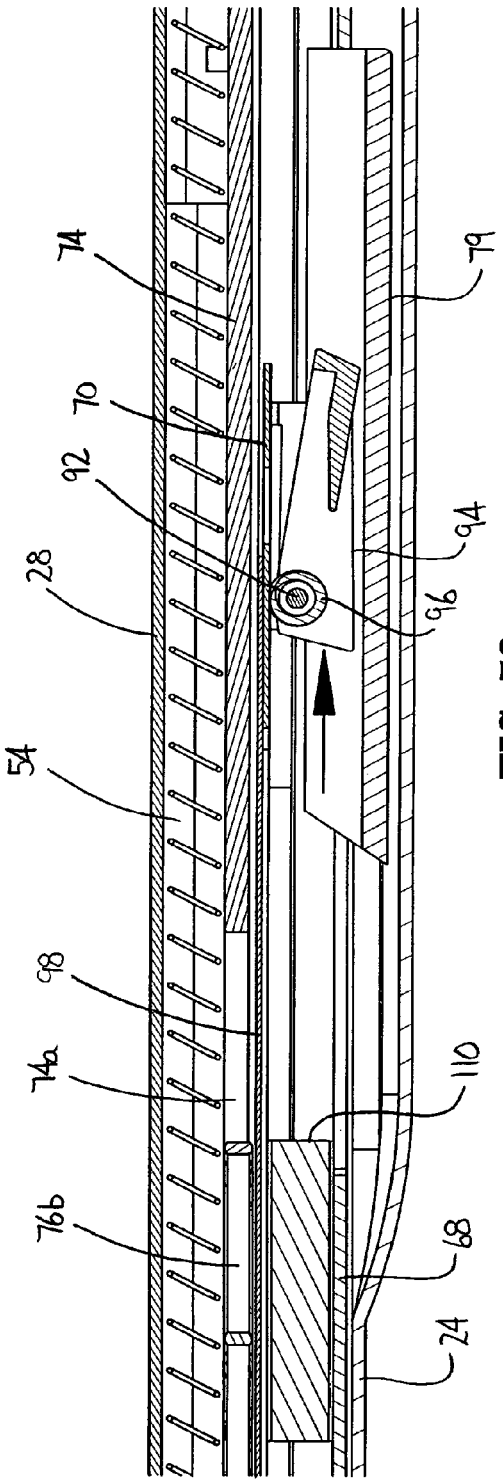
FIG. 57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92
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74a
76b
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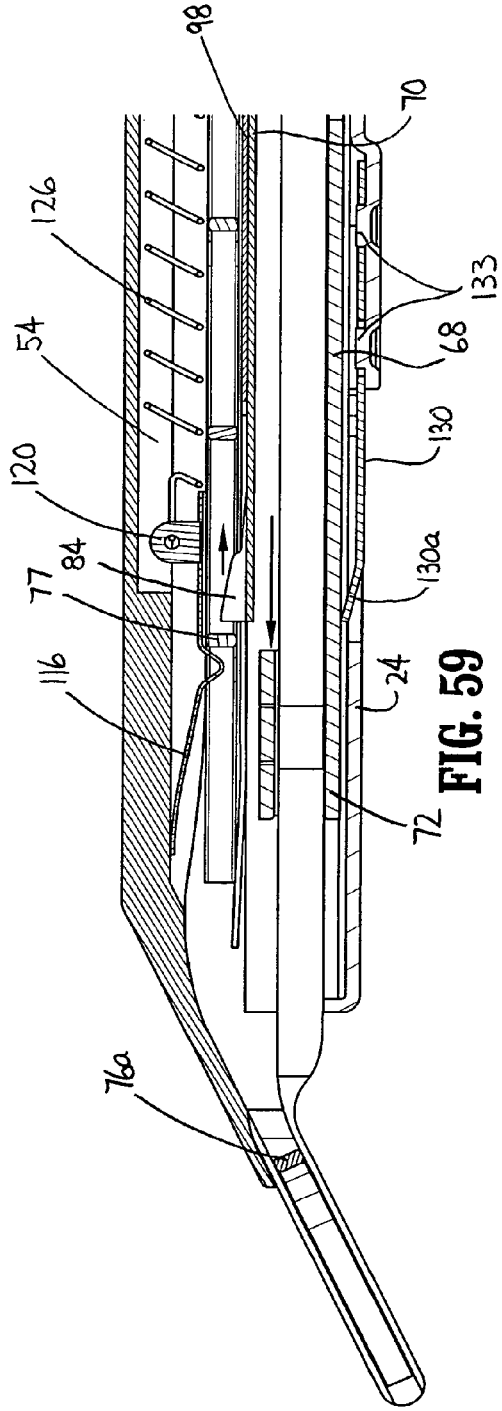
94
96
110
68
24

FIG. 58


98
70
126
133
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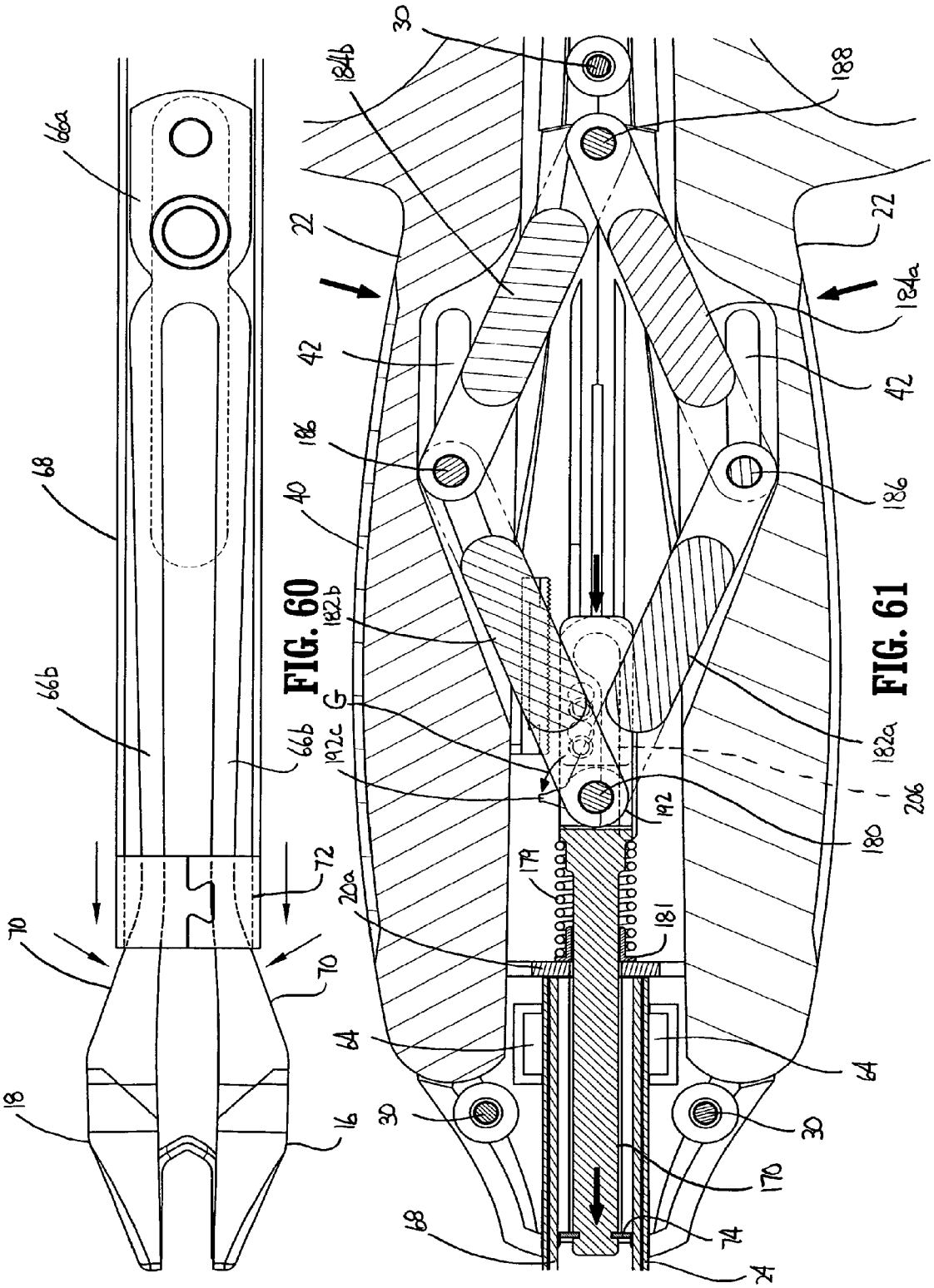
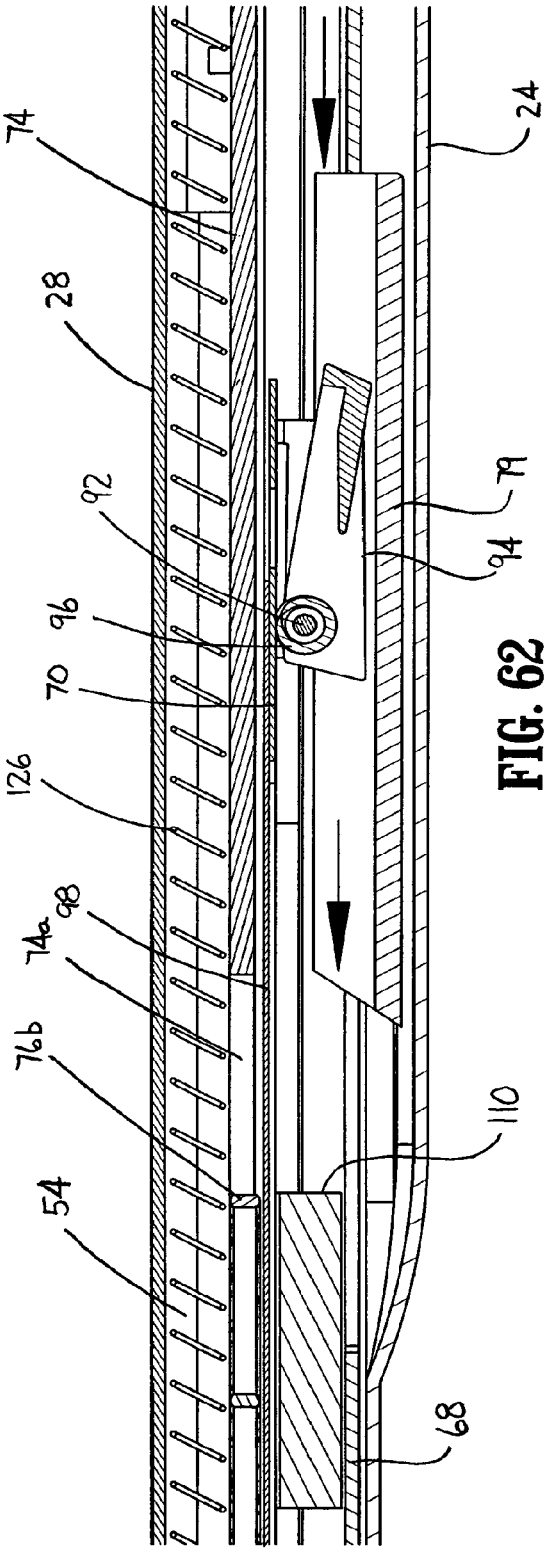
68
130
120
77
84
130a
116
24
72
76a

FIG. 59


66a
68
66b
66b
72
70
70
18
16
FIG. 60
30
184b
188
22
22
184a
42
42
186
186
40
182b
G
192c
182a
206
192
180
179
20a
181
64
64
30
30
170
68
74
74
FIG. 61


74
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92
96
70
126
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74a
76b
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24
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94
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68

FIG. 62

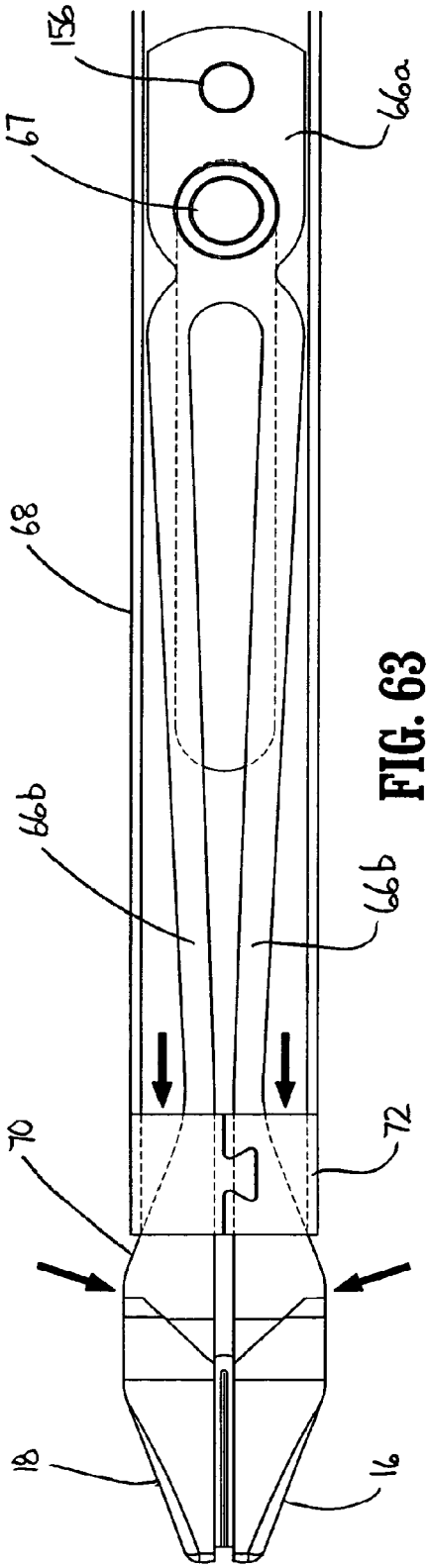
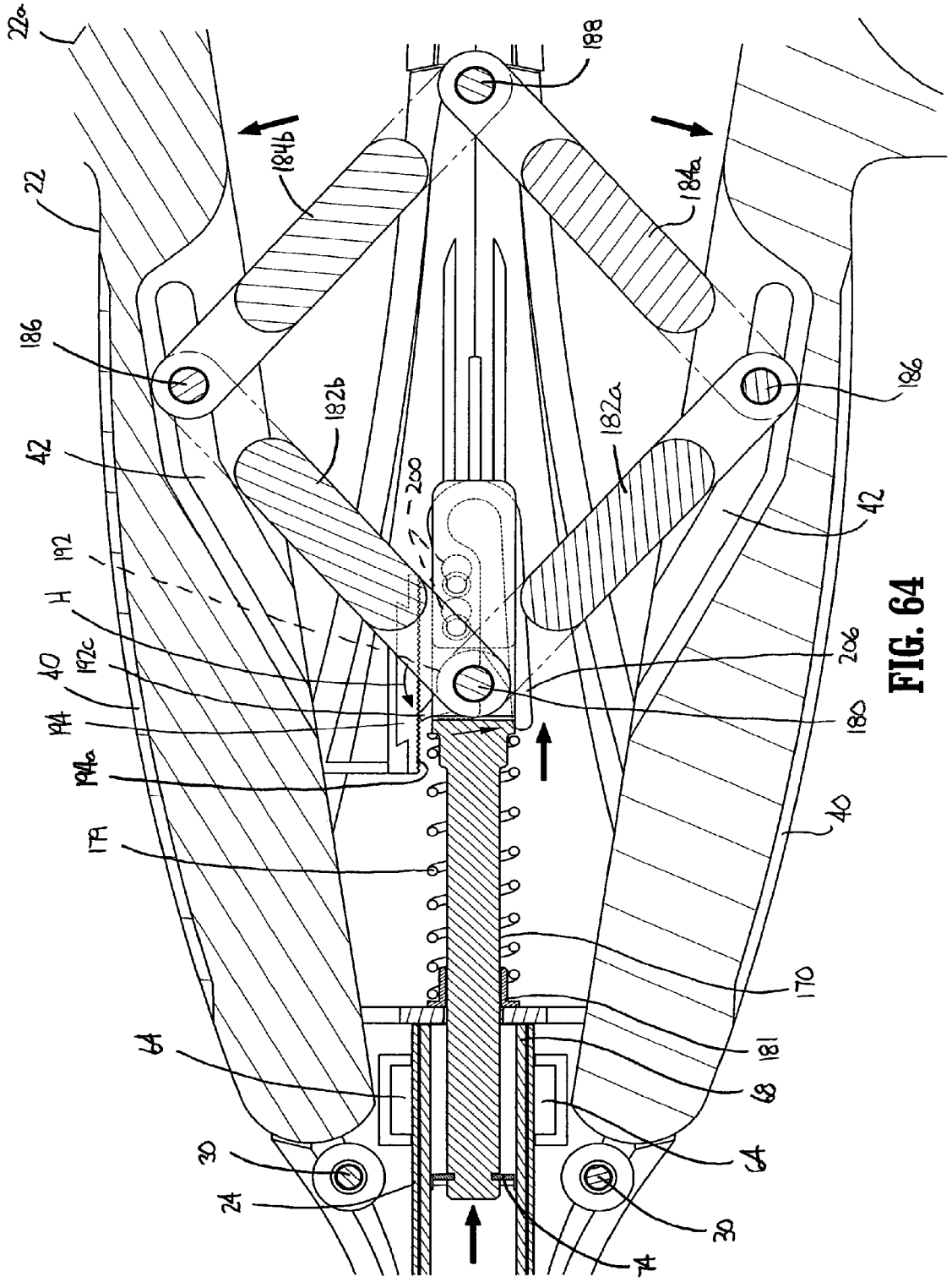

156
67
66a
68
66b
66b
70
72
18
16

FIG. 63


22a
188
184b
184a
22
186
186
182b
182a
42
42
200
192
H
40
192c
206
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180
194a
40
178
170
64
181
68
64
30
24
30
74

FIG. 64

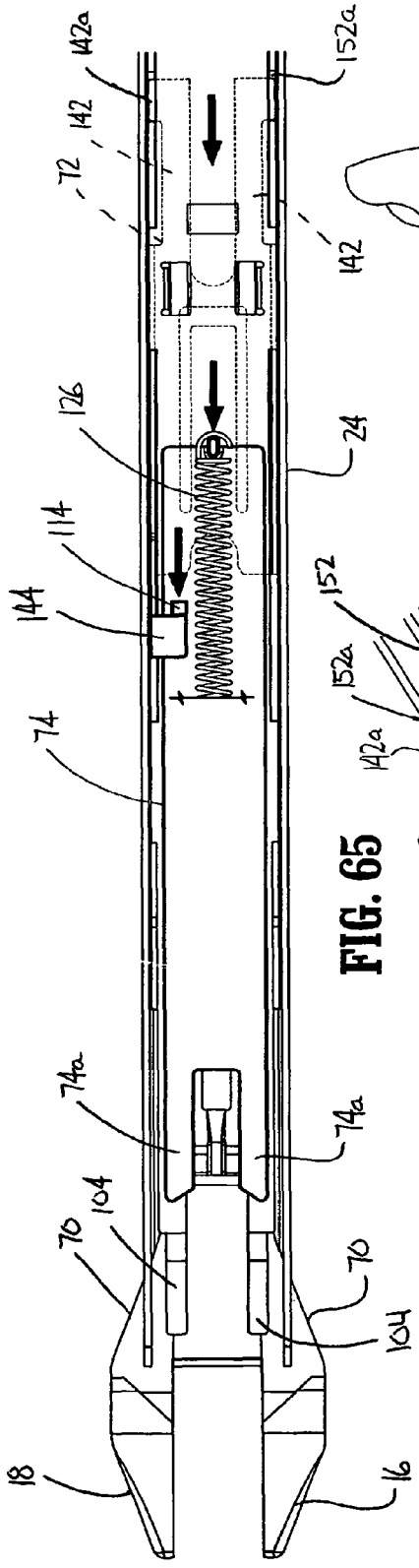

FIG. 65

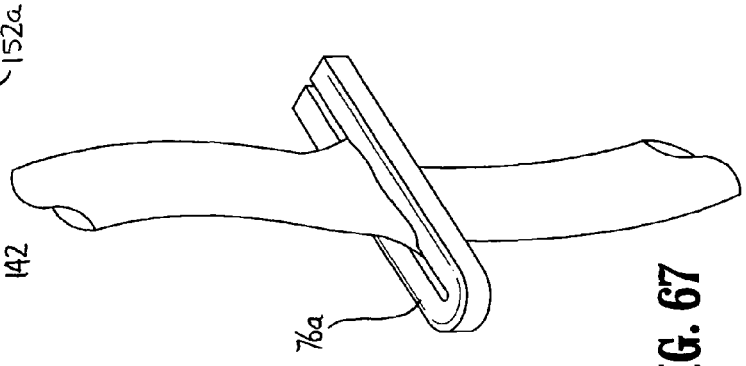

FIG. 67

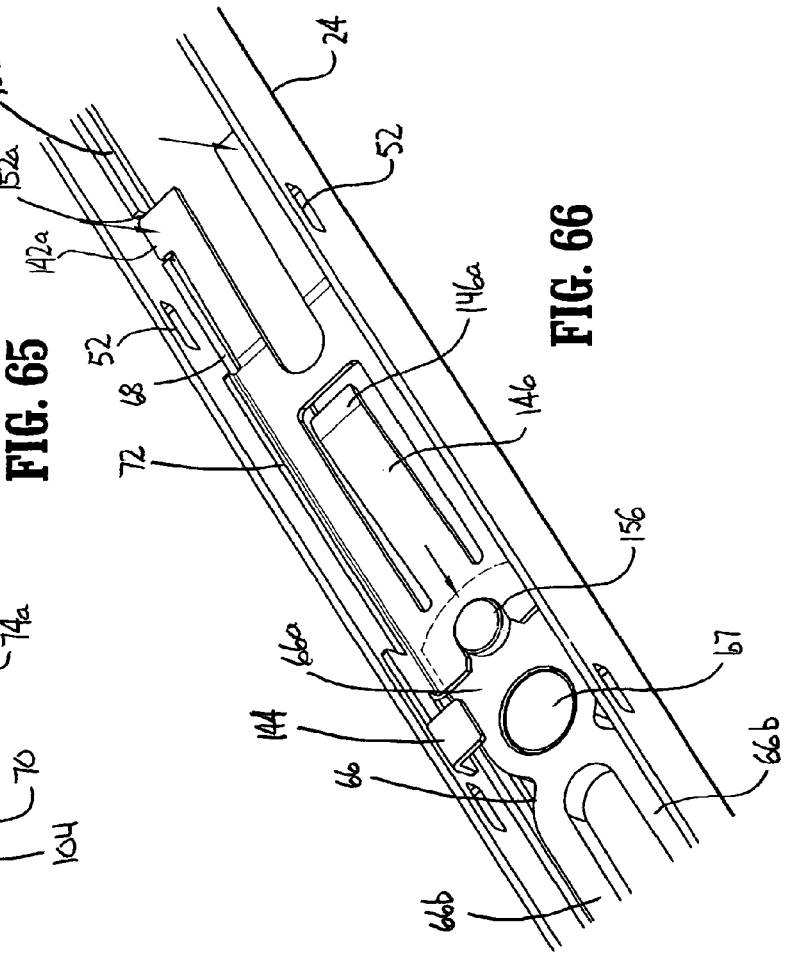

FIG. 66

APPARATUS FOR APPLYING SURGICAL CLIPS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/245,866, filed Oct. 7, 2005, now U.S. Pat. No. 8,920,438, which claims benefit of U.S. Provisional Application No. 60/617,017 filed Oct. 8, 2004, and the disclosures of each of the above-identified applications are hereby incorporated by reference in their entirety.

BACKGROUND

1. Technical Field

This present disclosure relates generally to an apparatus for applying surgical clips to tissue. More specifically, the present disclosure relates to an apparatus for applying a series of clips to tissue seriatim.

2. Background of Related Art

Surgical procedures frequently require ligation of blood vessels, severed tissues and/or other organs to control or stop bleeding. Clip applying apparatus for quickly applying a surgical clip about tissue are well known. Such clip applying apparatus include single clip applicators and multiple clip applicators. In single clip applicators, a new clip is loaded into the apparatus after application of each clip. Multiple clip applicators include a series of clips which can be sequentially applied to tissue during the course of a surgical procedure. Because surgical procedures usually require the use of a multiplicity of surgical clips, multiple clip applicators are generally preferred.

Typically, clip applying apparatus include a handle mechanism, an elongated body portion, and a clip crimping assembly, e.g., a jaw or pair of jaws. Such clip applying apparatus are configured for endoscopic or open surgical procedures. Although known clip applying apparatus for sequentially advancing individual clips have provided good results, a continuing need exists for a clip applying apparatus which is less complex and provides effective hemostasis.

SUMMARY

In accordance with the present disclosure, an apparatus for applying surgical clips is provided which includes a handle portion including a housing and at least one movable handle and a body portion housing a clip stack. A pair of jaws is supported at the distal end of the body portion. The body portion includes a clip pusher, a camming member and a clip follower. The clip pusher is movably positioned within the body portion and is operable to advance a distal-most clip from the clip stack to a position between the pair of jaws. The camming member is movably positioned within the body portion and is operable to approximate or move the pair of jaws toward each other to deform the distal-most clip of the clip stack. The clip follower is positioned proximally of the clip stack and is operable to urge the clip stack distally towards the pair of jaws. In one embodiment, the body portion includes a lockout member and a stop member. The lockout member is movable from a first position in slidable relation to the camming member to a second position interlocked with the camming member. In its second position, the lockout member is positioned to abut the stop member to limit distal movement of the camming member.

In one embodiment, the lockout member includes at least one flexible leg having a projection and the camming member includes at least one slot dimensioned to receive the projection to interlock or secure the lockout member to the camming member. The at least one flexible leg can include a pair of flexible legs and the at least one slot can include a pair of slots. The lockout member can include a resilient finger which is positioned to releasably retain the lockout member in its first position. In one embodiment, the body portion further includes a separator plate which includes an opening dimensioned to receive a portion of the resilient finger of the lockout member to retain the lockout member in its first position. The clip follower may include a tab and the lockout member may include an engagement member such that the tab is movable into the engagement member to move the lockout member from its first position to its second position. In one embodiment, the tab is positioned to engage the engagement member after the proximal most clip has been advanced to the pair of jaws. Alternately, the tab can be positioned to engage the engagement member when one or more clips are remaining in the apparatus.

In one embodiment, an apparatus for applying surgical clips is provided which includes a handle portion having at least one movable handle and a body portion including a clip pusher and a camming member. The clip pusher is movably supported within the body portion to advance a distal-most clip of a clip stack to a position between a pair of jaws supported at a distal end of the body portion. The camming member is movably supported within the body portion from a retracted position to an advanced position to approximate the pair of jaws. A latch assembly is supported on the clip pusher and includes a pivotal latch member which is movable from a first position engaged with an abutment supported on the camming member to a second position disengaged from the abutment of the camming member. The camming member is operably connected to the at least one movable handle such that movement of the at least one movable handle through an actuation stroke effects movement of the camming member from its advanced position to its retracted position. In one embodiment, the pivotal latch member is urged towards its first position by a biasing member such that movement of the camming member from its retracted position to its advanced position initially effects advancement of the clip pusher. A latch cam is fixedly supported on the body portion and is positioned to engage the pivotal latch member after the clip pusher has advanced the distal-most clip of the clip stack to its position between the jaws to disengage the latch member from the abutment. In one embodiment, a biasing member is positioned to urge the clip pusher to a retracted position after the latch member is disengaged from the abutment. In one embodiment, the body portion includes a housing body and a housing cover and the latch cam is supported on the housing cover. The handle portion can include a yoke which is connected to a proximal end of the camming member. In one embodiment, the at least one handle is operably connected to the yoke by at least one front link such that movement of the at least one handle through an actuation stroke effects advancement of the yoke and the camming member. The handle portion can include a pair of handles with each handle operably connected to the yoke by one front link. In one embodiment, a pair of rear links are provided. Each of the rear links has a first end pivotally connected to a respective front link by a first pivot member and a second end pivotally connected to the handle portion by a second pivot member. Each of the pair of handles defines a cam channel for slidably receiving a respective one of the first pivot members.

In one embodiment, an apparatus for applying surgical clips includes a handle portion, a body portion extending

distally from the handle portion, and a jaw body supported at a distal end of the body portion. The jaw body includes first and second jaws movable from a spaced position to a more approximated position. In one embodiment, the body portion includes a camming member which is movable from a retracted position to an advanced position to effect movement of the first and second jaws from their spaced position to their more approximated position. The body portion further includes a resilient jaw locking member removably positioned between the first and second jaws to prevent the jaws from moving from their spaced position to their more approximated position. In one embodiment, the jaw locking member is in the form of a resilient plate and the jaw body includes a pair of inwardly deformable legs. Each of the legs supports one of the first and second jaws and the locking member being positioned between the legs of the jaw body. A distal end of the camming is slidably positioned about the legs of the jaw body and is movable from its retracted position to its advanced position to move the locking member from between the legs of the jaw body and subsequently to effect movement of the first and second jaws to their more approximated position.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the presently disclosed clip applying apparatus are described herein with reference to the drawings, wherein:

FIG. **1** is a perspective view of one embodiment of the presently disclosed clip applying apparatus;

FIG. **2** is an enlarged perspective view of the distal end of the clip applying apparatus shown in FIG. **1**;

FIG. **3** is a top view of the clip applying apparatus shown in FIG. **1**;

FIG. **4** is a side view of the clip applying apparatus shown in FIG. **1**;

FIG. **5** is a perspective view of the proximal portion of the clip applying apparatus shown in FIG. **4** with the top housing half-section exploded;

FIG. **6** is a perspective view of the clip applying apparatus shown in FIG. **1** with the top housing half-section removed;

FIG. **7** is an enlarged view of the indicated area of detail shown in FIG. **6**;

FIG. **8** is an enlarged view of the indicated area of detail shown in FIG. **6**;

FIG. **9** is a perspective view of the proximal end of the body portion and the interior of a housing half-section with the internal components of the handle portion removed;

FIG. **10** is an exploded view of the body portion of the clip applying apparatus shown in FIG. **1**;

FIG. **11** is a perspective view of the clip stop member of the clip applying apparatus shown in FIG. **1**;

FIG. **12** is an enlarged view of the indicated area of detail shown in FIG. **12**;

FIG. **13** is a bottom perspective view of the housing cover of the clip applying apparatus shown in FIG. **1**;

FIG. **14** is an enlarged view of the indicated area of detail shown in FIG. **13**;

FIG. **15** is an enlarged view of the indicated area of detail shown in FIG. **13**;

FIG. **16** is an enlarged view of the indicated area of detail shown in FIG. **10**;

FIG. **17** is a perspective view of the proximal end of the clip pusher of the clip applying apparatus shown in FIG. **1** with the pusher latch assembly secured thereto;

FIG. **18** is a bottom perspective view of the separator plate of the clip applying apparatus shown in FIG. **1**;

FIG. **19** is an enlarged view of the indicated area of detail shown in FIG. **18**;

FIG. **20** is a bottom perspective view of the clip pusher of the clip applying apparatus shown in FIG. **1**;

FIG. **21** is a bottom perspective view of the housing body of the clip applying apparatus shown in FIG. **1**;

FIG. **22** is a top perspective view of the clip follower of the clip applying apparatus shown in FIG. **1**;

FIG. **23** is a top perspective view of the jaw body of the clip applying apparatus shown in FIG. **1**;

FIG. **24** is a top perspective view of the clip applying apparatus shown in FIG. **1**;

FIG. **25** is an exploded perspective view of the handle portion of the clip applying apparatus shown in FIG. **1**;

FIG. **26** is a perspective view of the pawl of the handle portion shown in FIG. **25**;

FIG. **27** is a perspective view of the pawl biasing member of the handle portion shown in FIG. **25**;

FIG. **28** is a perspective view of the yoke of the handle portion shown in FIG. **25**;

FIG. **29** is a perspective view of the body portion of the clip applying apparatus shown in FIG. **1** with the housing cover removed;

FIG. **30** is an enlarged perspective view of the distal end of the body portion shown in FIG. **29**;

FIG. **31** is an enlarged perspective view of the proximal end of the body portion shown in FIG. **29**;

FIG. **32** is an enlarged perspective view of the distal end of the body portion shown in FIG. **29** with the clip follower biasing member and the clip stop member removed;

FIG. **33** is an enlarged perspective view of the distal end of the body portion shown in FIG. **32** with the clip stack removed;

FIG. **34** is an enlarged perspective view of the distal end of the body portion shown in FIG. **33** with the separator plate shown removed;

FIG. **35** is an enlarged perspective view of the distal end of the body portion shown in FIG. **34** with the clip pusher removed;

FIG. **36** is a top cross-sectional view of the clip applying apparatus shown in FIG. **1** prior to actuation of the apparatus;

FIG. **37** is a side cross-sectional view of the clip applying apparatus shown in FIG. **36**;

FIG. **38** is an enlarged view of the indicated area of detail shown in FIG. **36**;

FIG. **39** is an enlarged view of the indicated area of detail shown in FIG. **37**;

FIG. **40** is an enlarged view of the indicated area of detail shown in FIG. **37**;

FIG. **41** is an enlarged view of the indicated area of detail shown in FIG. **36**;

FIG. **42** is an enlarged view of the indicated area of detail shown in FIG. **37**;

FIG. **43** is an enlarged view of the indicated area of detail shown in FIG. **36**;

FIG. **44** is an enlarged view of the indicated area of detail shown in FIG. **37**;

FIG. **45** is an enlarged view of the indicated area of detail shown in FIG. **36**;

FIG. **46** is a top view of the jaw body and the distal end of the camming member of the clip applying apparatus shown in FIG. **36**;

FIG. **47** is a cross-sectional view taken along section lines **47-47** of FIG. **44**;

FIG. **48** is a cross-sectional view taken along section lines **48-48** of FIG. **40**;

FIG. **49** is a cross-sectional view taken along section lines **49-49** of FIG. **42**;

FIG. **50** is an enlarged view of the indicated area of detail shown in FIG. **49**;

FIG. **51** is a top cross-sectional view of the handle portion of the clip applying apparatus shown in FIG. **1** during initial actuation of the handle portion;

FIG. **52** is a side cross-sectional view of the proximal portion of the body portion of the clip applying apparatus shown in FIG. **1** during initial actuation of the handle portion.

FIG. **53** is a side cross-sectional view of the distal end of the body portion of the clip applying apparatus shown in FIG. **1** during initial actuation of the handle portion;

FIG. **54** is a side cross-sectional view of the distal end of the body portion of the clip applying apparatus shown in FIG. **1** during further actuation of the handle portion;

FIG. **55** is a side cross-sectional view of the distal end of the body portion of the clip applying apparatus shown in FIG. **1** during further actuation of the handle portion;

FIG. **56** is a side cross-sectional view of the body portion shown in FIG. **42** after further actuation of the handle portion;

FIG. **57** is a side cross-sectional view of the body portion shown in FIG. **44** after further actuation of the handle portion;

FIG. **58** is a side cross-sectional view of the body portion shown in FIG. **57** after further actuation of the handle portion;

FIG. **59** is a side cross-sectional view of the distal end of the body portion shown in FIG. **55** after further actuation of the handle portion;

FIG. **60** is a top view of the jaw body and camming member shown in FIG. **46** with the camming member advanced further distally;

FIG. **61** is a top cross-sectional view of the handle portion shown in FIG. **51** with the handle portion after further actuation of the handle portion;

FIG. **62** is a side cross-sectional view of the body portion shown in FIG. **58** after further actuation of the handle portion;

FIG. **63** is a top view of the jaw body and camming member shown in FIG. **60** with camming member fully advanced;

FIG. **64** is a top cross-section view of the handle portion shown in FIG. **61** after the handle portion has been returned to the unactuated position;

FIG. **65** is a top view of the distal portion of the body portion of the clip applying apparatus shown in FIG. **36** illustrating the lockout tab of the clip follower engaging the engagement member of the lockout;

FIG. **66** is top perspective view of a portion of the body portion of the clip applying apparatus shown in FIG. **36** illustrating the lockout engaging the stop member; and

FIG. **67** is a perspective view of a clip of the clip stack of the clip applying apparatus shown in FIG. **36** deformed about tissue.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments of the presently disclosed surgical clip applier will now be described in detail with reference to the drawings wherein like reference numerals designate identical or corresponding elements in each of the several views. Throughout this description, the term "proximal" will refer to the portion of the instrument closest to the operator and the term "distal" will refer to the portion of the instrument furthest from the operator.

Referring to FIGS. **1-4**, the presently disclosed surgical clip applier, shown generally as **10**, includes a handle portion **12**, an elongated body portion **14** extending distally from handle portion **12** and first and second jaws **16** and **18** which extend from the distal end of body portion **14**. Briefly, handle portion **12** includes a handle housing **20** and a pair of movable handles or triggers **22**. Each handle **22** includes a finger loop **22***a* for receiving a finger of a surgeon's hand.

Referring also to FIGS. **5-9**, handle housing **20** can be formed from molded housing half-sections **20***a* and **20***b* (FIG. **5**) which are secured together using screws **30** and nuts **32**. Alternately, other fastening techniques may be used to secure housing half-sections **20***a* and **20***b* together, e.g., welding, rivets, interlocking structure, adhesives, etc. In one embodiment, the distal end of each handle **22** is pivotally secured about a pivot member **34** such that handles **22**, when actuated, move in a scissor-like manner. Each pivot member **34** is positioned between recesses **36***a* and **36***b* formed in half-sections **20***a* and **20***b*, respectively, and may be formed integrally with a respective handle **22** or, in the alternative, as a separate element from a respective handle **22**. In one embodiment, each handle **22** has a slip resistant grip member **40** secured to an outside surface thereof and a cam channel **42** formed on an inside surface thereof. Slip resistant grip member **40** can be formed from a cushioning material and overmolded onto each handle **22**. It is also contemplated that other slip resistant materials and methods of application may be used to form grip member **40** and apply grip member **40** to a handle **22**. Each cam channel **42** is configured to receive a pivot member for connecting a pair of pivotal links as will be described in more detail below.

Referring to FIG. **10**, elongated body portion **14** includes a housing body **24** defining a channel **26** for receiving internal components of surgical clip applier **10**. A housing cover **28** is secured to housing body **24** and covers channel **26**. In one embodiment, housing cover **28** has a series of projections **50** which are dimensioned to be received within openings **52** formed along channel walls **26***a* of housing body **24** to secure housing cover **28** to housing body **24**. Alternately, other securement techniques are contemplated, e.g., adhesives, crimping, screws, etc.

Referring also to FIGS. **13-15**, an internal surface of housing cover **28** includes a first longitudinal groove **54** and a second longitudinal groove **56**. Grooves **54** and **56** accommodate other components of the elongated body portion as will be discussed in further detail below. The distal end of housing cover **28** includes an outer surface **28***a* which is tapered or angled downwardly towards housing body **24**. Angled outer surface **28***a* provides easier access to tissue and reduces the likelihood of the clip applier snagging tissue during use. An inner surface **28***b* formed on the distal end of housing cover **28** has a curvature which corresponds to the curvature of a top surface of jaws **16** and **18**. Inner surface **28***b* is positioned in abutting relation to jaws **16** and **18** to provide stability to and prevent misalignment of jaws **16** and **18** during operation of clip applier **10**.

Referring to FIGS. **10** and **21**, housing body **24** includes a pair of distally located cutouts **60** configured to slidably receive jaws **16** and **18**. Cutouts **60** are dimensioned to confine jaws **16** and **18** to prevent misalignment of the jaws during actuation of clip applier **10** (FIG. **30**). The proximal end of housing body **24** includes a pair of transversely extending wings **62** which are dimensioned to be received

within recesses **64** formed in housing half-sections **20***a* and **20***b* (FIG. **9**) to secure elongated body portion **14** to handle portion **12**.

As illustrated in FIG. **10**, the internal components of clip applier **10** include a jaw body **66**, a camming member **68**, a clip pusher **70**, a clip pusher lockout **72**, a clip stack follower **74**, and a clip stack **76** including a distal-most clip **76***a* and a proximal-most clip **76***b*. Referring also to FIG. **23**, jaw body **66** includes jaws **16** and **18**, a proximal mounting portion **66***a* and a pair of spaced distally extending legs **66***b*. Each of jaws **16** and **18** is supported on a distal end of a respective one of legs **66***b* and includes a clip channel **16***a* and **18***a*, respectively. A cam surface **70** is formed on an outer surface of each jaw **16** and **18**. Cam surfaces **70** are positioned to be engaged by camming member **68** (FIG. **10**) in a manner to be described in further detail below. Jaw body **66** is mounted within channel **26** of housing body **24** using a bolt **67** or the like. Bolt **67** extends through an opening **66***d* in body **66** and through housing body **24**.

Referring now to FIGS. **10** and **16**, camming member **68** is slidably supported within channel **26** (FIG. **10**) of housing body **24** and includes a distal engagement member **72** which is positioned about legs **66***b* of jaw body **66** (FIG. **48**). Engagement member **72** can have a substantially rectangular configuration. Alternately, other configurations are contemplated, e.g., C-shaped configuration. The proximal end of camming member **68** includes a bracket **74** to operably connect camming member **68** to handle portion **12** as will be discussed in further detail below. Handles **22** of handle portion **12** (FIG. **1**) are operable to move camming member **68** between a retracted position and an advanced position along channel **26** of housing body **24**. In the retracted position of camming member **68**, engagement member **72** is positioned about legs **66***b* of jaw body **66** at a location proximal of cam surfaces **70** (FIG. **46**). In the advanced position of camming member **68**, engagement member **72** is positioned about jaws **16** and **18** in abutting relation to cam surfaces **70** (FIG. **60**).

The proximal end of camming member **68** supports an abutment member **79**. In one embodiment, abutment member **79** is supported within a cutout **78** formed in the proximal end of camming member **68**. Cutout **78** includes a plurality of grooves **78***a* which receive tongues or projections **82** formed on abutment member **79** to secure abutment member **79** to camming member **68**. It is contemplated that abutment member **79** may be attached to camming member **68** using other known fastening techniques. Alternately, abutment member **79** can be formed integrally with camming member **68**. Abutment member **79** is positioned to engage a pusher latch assembly **80**, as will be described in detail below.

Referring to FIGS. **10**, **16**, **17** and **20**, clip pusher **70** includes an elongated body **82**, a distal finger **84**, and a proximal latch assembly mount **86**. Distal finger **84** is semi-circular in shape and is positioned to engage distal-most clip **76***a* of the stack of clips **76** when clip pusher **70** is moved from a retracted position to an advanced position (FIG. **53**). Latch assembly mount **86** includes a pair of spaced, vertical brackets **88**. Brackets **88** each include an opening **90** for receiving a pivot pin **92** (FIG. **16**) of pusher latch assembly **80**.

Pusher latch assembly **80** includes a latch member **94**, a biasing member **96**, and pivot pin **92**. Latch member **94** is pivotally secured at its distal end between brackets **88** of clip pusher **70** about pivot pin **92**. Biasing member **96** is positioned between the proximal end of clip pusher **70** and latch member **94** to urge the proximal end of latch member **94** away from clip pusher **70** to a position to engage abutment member **79** when camming member **68** is moved from its retracted to its advanced position. Latch member **94** is pivotal against the urging of biasing member **96** towards the proximal end of clip pusher **70** to move latch member **94** out of engagement with abutment member **79** as will be discussed in further detail below.

Referring to FIGS. **10** and **18**, a separator plate **98** is fixedly supported between housing body **24** and housing cover **28**. Separator plate **98** includes a series of projections **100** which are received within recesses **102** formed in housing cover **28** to secure separator plate **98** to housing cover **28**. The distal end of separator plate **98** includes a pair of spaced spring fingers **104** which are positioned to guide the distal-most clip **76***a* of clip stack **76** into jaws **16** and **18**. A biasing member securement member **106** (FIG. **19**) is formed on separator plate **98**. A biasing member, which can be a coil spring **108**, has one end secured to securement member **106** of separator plate **98** and a second end secured to a securement member **110** (FIG. **20**) formed on clip pusher **70**. Coil spring **108** is in tension and urges clip pusher **70** to its retracted position. When handles **22** (FIG. **1**) are operated to move camming member **68** from its retracted position to its advanced position, abutment member **79** engages latch member **94** to move latch member **94** and clip pusher **70** distally toward its advanced position against the urging of coil spring **108**. As clip pusher **70** moves distally with camming member **68**, distal finger **82** of clip pusher **70** engages distal-most clip **76***a* of clip stack **76** to advance distal-most clip **76***a* into jaws **16** and **18**.

Referring to FIGS. **10** and **12**, a pusher latch cam **110** is supported in channel **26** between housing body **24** and housing cover **28**. Pusher latch cam **110** includes a pair of tabs **110***a* which are received within recesses **112** formed in housing cover **28** to fixedly secure pusher latch cam **110** in relation to housing cover **28**. Pusher latch cam **110** is positioned in channel **26** at a position to engage the distal end of latch member **94** (FIG. **57**) to pivot and disengage latch member **94** from abutment member **79** when distal-most clip **76***a* has been fully advanced into jaws **16** and **18**. When latch member **94** is disengaged from abutment member **79**, coil spring **108** returns clip pusher **70** to its retracted position. Although pusher latch cam **110** is illustrated as block shaped, other configurations are envisioned. Further, pusher latch cam may be integrally formed with housing cover **28** or housing body **24**.

Referring to FIGS. **10** and **22**, clip stack **76** is slidably supported on a top surface of separator plate **98**. A clip follower **74** is positioned behind the proximal-most clip **76***b* of clip stack **76**. Clip follower **74** includes a pair of distally extending arms **74***a*. The distal end of each arm **74***a* is configured to engage the backspan of proximal-most clip **76***b*. A top surface of clip follower **74** includes a spring securement member **112** and a lockout tab **114**. Lockout tab **114** is positioned to travel in second longitudinal groove **56** (FIG. **14**) of housing cover **28** and is movable with clip follower **74** as clip follower **74** is advanced to move clip stack **76** distally within elongated body portion **14**.

Referring to FIGS. **10** and **11**, a clip stop member **116** includes a spring arm **118**, a spring securement member **120** and a pair of anchor members **122**. Anchor members **122** are dimensioned to be snap-fit into a pair of openings **124** formed through a distal portion of housing cover **28** to secure clip stop member **116** to the underside of housing cover **28**. A biasing member **126** extends between spring securement member **120** of clip stop member **116** and spring securement member **112** of follower **74**. Biasing member

126, which can be a coil spring, is supported in tension between follower 74 and clip stop member 116 to urge follower 74 and clip stack 76 distally within body portion 14 towards jaws 16 and 18. Biasing member 126 is positioned within first longitudinal groove 54 of housing cover 28 (FIG. 14). Clip stop member 116 prevents distal-most clip 76*a* from being pushed distally into jaws 16 and 18 until clip pusher 70 is moved to its advanced position. When clip pusher 70 is moved to its advanced position, clip stop member 116 is deflected upwardly by movement of distal-most clip 76*a* (FIG. 53).

A jaw locking member, e.g., plate 130 (FIG. 10) is secured to housing body 24 within channel 26 of housing body 24. Jaw locking plate 130 includes openings 131 which are dimensioned to receive projections 133 (FIG. 59) formed on housing body 24 to secure plate 130 to body 24. Jaw locking plate 130 has a resilient and flexible arm 130*a* which is positioned between legs 66*b* of jaw body 66 to prevent jaws 16 and 18 from being closed inadvertently during positioning of clip applier 10 at a surgical site. When camming member 68 is moved to its advanced position, the distal end of engagement member 72 of camming member 68 deflects arm 130*a* downwardly to move arm 130*a* from between jaws 16 and 18 and allow for closure of jaws 16 and 18 (FIG. 59). Alternately, the jaw locking member need not be in the form of a flat plate but rather other configurations are envisioned, e.g., cylindrical or any configuration positionable between jaws 16 and 18 to prevent closure of the jaws.

Referring to FIGS. 10 and 24, a lockout member 72 is positioned above camming member 68 within channel 26 of housing body 24. Lockout member 72 includes a central body portion 140, a pair of flexible legs 142 and a distally extending engagement member or flag 144. Central body portion 140 includes a proximally extending resilient finger 146 which extends upwardly towards separator plate 98 and includes a downwardly curved end 146*a*. End 146*a* is positioned to extend through an elongated slot 148 formed in clip pusher 70 and to be partially received within an opening 150 formed in separator plate 98. Engagement of end 146*a* of finger 146 in opening 150 of separator plate 98 releasably retains lockout 72 at a fixed position in relation to separator plate 98 until an external force is applied to engagement member 144 as will be discussed in detail below.

Each of flexible legs 142 of lockout 72 includes a radial projection 142*a*. Legs 142 are positioned within the confines of sidewalls 152 of camming member 68 and are urged inwardly by sidewalls 152. A pair of slots 152*a* are formed in sidewalls 152 such that when projections 142*a* are moved into alignment with slots 152*a*, legs 142 spring outwardly to move radial projections 142*a* into slots 152*a*. When projections 142*a* are positioned within slots 152*a*, lockout 72 is fixedly secured to camming member 68.

As discussed above, follower 74 is urged distally by biasing member 126 to urge clip stack 76 distally along separator plate 98. As each clip 76*a* is advanced into jaws 16 and 18, follower 74 moves further distally within elongated body 14. As the proximal-most clip 76*b* is advanced in jaws 16 and 18, lockout tab 114 of follower 74 engages engagement member or flag 144 of lockout 72 and effects distal movement of lockout 72 in relation to camming member 68, such that after proximal-most clip 76*b* is crimped between jaws 16 and 18 and camming member 68 is returned to its retracted position, radial projections 142*a* align with slots 152*a* in camming member 68 to fixedly secure lockout 72 to camming member 68.

A stop member 156 (FIG. 10) is secured to a proximal end of mounting portion 66*a* of jaw body 66. In one embodiment, stop member 156 includes a cylindrical dowel. Alternately, other stop member configurations are envisioned. The distal end of lockout 72 includes a recess 158 for receiving stop member 156. Since stop member 156 is fixedly secured within channel 26 of housing body 24, engagement between lockout 72 and stop member 156 prevents further distal advancement of lockout 72. As discussed above, after the proximal-most clip 76*b* has been applied to tissue, lockout 72 is fixedly secured to camming member 68. Stop member 156 is also received in recess 158 of lockout 72. Thus, after proximal-most clip 76*b* has been applied to tissue and lockout 72 is fixed to camming member 86, engagement between lockout 72 and stop member 156 prevents distal advancement of camming member 68. As will be discussed below, since camming member 68 is connected via linkages to handles 22 (FIG. 1), engagement between lockout 72 and stop member 156 will prevent actuation of handles 22 and thus, indicate to a surgeon that the clip applier clip stack 76 has been depleted.

Referring to FIGS. 5, 8, 25 and 28, handle portion 12 includes a yoke 170 which is slidably positioned between housing half-sections 20*a* and 20*b* between retracted and advanced positions. The distal end of yoke 170 includes an annular recess 172 which is dimensioned to be positioned in a semi-circular slot 174 (FIG. 16) formed in bracket 74 of camming member 68 to attach yoke 170 to camming member 68. The proximal end of yoke 170 includes a U-shaped connector 176 having a throughbore 178 dimensioned to receive a pivot pin 180. Pivot pin 180 pivotally connects yoke 170 to the distal end of front links 182*a* and 182*b* of a linkage assembly which connects handles 22 to yoke 170. The proximal end of front links 182*a* and 182*b* are pivotally secured to the distal end of rear links 184*a* and 184*b*, respectively, by pivot members 186. The proximal ends of rear links 184*a* and 184*b* are connected to each other and to handle housing 20 by a pivot member 188. Pivot member 188 is pivotally mounted between bores 190 formed in housing half-sections 20*a* and 20*b* (FIG. 5). Pivot members 186 are received within a respective cam channel 42 formed in a respective handle 22. When handles 22 are actuated, i.e., moved towards housing 20, pivot members 186 are caused to move through cam channels 42 such that front links 182*a*, 182*b* and rear links 184*a*, 184*b* are moved from a first misaligned position towards an aligned position (FIG. 51). Since the proximal end of rear links 184*a* and 184*b* are axially fixed between housing half-sections 20*a* and 20*b*, movement of front links 182*a* and 182*b* and rear links 184*a* and 184*b* toward an aligned position moves the distal end of front links 182*a* and 182*b* distally within housing 20. As discussed above, the distal end of front links 182*a* and 182*b* is axially fixed to yoke 170 by pivot member 180. As such, when handles 22 are actuated, yoke 170 is moved distally to move camming member 68 distally. A biasing member, e.g., coil spring 179, is positioned about a distal end of yoke 170 and abuts a spring stop 181 supported within housing 20 to urge yoke 170 to its retracted position.

Referring to FIGS. 25-27, handle portion 12 includes an anti-reverse ratchet mechanism which includes a pawl 192, a rack 194, and a pawl biasing member 196. Rack 194 includes a series of teeth 194*a* and is supported within a recess 198 formed in housing half-section 20*a*. In one embodiment, recess 198 is dovetail shaped and the backside of rack 194 has a dovetail shape projection 194*b* which is slidably received within recess 198 to secure rack 194 within

housing **20**. Alternately, other fastening techniques can be used to secure rack **194** within housing **20**, e.g., adhesives, pins, welding, etc.

Pawl **192** includes a bore **192***a* dimensioned to receive pivot member **180** such that pawl **192** is rotatably mounted to yoke **170** about pivot member **180**. Pawl biasing member **196** includes a pair of mounting holes **200** for securing bracket **196** to a plate extension **202** (FIG. **28**) of yoke **170**. Pawl biasing member **196** also includes a semi-circular cutout **204** which is positioned to be clipped partially about pivot member **180**, and a cantilever or spring arm **206** which is positioned within a slot **192***b* formed in a backside of pawl **192**. Cantilever arm **206** is resilient and provides a biasing force to urge pawl **192** to a position in which pawl finger **192***c* is substantially perpendicular to arm **206**. Finger **192***c* is positioned to engage teeth **194***a* of rack **194** to retain yoke **170** at partially advanced positions during actuation of clip applier **10** against the bias of spring **179** which urges yoke **170** to its retracted position. The anti-reverse ratchet mechanism prevents retraction of yoke **170** and camming member **68** after handles **22** have been partially actuated until the clip applier has been fully actuated.

Referring to FIGS. **36-67**, operation of clip applier **10** will now be described. FIGS. **36-50** illustrate clip applier **10** prior to actuation of handles **22**, i.e., in the prefired position. In the prefired position, biasing member **179** urges yoke **170** to its retracted position. When yoke **170** is in its retracted position, pivot members **186** are positioned within cam channels **42** (FIG. **36**) such that front links **182***a* and **182***b* and rear links **184***a* and **184***b* are in their misaligned position, handles **22** are spaced from housing **20** of clip applier **10**, and pawl **192** (FIG. **38**) is positioned proximally of rack **194** (FIG. **38**). Referring to FIGS. **40-50**, in the prefired position, camming member **68** is urged to its retracted position by yoke **170** and biasing member **179** (FIG. **39**). Clip pusher **70** is urged to its retracted position by biasing member **108** (FIG. **42**). Clip stack **76** is urged by follower **74** (FIG. **44**) and biasing member **126** distally within body **14**, but distal-most clip **76***a* is prevented from moving into jaws **16** and **18** by spring arm **118** of clip stop member **116** (FIG. **40**). Jaw locking plate **130** is positioned between jaw legs **66***b* to prevent inadvertent closure of jaws **16** and **18** (FIG. **40**). It is also noted that latch member **94** of pusher latch assembly **80** is spaced distally of but in a position to engage abutment member **79** which is supported on camming member **68** (FIG. **44**). Further, radial projections **142***a* of lockout **72** are positioned proximally of slots **152***a* of camming member **68** and recess **158** of lockout **72** is positioned proximally of stop member **156**.

FIGS. **51-63** illustrate clip applier **10** in various stages of operation. Referring to FIG. **51**, handles **22** have been partially actuated or moved towards housing **20** in the direction indicated by arrow "A". Actuation of handles **22** moves front links **182***a* and **182***b* towards their aligned position to advance yoke **170** distally in the direction indicated by arrow "B". Referring to FIG. **52**, as yoke **170** is advanced, camming member **68** which is secured to yoke **170** is advanced distally within elongated body **14** of clip applier **10**. Abutment member **79** is supported on camming member **68** and is also advanced distally within elongated body **14** in the direction indicated by arrow "C". During the initial actuation stroke of handles **22**, abutment member **79** engages latch member **94** of pusher latch assembly **80** to effect advancement of clip pusher **70** in the direction indicated by arrow "D". Referring to FIG. **53**, as clip pusher **70** advances, engagement finger **84** of clip pusher **70** advances distal-most clip **76***a* of clip stack **76** past spring arm **118** of clip stop member **116** into jaws **16** and **18**. As the distal-most clip **76***a* of clip stack **76** is advanced into the jaws, follower **74** (FIG. **52**) under the force of biasing member **126** advances clip stack **76** distally in the direction indicated by arrow "E" in FIG. **53** to position the second distal-most clip **77** adjacent clip stop member **116** (See FIGS. **53-55**).

Referring to FIGS. **55-57**, as camming member **68** and clip pusher **70** advance within elongated body **14**, the tension in spring **108** is increased, i.e., spring **108** is stretched (FIG. **56**). When distal-most clip **76***a* is fully positioned within jaws **16** and **18**, pusher latch cam **110** engages a distal end of latch member **94** and pivots latch member **94** in the direction indicated by arrow "F" against the urging of biasing member **96** to release latch member **94** from abutment member **79**. When latch member **94** is released from abutment member **79**, biasing member **108** returns clip pusher **70** to its retracted position (FIGS. **58** and **59**).

As handles **22** are more fully actuated, i.e., moved closer to housing **20**, camming member **68** engages finger **130***a* of jaw locking plate **130** (FIG. **55**) to deform plate **130** downwardly from between legs **66***b* of jaw body **66**. Continued advancement of camming member **68** advances engagement member **72** into camming surfaces **70** of jaws **16** and **18** to move jaws **16** and **18** from a spaced position (FIG. **46**) to a crimping position (FIG. **63**).

Referring to FIG. **51**, as yoke **170** is moved from its retracted position within housing **20** to its advanced position, a finger **192***c* of pawl **192** engages teeth **194***a* of rack **194** to prevent spring **179** from returning yoke **170** to its retracted position when handles **22** are released. As such, once handles **22** begin to be actuated and pawl **192** engages rack **194** (FIG. **51**) yoke **170** cannot be returned to its retracted position until clip applier **10** is fully actuated. When yoke **170** is moved to its advanced position, pawl **192** passes by the distal end of rack **194** (FIG. **61**) and cantilevered or spring arm **206** of pawl biasing member **196** will rotate pawl **192** in the direction indicated by arrow "G" in FIG. **61** to a position in which finger **192***a* of pawl **192** is positioned at 12:00. Thus, when handles **22** are released and spring **179** returns yoke **170** to its retracted positioned (FIG. **64**) finger **192***c* will engage the distal end of rack **194** and rotate counter-clockwise in the direction indicated by arrow "H" in FIG. **64** and ratchet over teeth **194***a* of rack **194**. Note, in the fully retracted position of yoke **170**, pawl **192** is positioned proximally of rack **194**. In this position cantilevered arm **206** (FIG. **61**) returns finger **192***c* of pawl **192** to the 12:00 position.

After the device has been fully actuated as shown in FIGS. **61-63** and handles **22** have been released, yoke **170** is moved to its retracted position by spring **179**. Camming member **68**, which is secured to yoke **170**, is also moved toward its retracted position. As this occurs, resilient jaws **16** and **18** return to their spaced position and camming member **68** moves past jaw locking plate **130** allowing locking plate finger **130***a* to return to a position located between legs **66***b* of jaw body **66**. As discussed above, the positioning of locking plate **130** between legs **66***b* of jaw body **66** prevents inadvertent closure of jaws **16** and **18**.

Referring to FIGS. **65** and **66**, after the proximal-most clip **76***b* has been advanced beyond clip stop member **116**, clip follower **74** is advanced towards its fully advanced position by biasing member **126**. As this occurs, lockout tab **114** formed on follower **74** engages engagement member **144** of lockout **72** to advance lockout **72** distally in relation to camming member **68** to move radial projections **142***a* of flexible legs **142** of lockout **72** into slots **152***a* of camming

member **68** and secure or interlock lockout **72** to camming member **68**. When lockout **72** is moved distally within elongated body **14** by follower **74**, distal recess **158** of lockout **72** receives stop member **156**, which is secured to mounting portion **66***a* of jaw body **66** such that the distal end of lockout **72** engages stop member **156**. Engagement between the distal end of lockout **72** and stop member **156** prevents further distal movement of lockout **72** and, thus, camming member **68**.

It will be understood that various modifications may be made to the embodiments disclosed herein. Therefore, the above description should not be construed as limiting, but merely as exemplifications of preferred embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

What is claimed is:

1. An apparatus for applying surgical clips, comprising:

a body portion;

a pair of jaw members extending distally from the body portion;

a clip stack housed within the body portion and including a distal-most clip;

a clip pusher movably positioned within the body portion to advance the distal-most clip from the clip stack to a position between the pair of jaw members;

a camming member movably positioned within the body portion to approximate the pair of jaw members to form the distal-most clip positioned between the pair of jaw members;

a lockout member including a central body portion defining a recess, the lockout member being movable from a first position in slidable relation to the camming member to a second position interlocked with the camming member such that the lockout member and the camming member move in unison with one another; and

a stop member configured to abut the recess of the lockout member to limit distal movement of the camming member while the lockout member is in the second position.

2. The apparatus according to claim **1**, wherein the lockout member includes at least one flexible leg having a projection and the camming member includes at least one slot dimensioned to receive the projection to interlock the lockout member to the camming member.

3. The apparatus according to claim **2**, wherein the at least one flexible leg includes a pair of flexible legs and the at least one slot includes a pair of slots.

4. The apparatus according to claim **2**, further including a clip follower operable to urge the clip stack distally towards the pair of jaw members, the clip follower including a tab, the lockout member including an engagement member that extends distally from a distal end of the lockout member, the tab of the clip follower being movable into the engagement member to move the lockout member from the first position to the second position.

5. The apparatus according to claim **4**, wherein while the lockout member is disposed in the second position, the lockout member and the camming member are positioned to simultaneously move distally.

6. The apparatus according to claim **1**, wherein the lockout member includes a resilient finger positioned to releasably retain the lockout member in the first position.

7. The apparatus according to claim **6**, wherein the body portion further includes a separator plate, the separator plate defining an opening dimensioned to receive a portion of the resilient finger of the lockout member.

8. The apparatus according to claim **1**, further including a clip follower operable to urge the clip stack distally towards the pair of jaw members, the lockout member including at least one flexible leg having a projection, the camming member including at least one slot, and the clip follower including at least one tab that is movable into an engagement member that extends distally from a central body portion of the lockout member, wherein engagement of the at least one tab with the engagement member moves the lockout member to the second position so that the projection of the at least one flexible leg is received by the at least one slot of the camming member to interlock the lockout member to the camming member.

9. The apparatus according to claim **1**, wherein the lockout member defines a plane in the first position, the lockout member being movable along and remaining within the plane as the lockout member moves from the first position to the second position.

10. An apparatus for applying surgical clips, comprising:

a handle portion including at least one movable handle;

a body portion including a clip pusher and a camming member, the clip pusher being movably supported within the body portion to advance a distal-most clip of a clip stack to a position between a pair of jaw members supported at a distal end of the body portion, the camming member being movably supported within the body portion for movement from a retracted position to an advanced position to approximate the pair of jaw members; and

a latch assembly supported on the clip pusher, the latch assembly including a pivotal latch member that is movable from a first position to engage an abutment supported on the camming member to a second position to disengage from the abutment of the camming member;

wherein the camming member is operably connected to the at least one movable handle such that movement of the at least one movable handle through an actuation stroke effectuates movement of the camming member from the advanced position to the retracted position.

11. The apparatus according to claim **10**, wherein the pivotal latch member is urged towards the first position by a biasing member such that movement of the camming member from the retracted position to the advanced position initially effectuates advancement of the clip pusher.

12. The apparatus according to claim **11**, further including a latch cam fixedly supported on the body portion, the latch cam being positioned to engage the pivotal latch member after the clip pusher advances the distal-most clip of the clip stack to the position between the pair of jaw members to disengage the latch member from the abutment of the camming member.

13. The apparatus according to claim **12**, further including a biasing member positioned to urge the clip pusher to a retracted position after the latch member is disengaged from the abutment of the camming member.

14. The apparatus according to claim **13**, wherein the body portion includes a housing body and a housing cover, the latch cam being supported on the housing cover.

15. The apparatus according to claim **10**, wherein the handle portion includes a yoke that is connected to a proximal end of the camming member, the at least one moveable handle being operably connected to the yoke by at least one front link such that movement of the at least one moveable handle through an actuation stroke effectuates advancement of the yoke and the camming member.

16. The apparatus according to claim 15, wherein the at least one moveable handle of the handle portion includes a pair of handles, each of the pair of handles being operably connected to the yoke by the at least one front link.

17. The apparatus according to claim 16, further including a pair of rear links, each of the rear links having a first end pivotally connected to a respective front link by a first pivot member and a second end pivotally connected to the handle portion by a second pivot member.

18. The apparatus according to claim 17, wherein each of the pair of handles defines a cam channel for slidably receiving a respective one of the first pivot members.

19. An apparatus for applying surgical clips, comprising:

a handle portion;

a body portion extending distally from the handle portion; and

a jaw body supported at a distal end of the body portion, the jaw body including first and second jaw members movable from a spaced position to an approximated position;

wherein the body portion includes a camming member movable from a retracted position to an advanced position to effectuate movement of the first and second jaw members from the spaced position to the approximated position, the body portion further including a resilient jaw locking member removably positioned between the first and second jaw members to prevent the first and second jaw members from moving from the spaced position to the approximated position.

20. The apparatus according to claim 19, wherein the resilient jaw locking member is a resilient plate and the jaw body includes a pair of inwardly deformable legs, each of the pair of inwardly deformable legs supporting one of the first or second jaw members, the resilient jaw locking member being disposed between the pair of inwardly deformable legs of the jaw body while unactuated.

21. The apparatus according to claim 20, wherein a distal end of the camming member is slidably positioned about the pair of inwardly deformable legs of the jaw body and is movable from the retracted position to the advanced position to move the resilient jaw locking member from between the pair of inwardly deformable legs of the jaw body and to effectuate movement of the first and second jaw members to the approximated position.

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