US 20250261974A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0261974 A1**

Fisk et al. (43) **Pub. Date: Aug. 21, 2025**

(54) **PEDICLE SCREW REDUCER INSTRUMENTS AND METHODS OF USE**

(71) Applicant: **DePuy Synthes Products, Inc.**, Raynham, MA (US)

(72) Inventors: **Justin Fisk**, Franklin, MA (US); **Thomas Runco**, Providence, RI (US)

(21) Appl. No.: **19/054,514**

(22) Filed: **Feb. 14, 2025**

Related U.S. Application Data

(60) Provisional application No. 63/556,378, filed on Feb. 21, 2024.

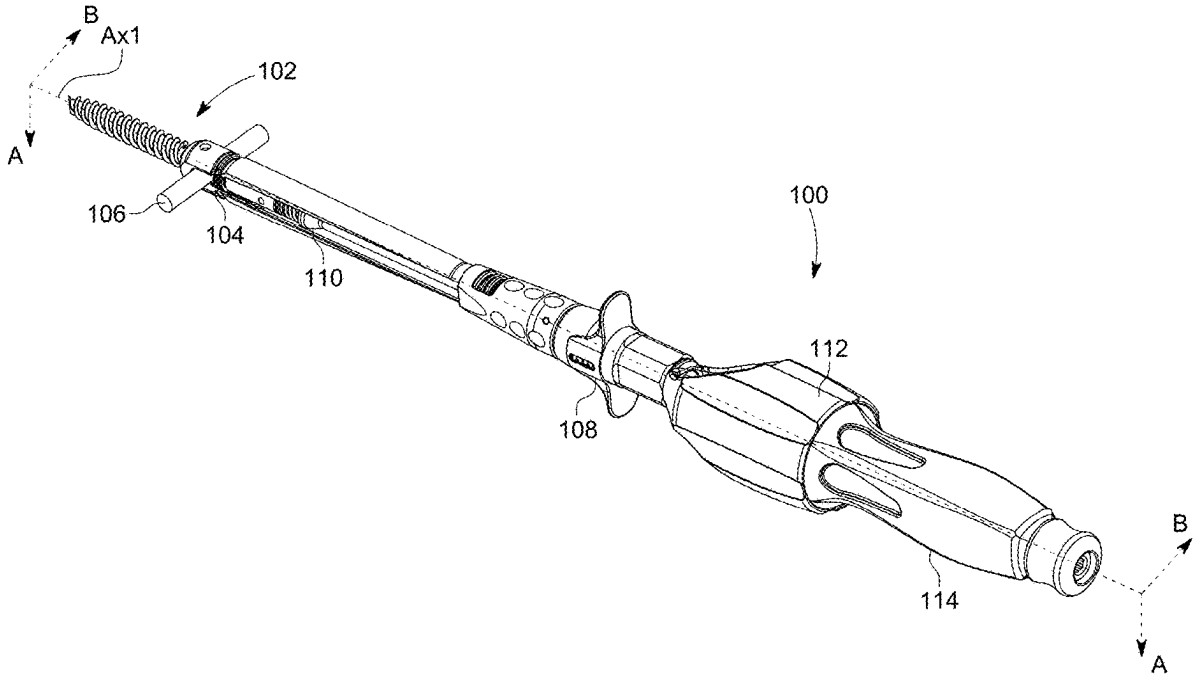
Publication Classification

(51) **Int. Cl.**
A61B 17/70 (2006.01)

(52) **U.S. Cl.**
CPC *A61B 17/7086* (2013.01); *A61B 17/7091* (2013.01)

(57) **ABSTRACT**

Surgical instruments and methods to aid in reducing or urging a spinal fixation element into a pedicle screw or other implant are disclosed. Disclosed instruments and methods facilitate delivery of a setscrew or other closure, reduction of a rod or other spinal fixation element into a pedicle screw, and securing the rod relative to the pedicle screw using the setscrew. Example instruments and methods can utilize a reducer clip that couples to a proximal end of a pedicle screw receiver head or extension tabs thereof, an inserter-reducer shaft that can couple with a setscrew at its distal end, a reducer handle that can threadably engage with the reducer clip to translate the shaft and thereby reduce a rod, and a driver handle that can rotate the inserter-reducer shaft to engage the setscrew with threads formed on the pedicle screw or extension tabs thereof.



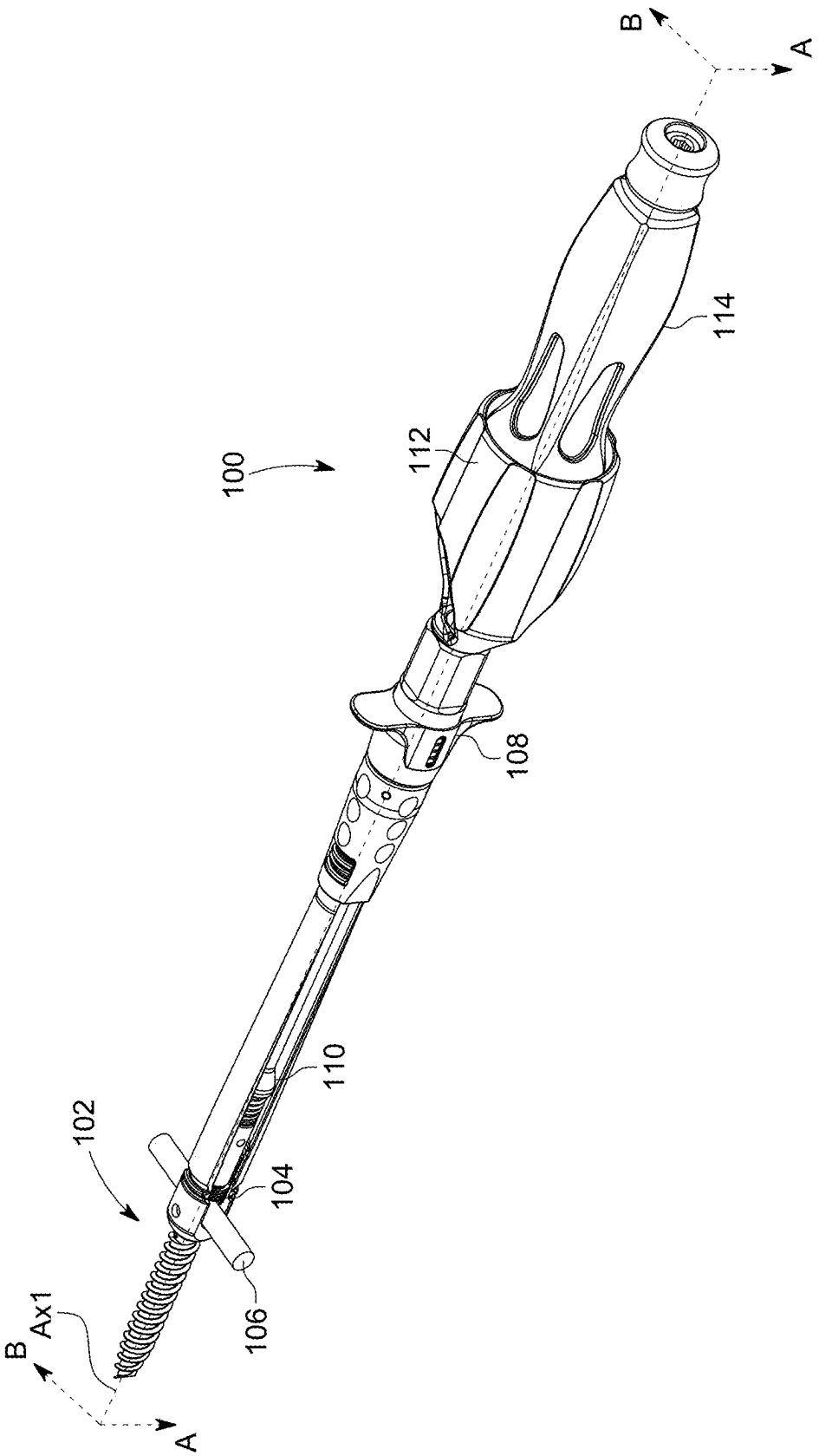


FIG. 1A

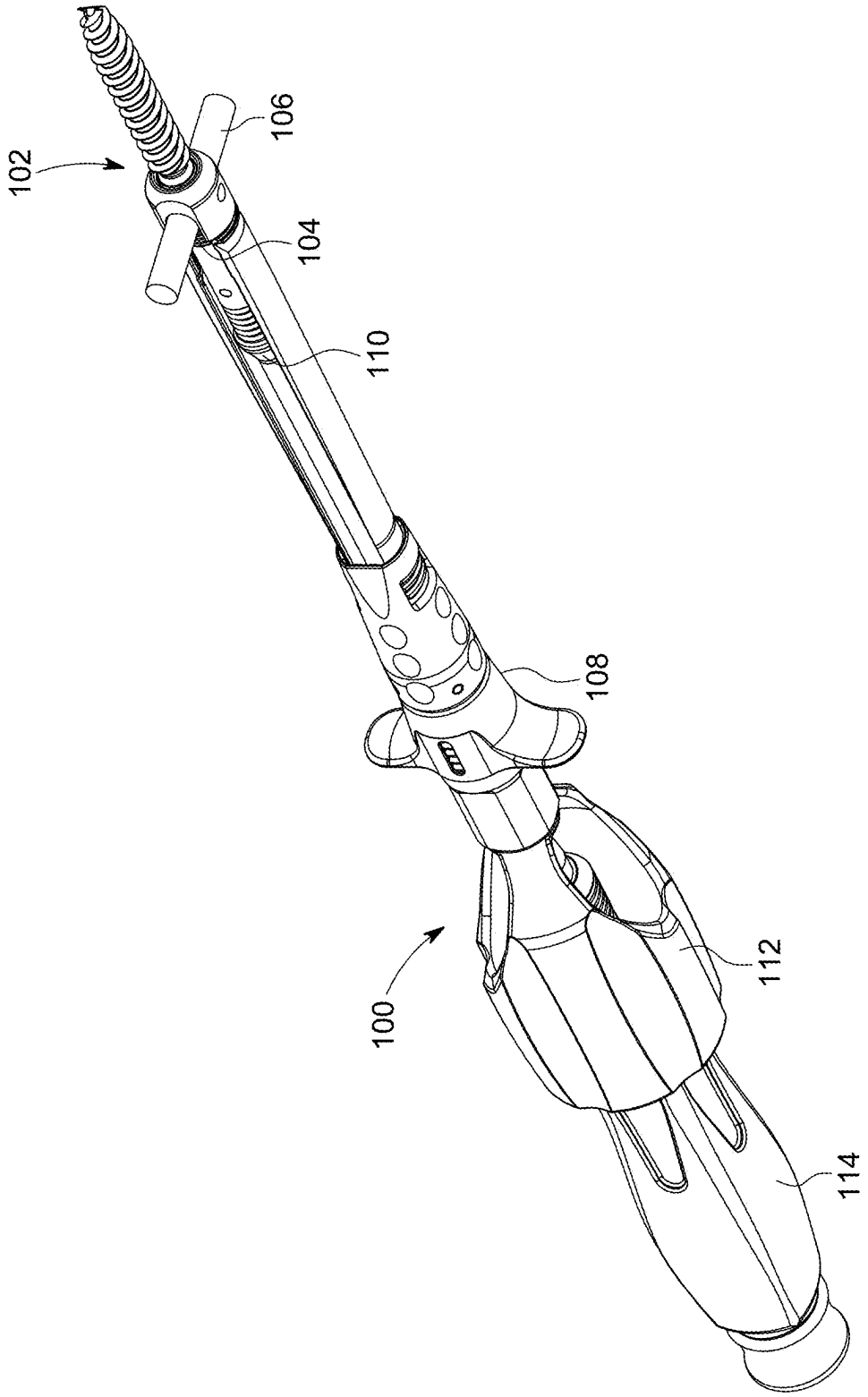


FIG. 1B

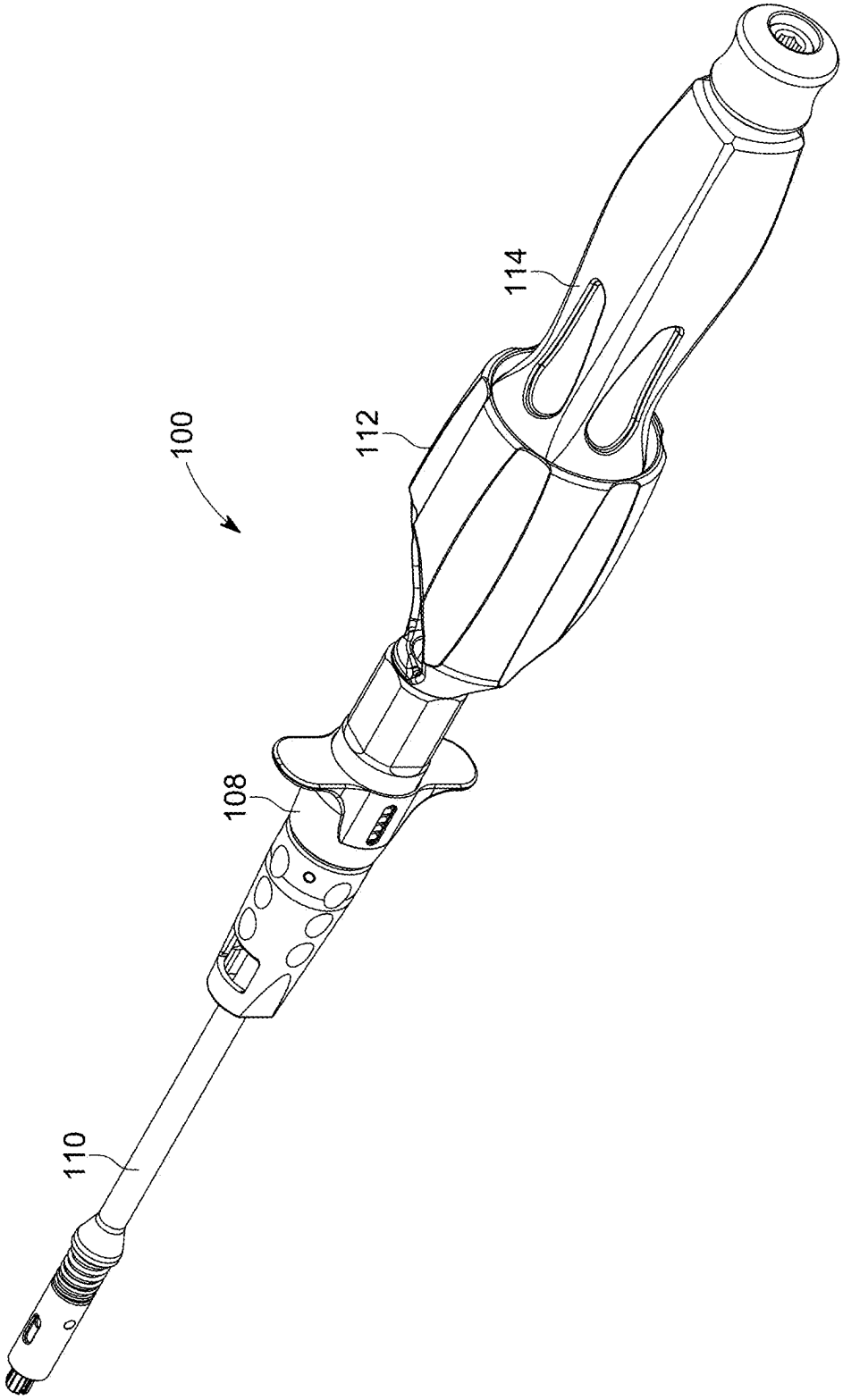


FIG. 2A

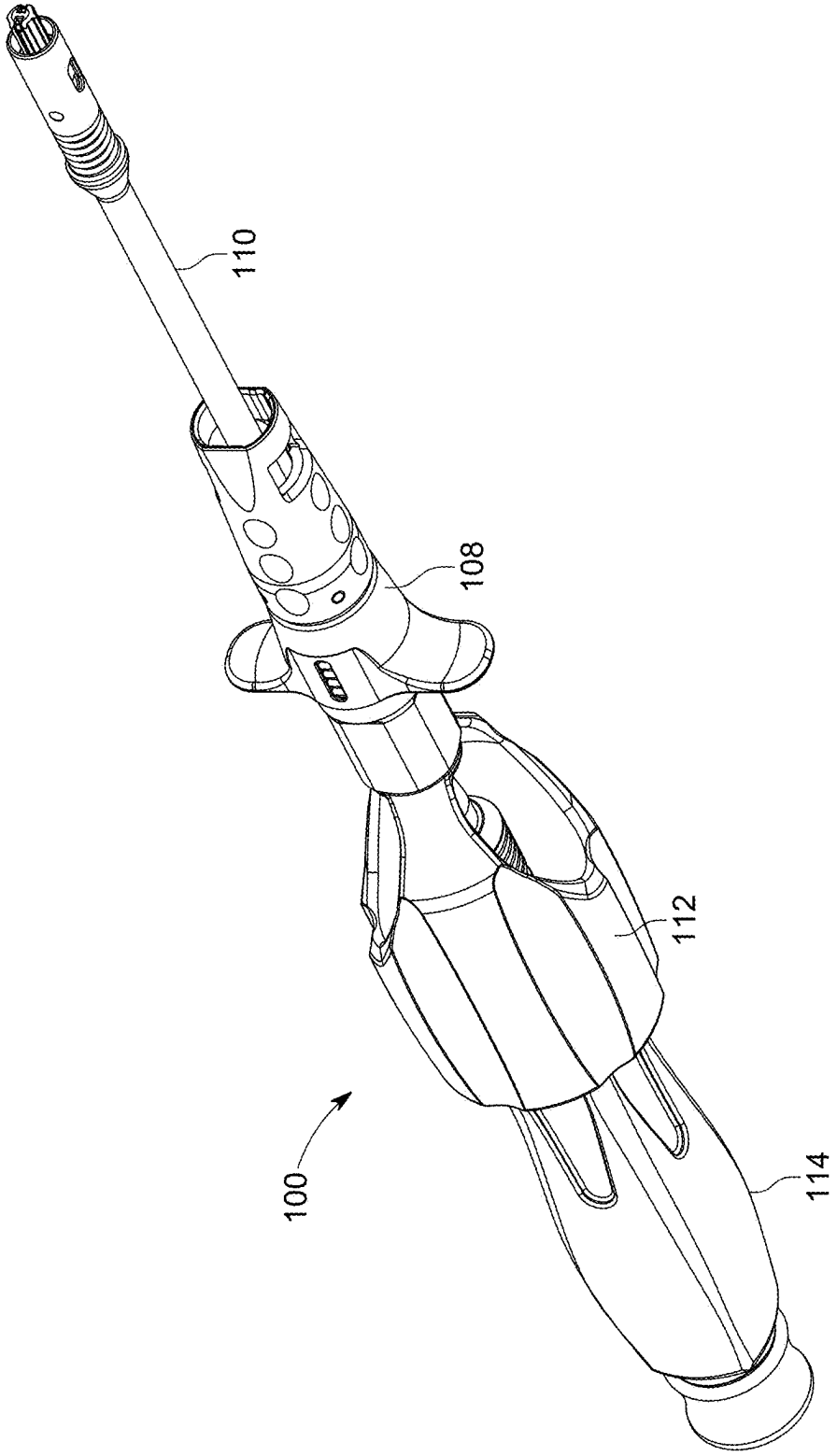


FIG. 2B

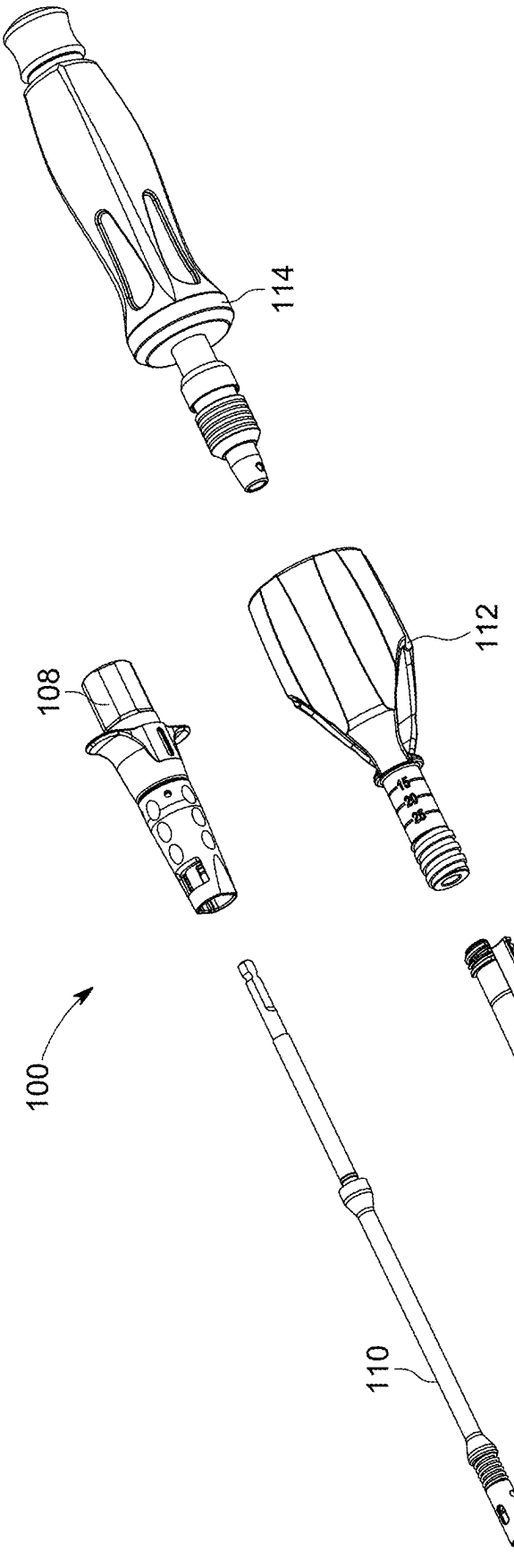


FIG. 3

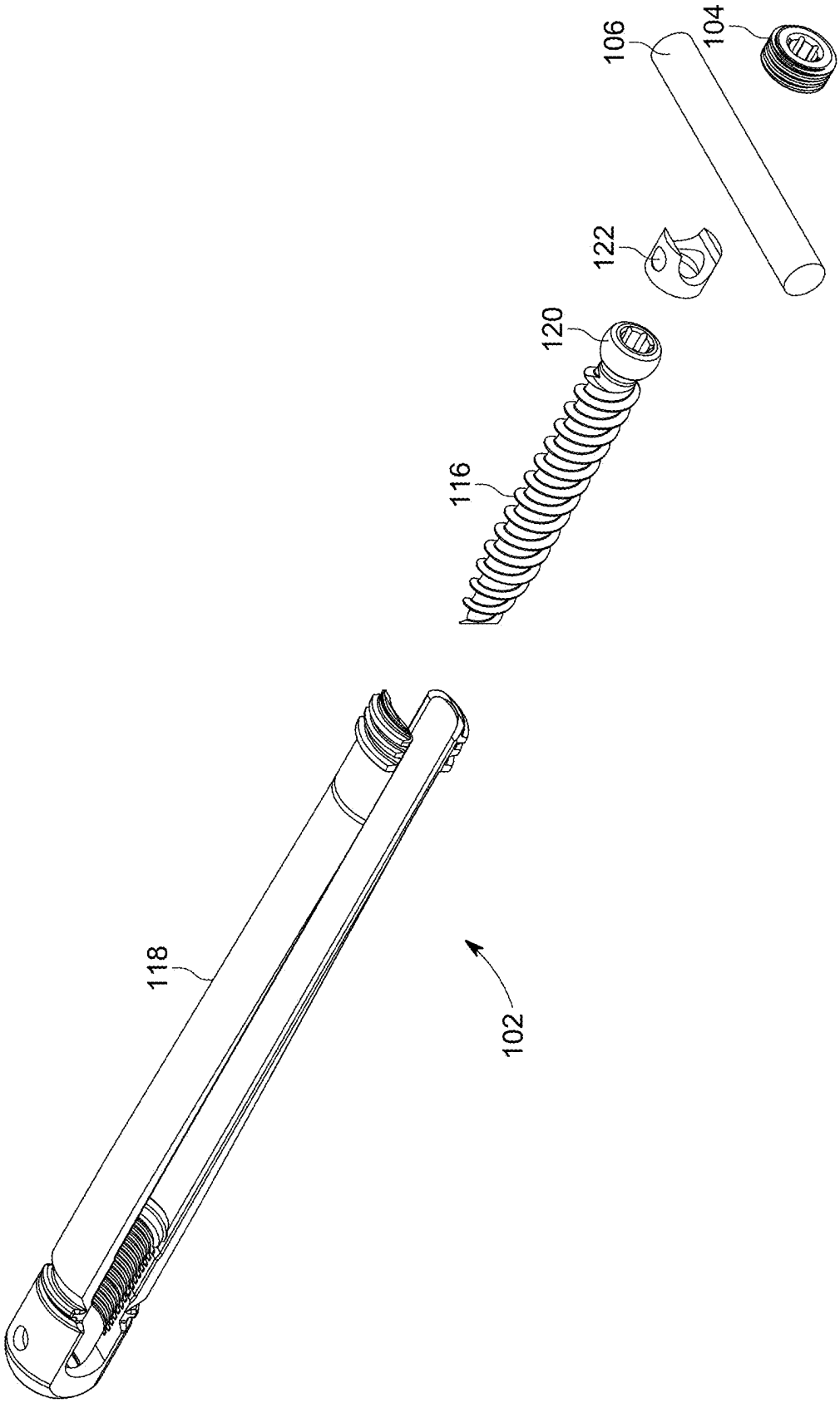


FIG. 4

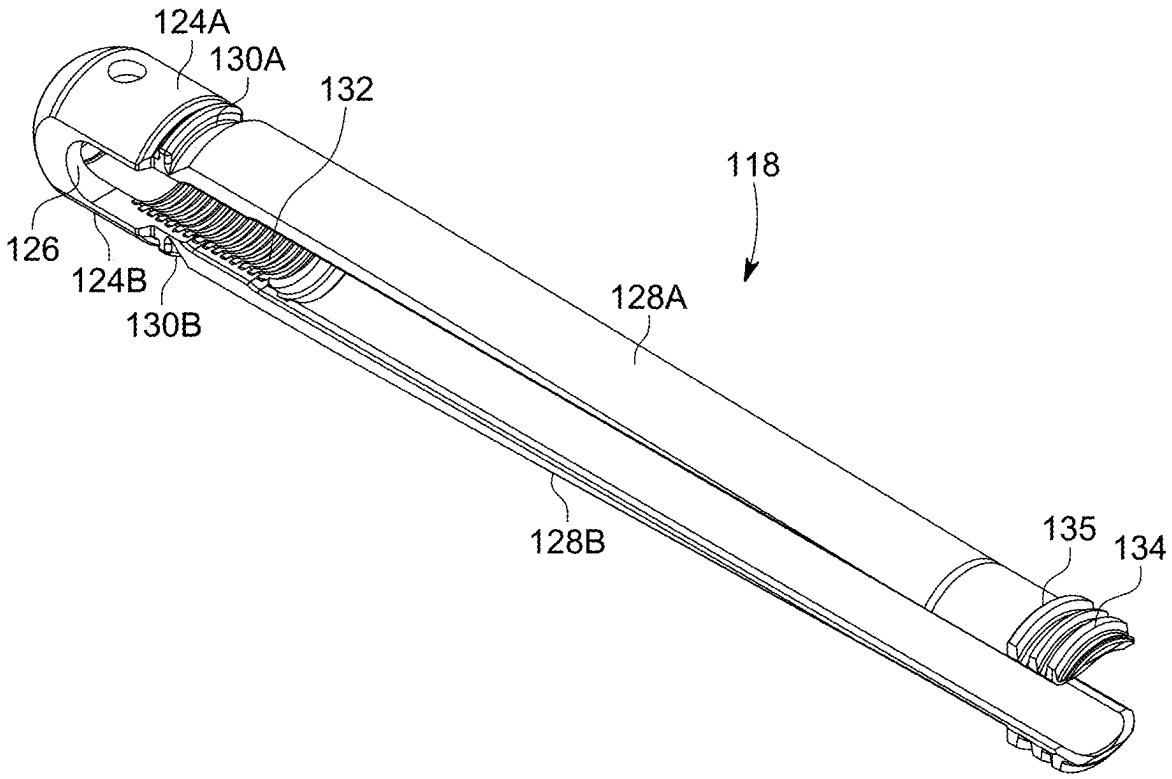


FIG. 5

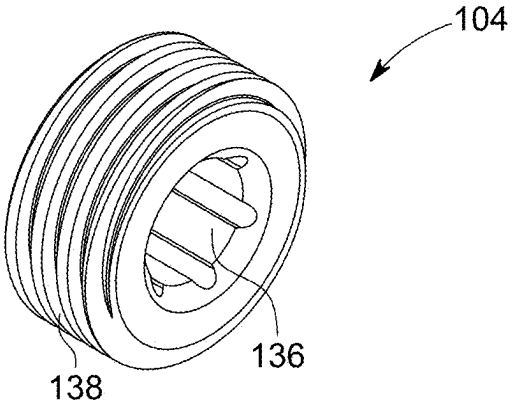


FIG. 6

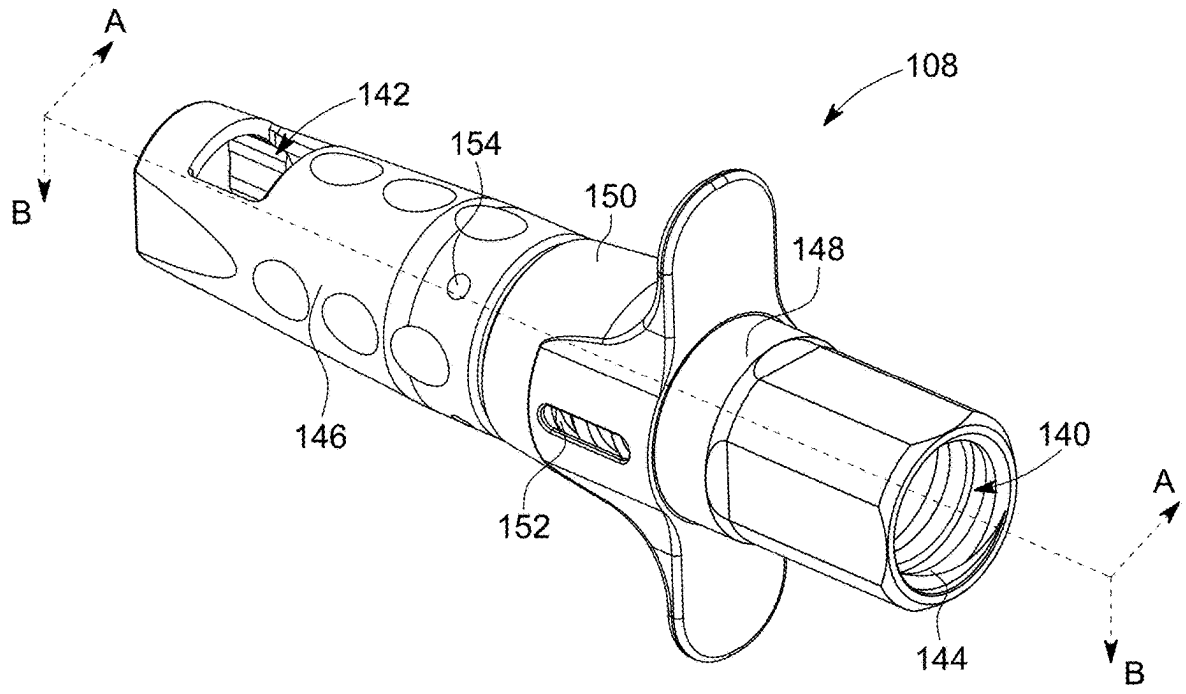

A
B
142
154
108
150
148
146
152
140
A
144
B

FIG. 7A

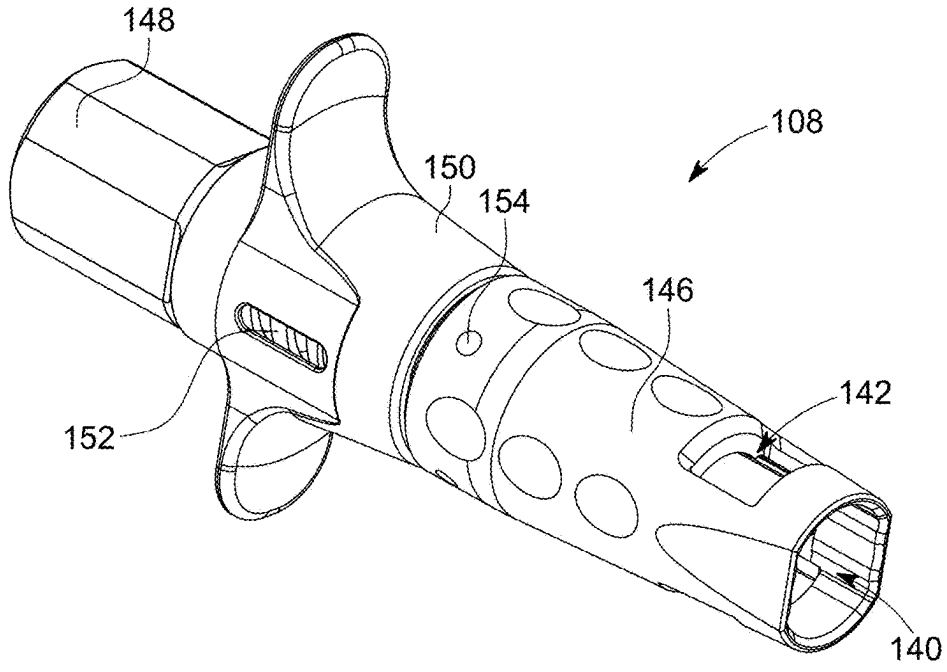

148
108
150
154
146
142
152
140

FIG. 7B

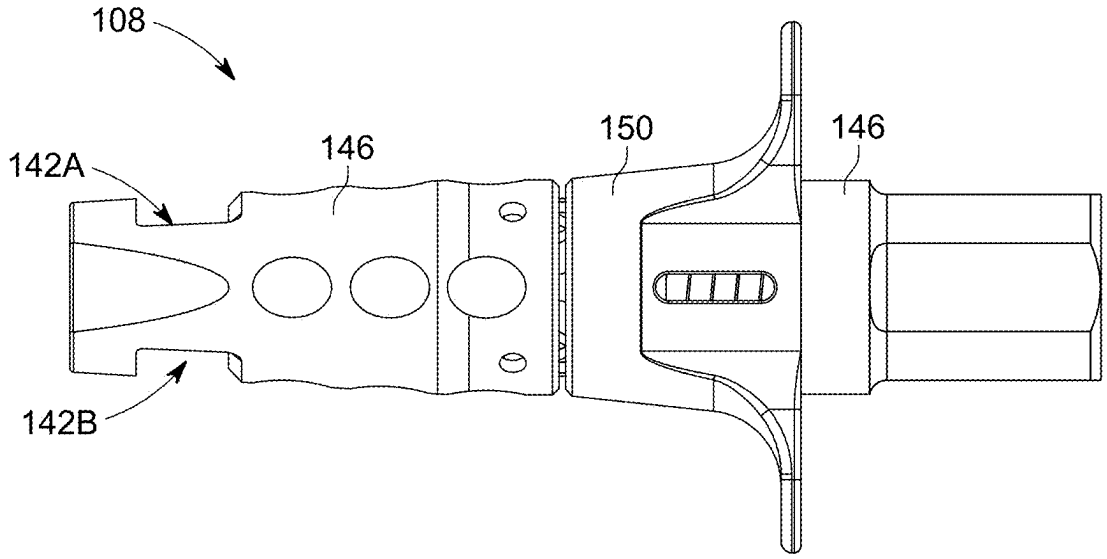


FIG. 7C

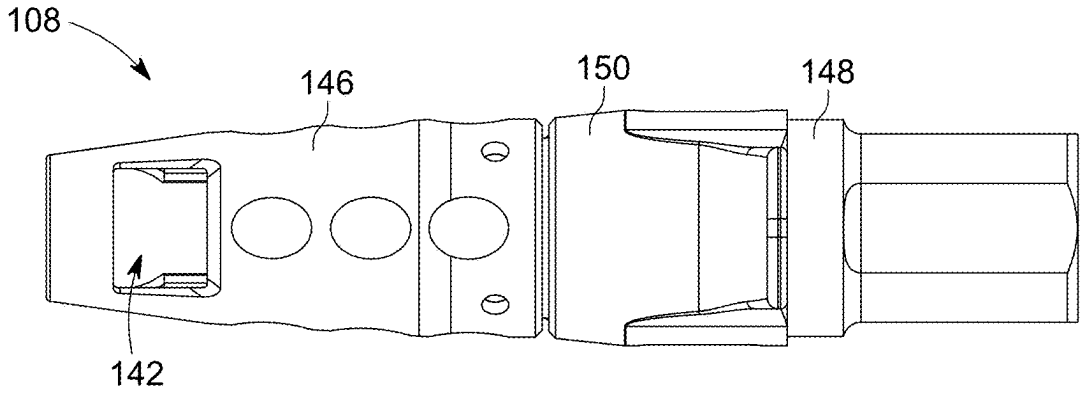


FIG. 7D

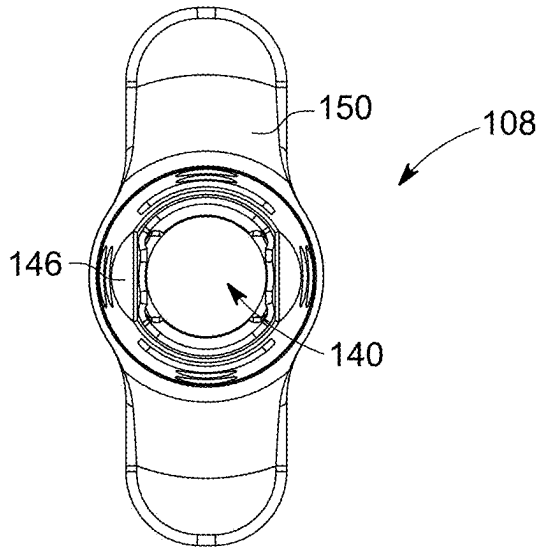


FIG. 7E

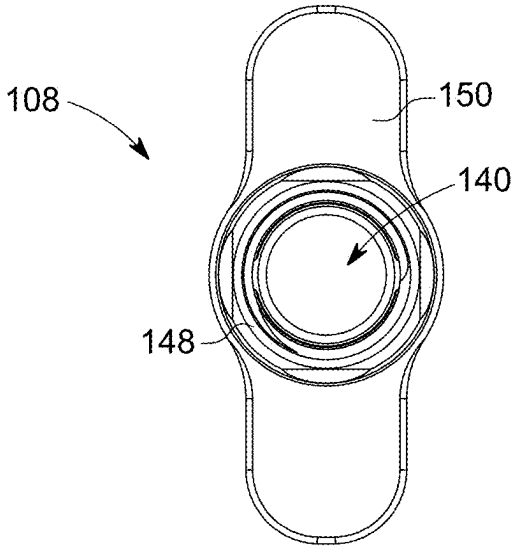


FIG. 7F

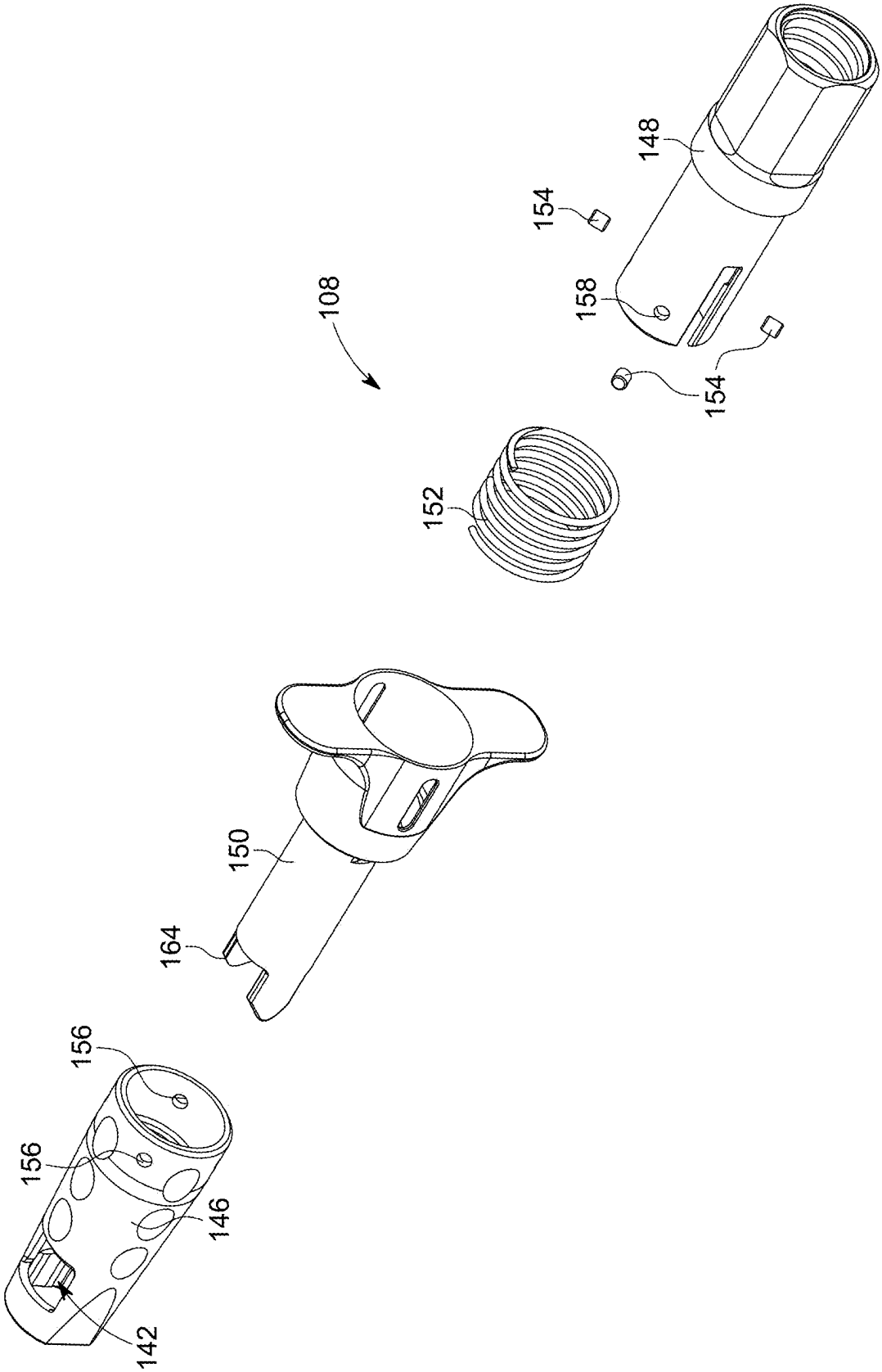


FIG. 8

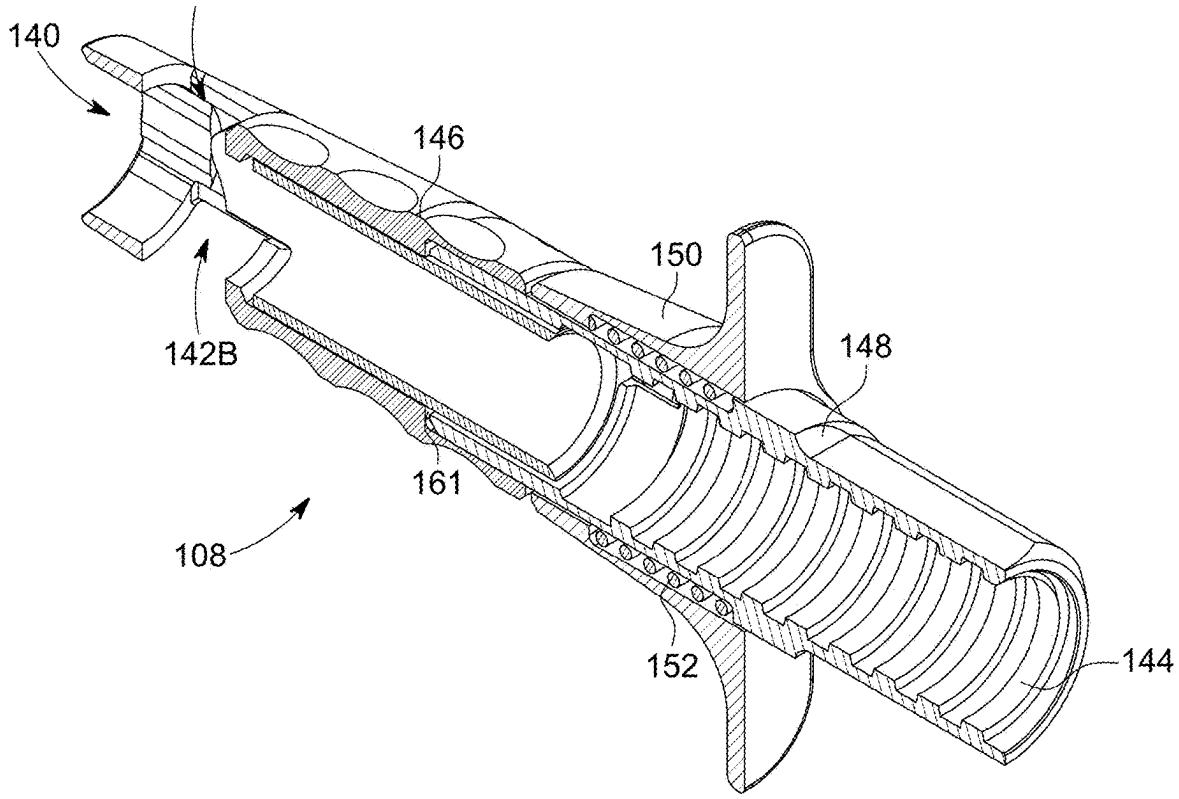

140
146
150
142B
148
161
108
152
144

FIG. 9

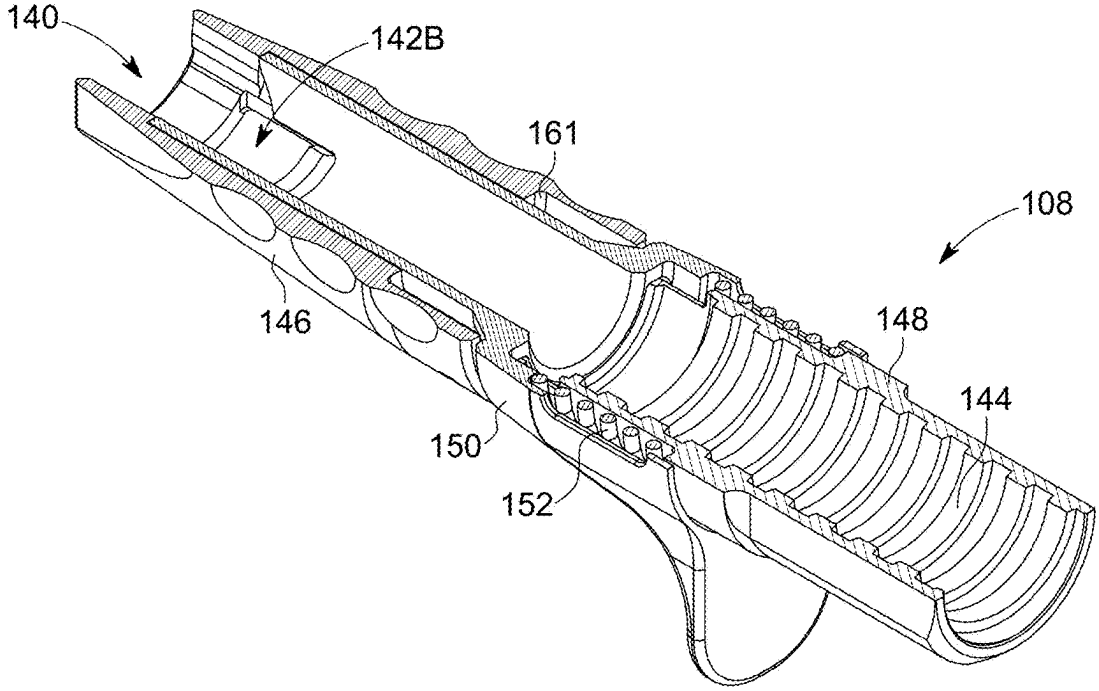

140
142B
161
108
146
148
144
150
152

FIG. 10

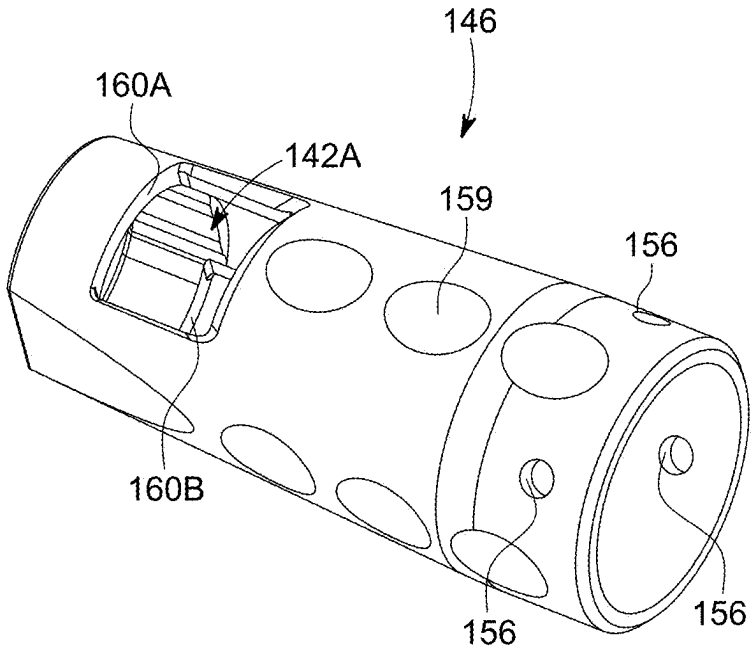


FIG. 11A

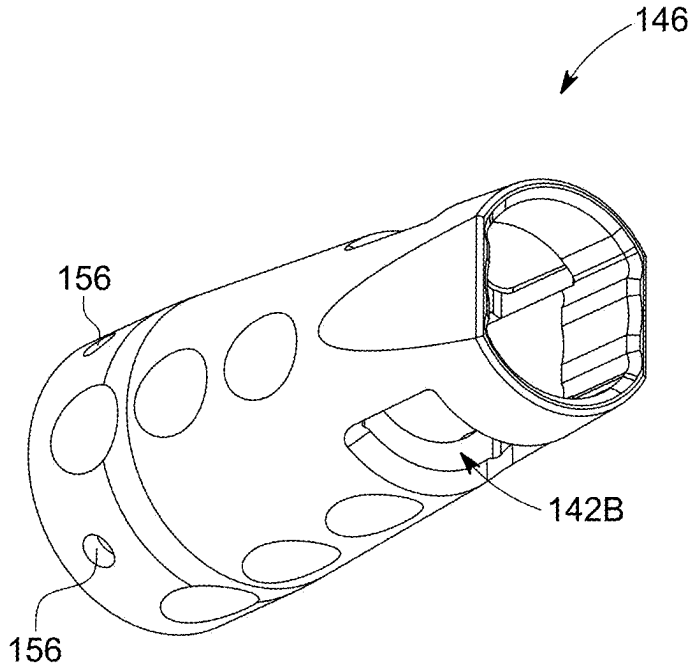


FIG. 11B

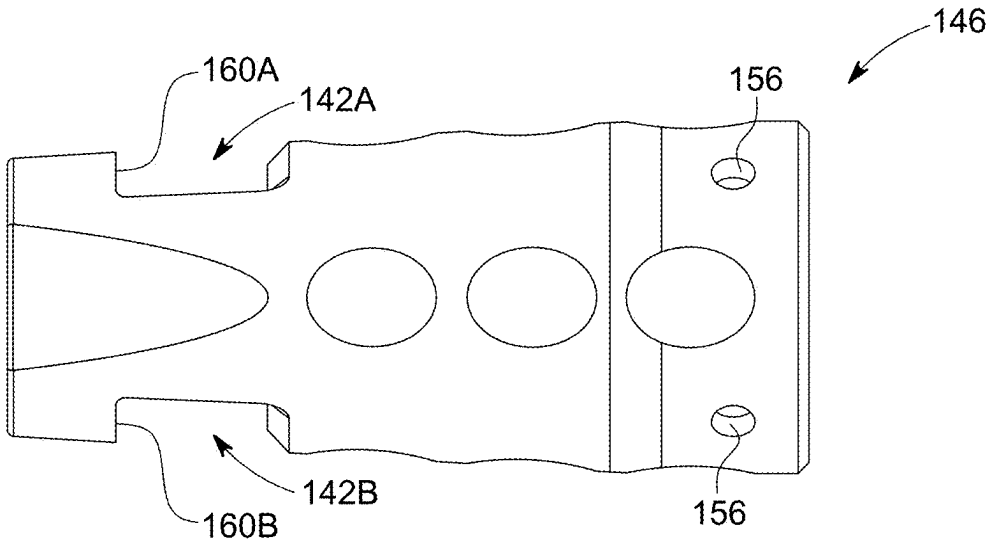


FIG. 11C

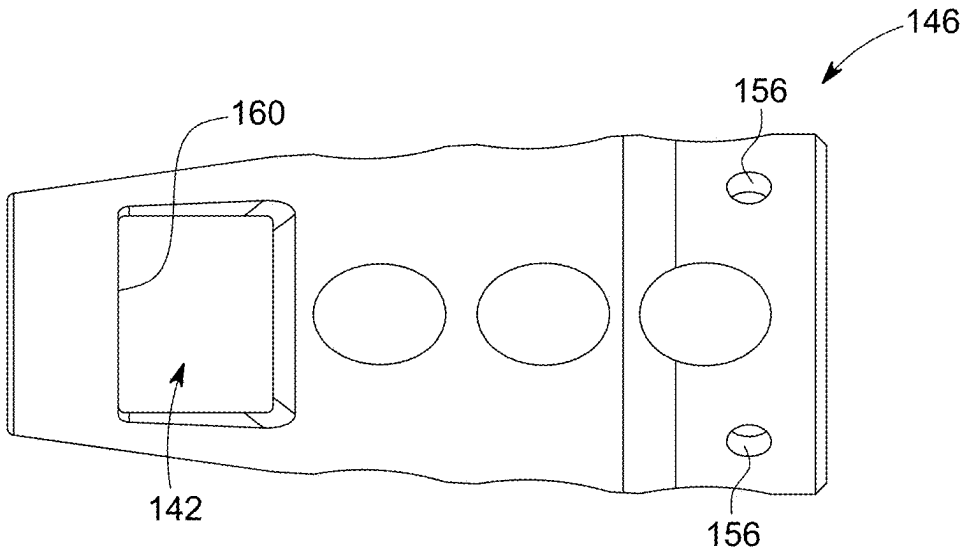


FIG. 11D

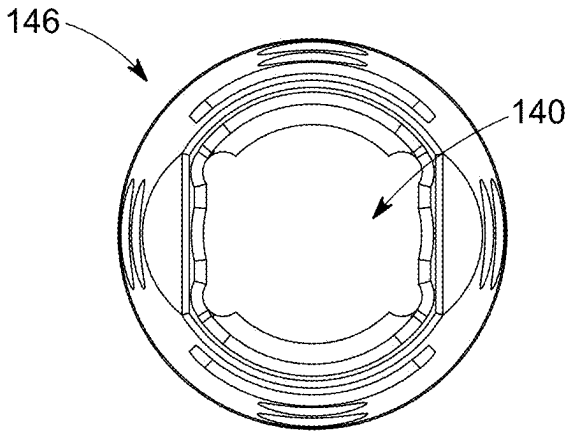


FIG. 11E

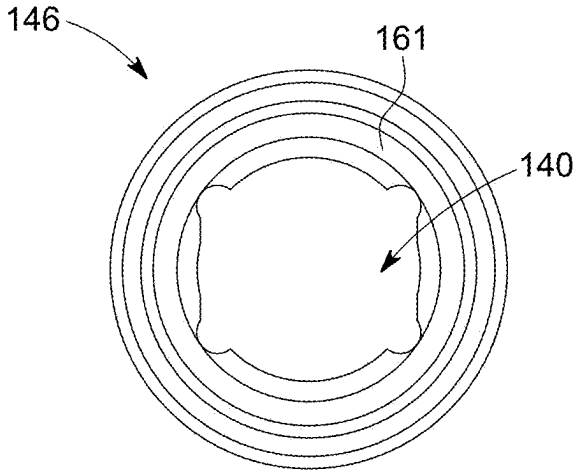


FIG. 11F

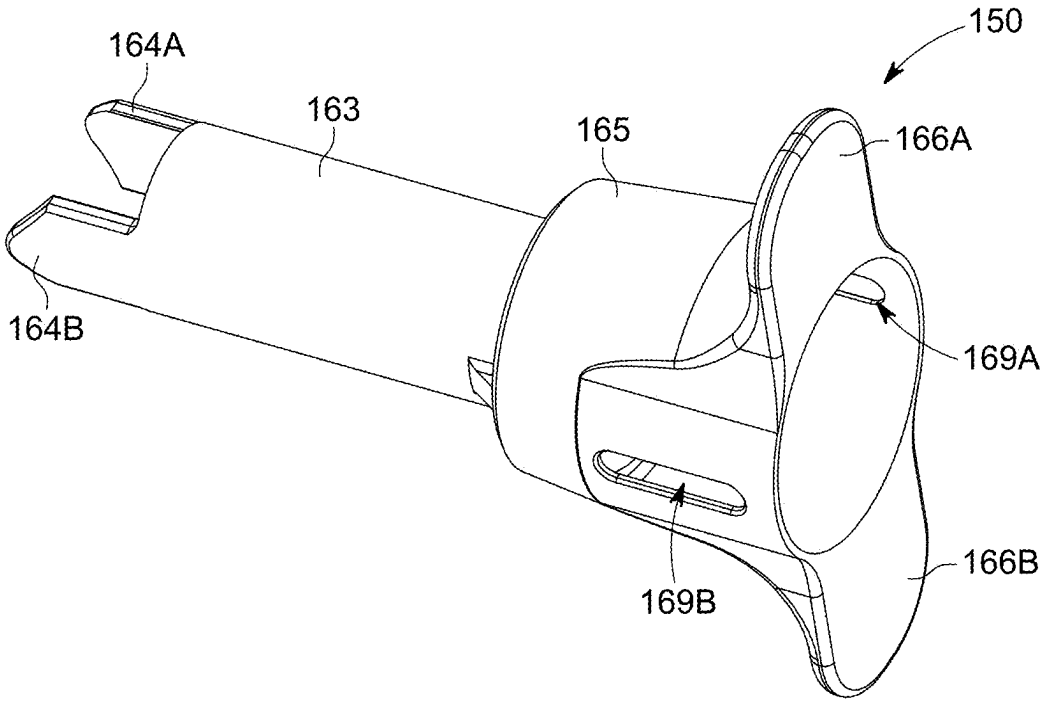


FIG. 12A

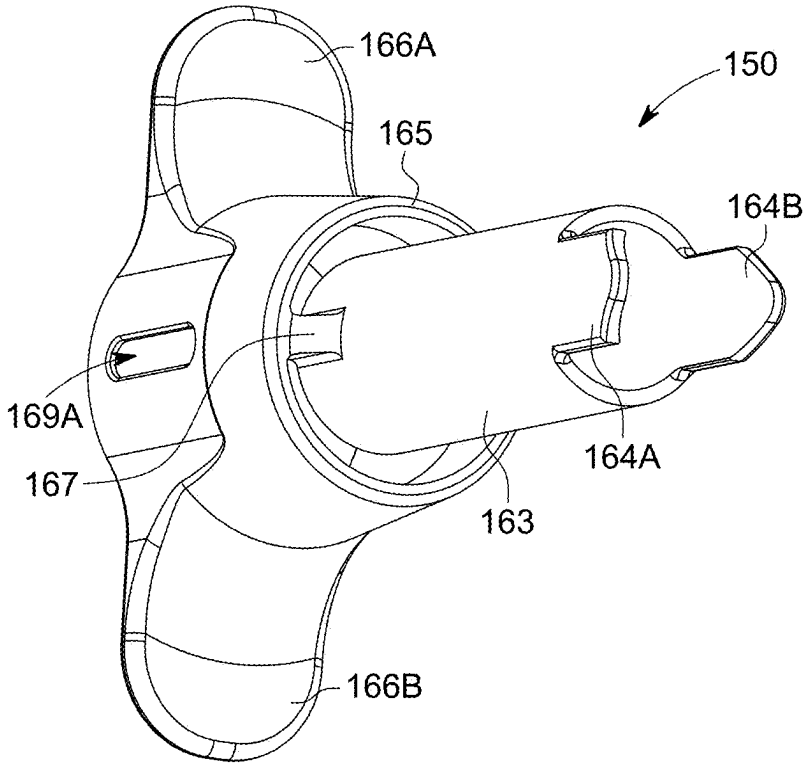


FIG. 12B

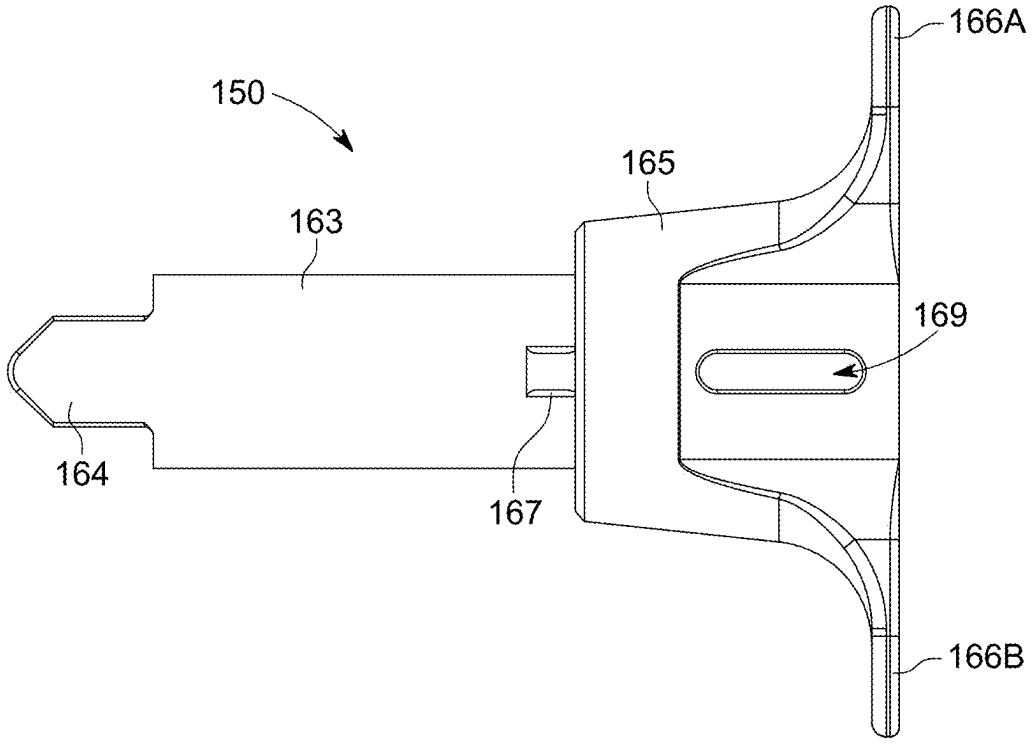


FIG. 12C

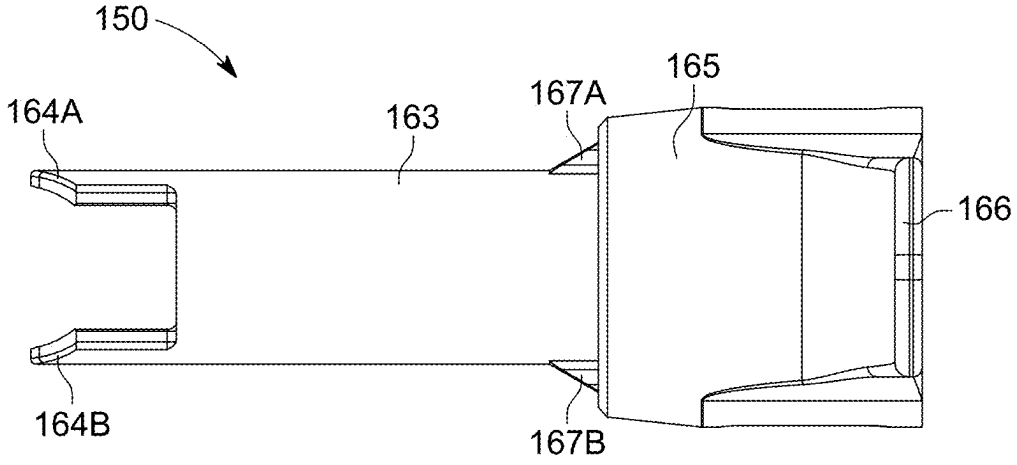


FIG. 12D

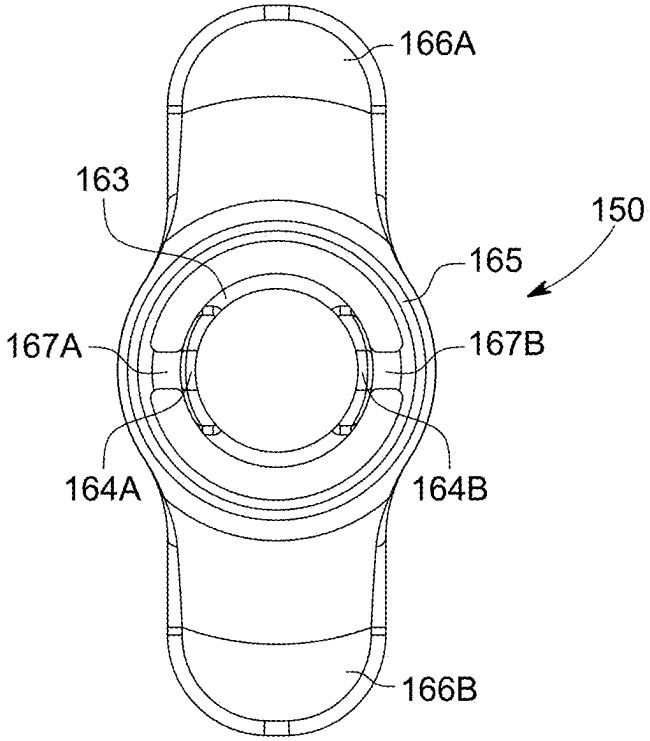


FIG. 12E

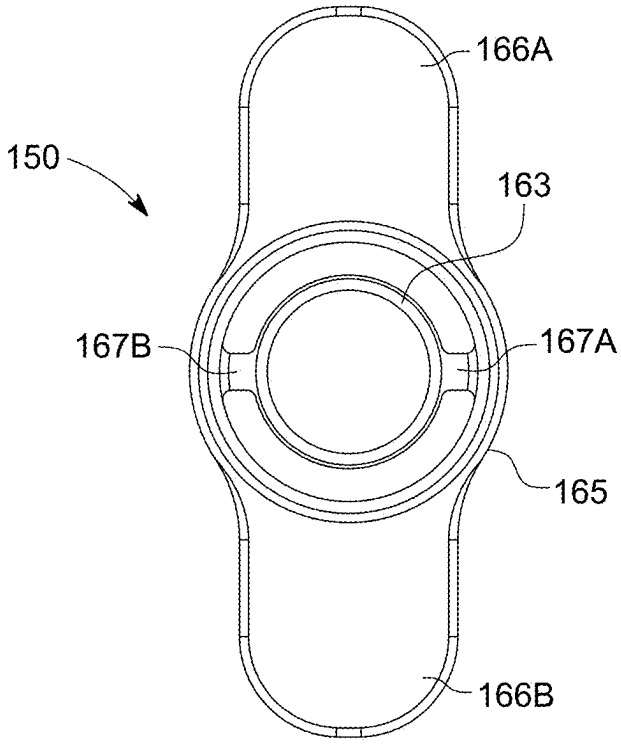


FIG. 12F

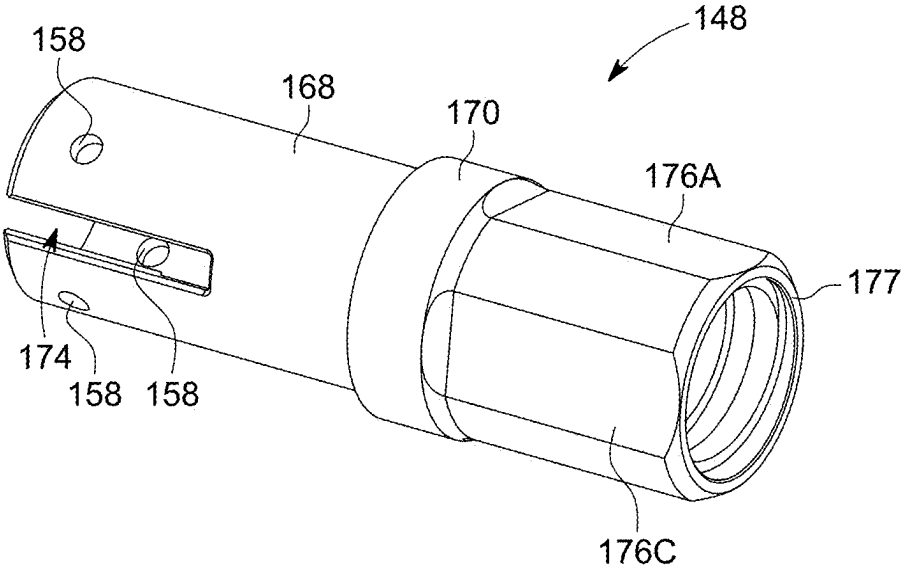


FIG. 13A

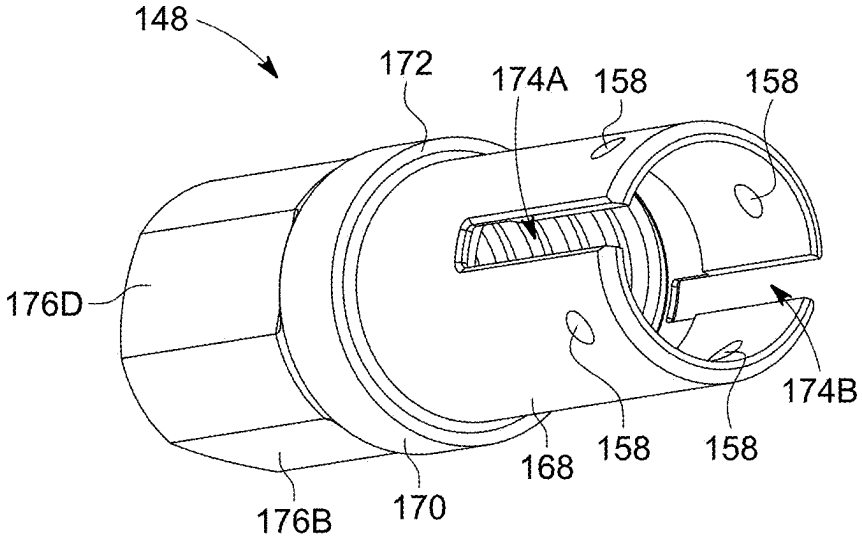


FIG. 13B

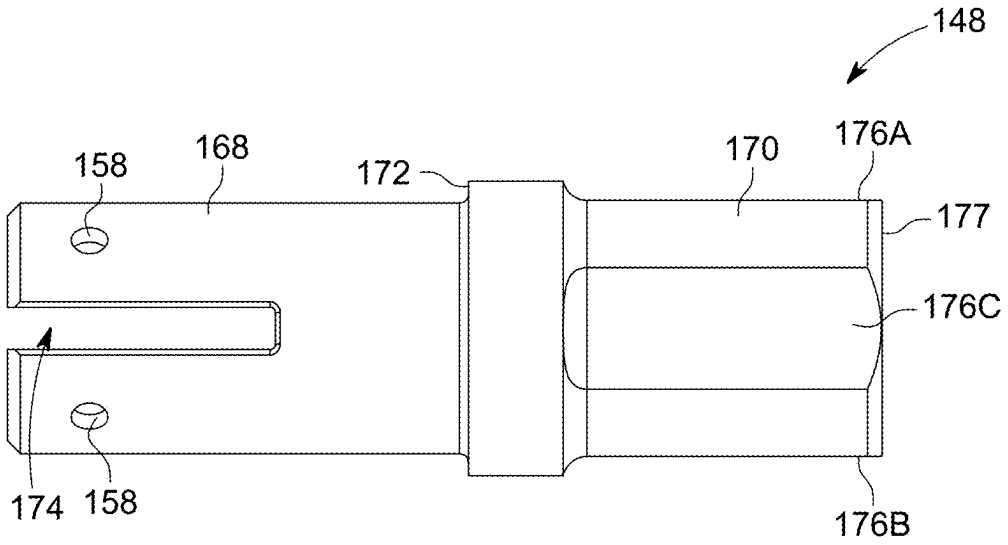


FIG. 13C

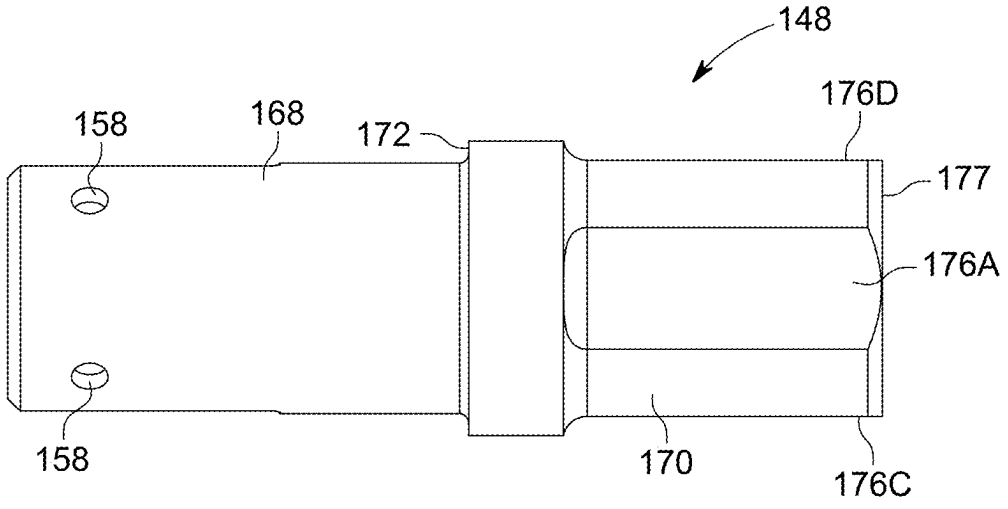


FIG. 13D

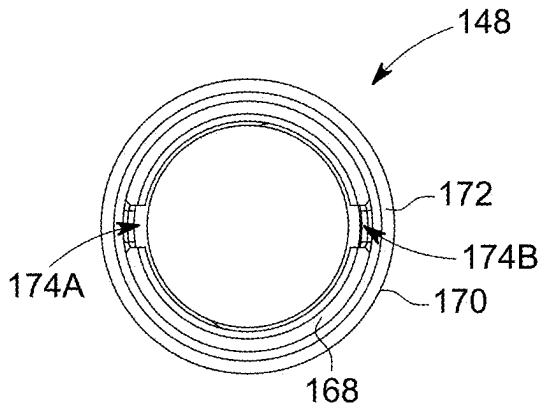


FIG. 13E

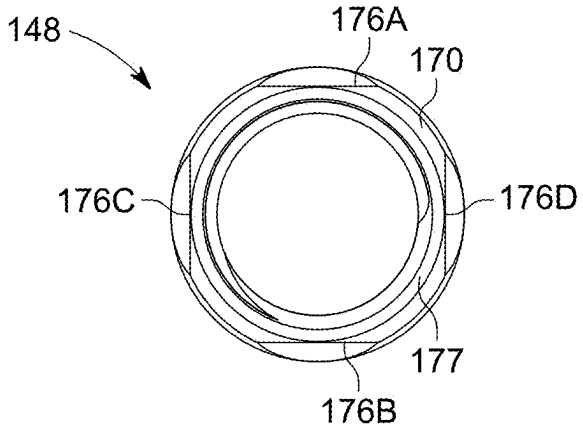


FIG. 13F

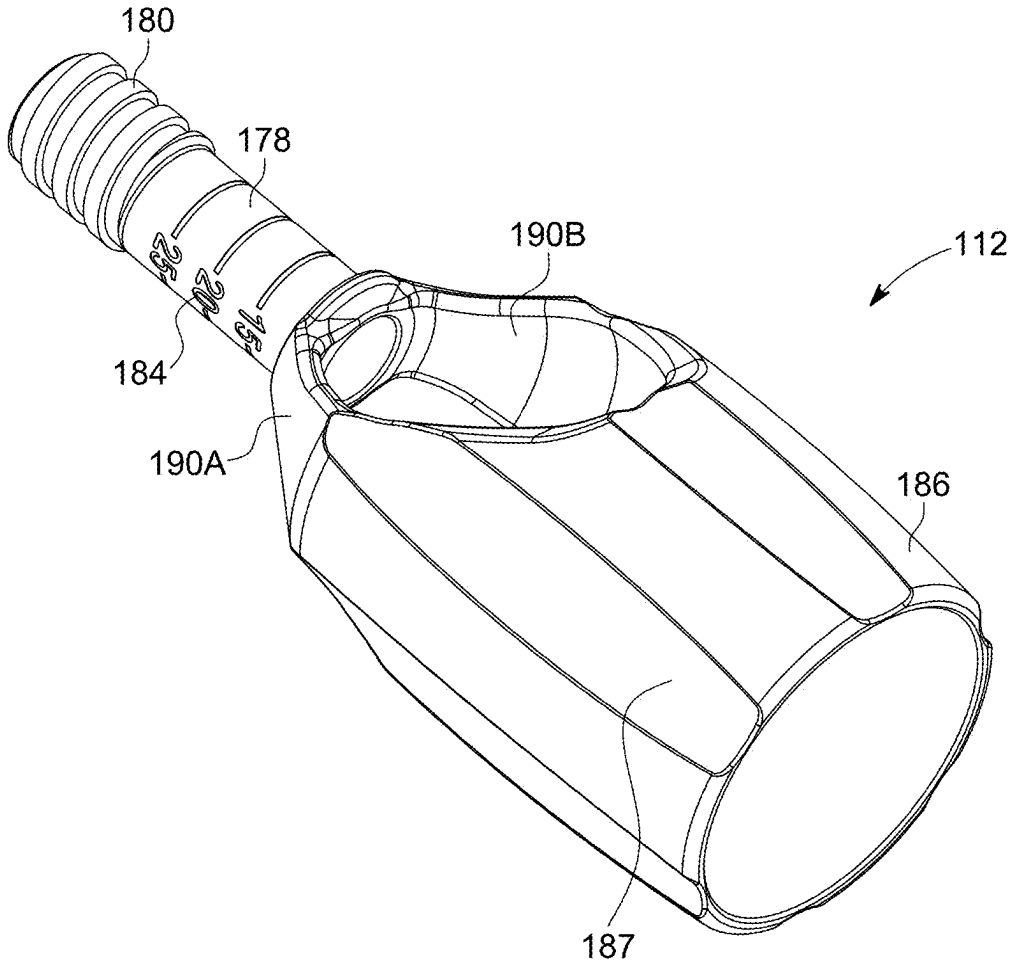


FIG. 14A

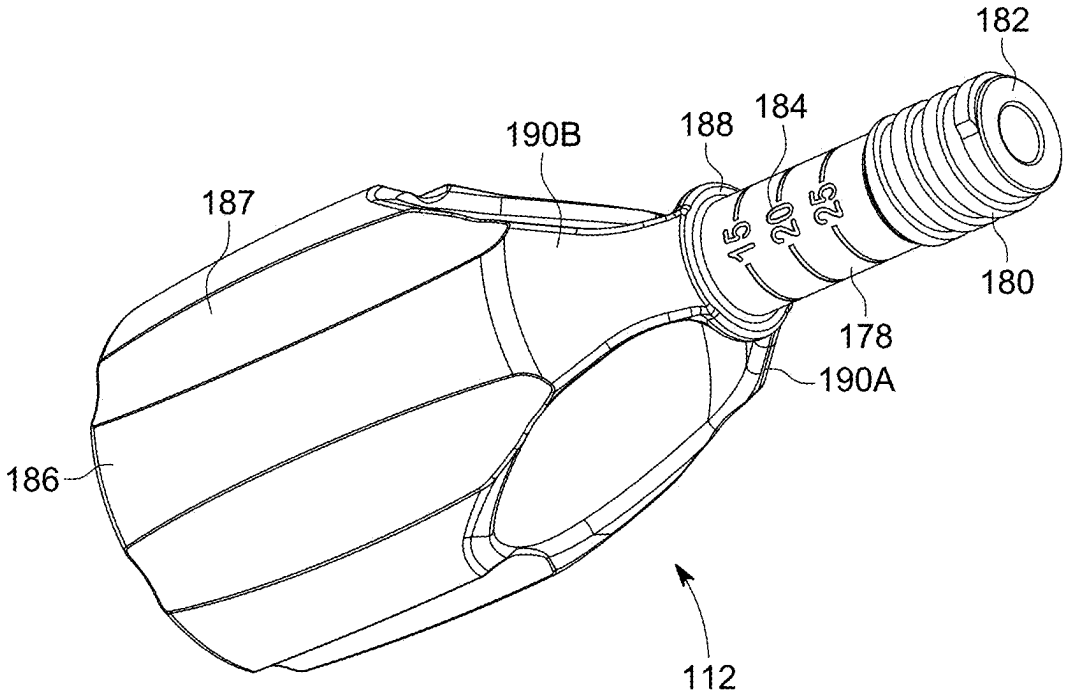


FIG. 14B

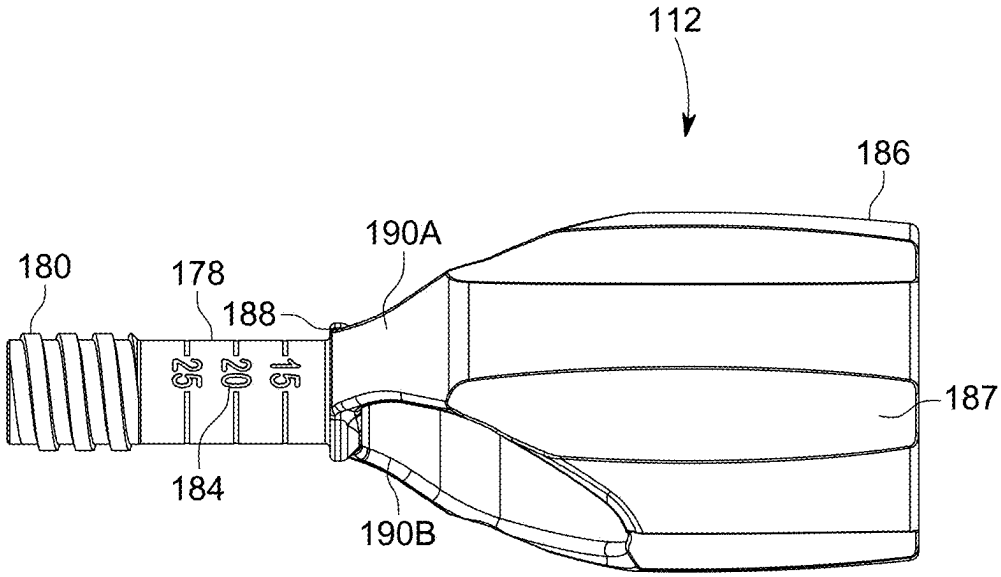


FIG. 14C

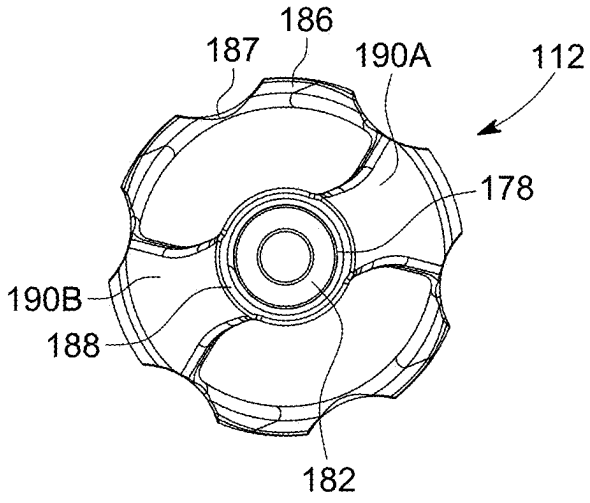


FIG. 14D

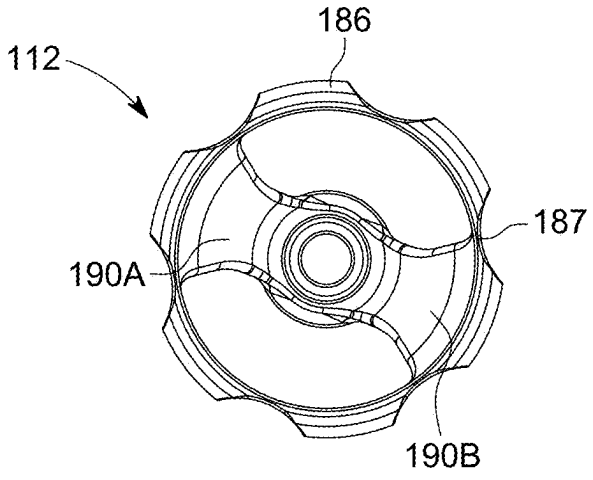


FIG. 14E

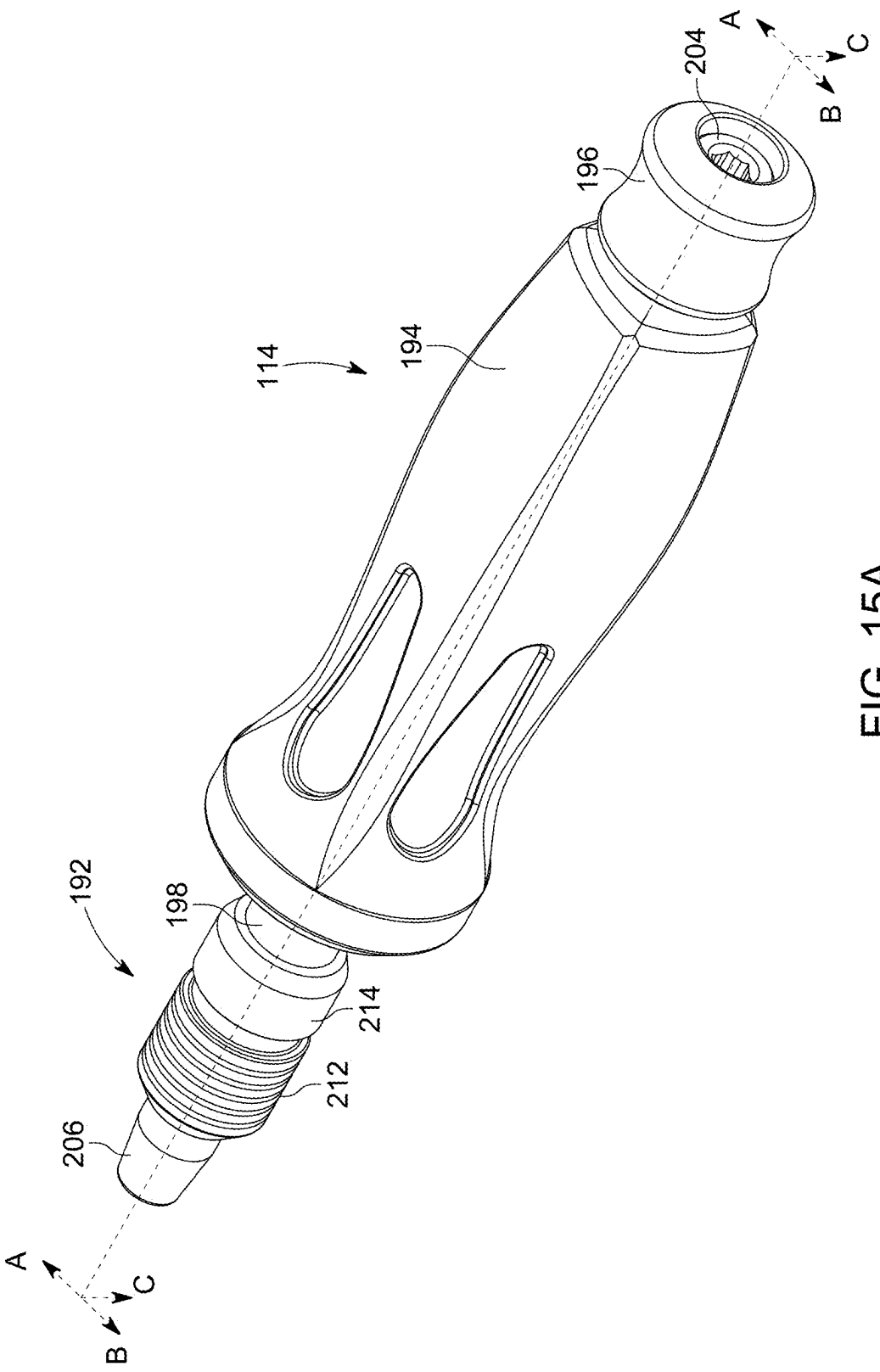


FIG. 15A

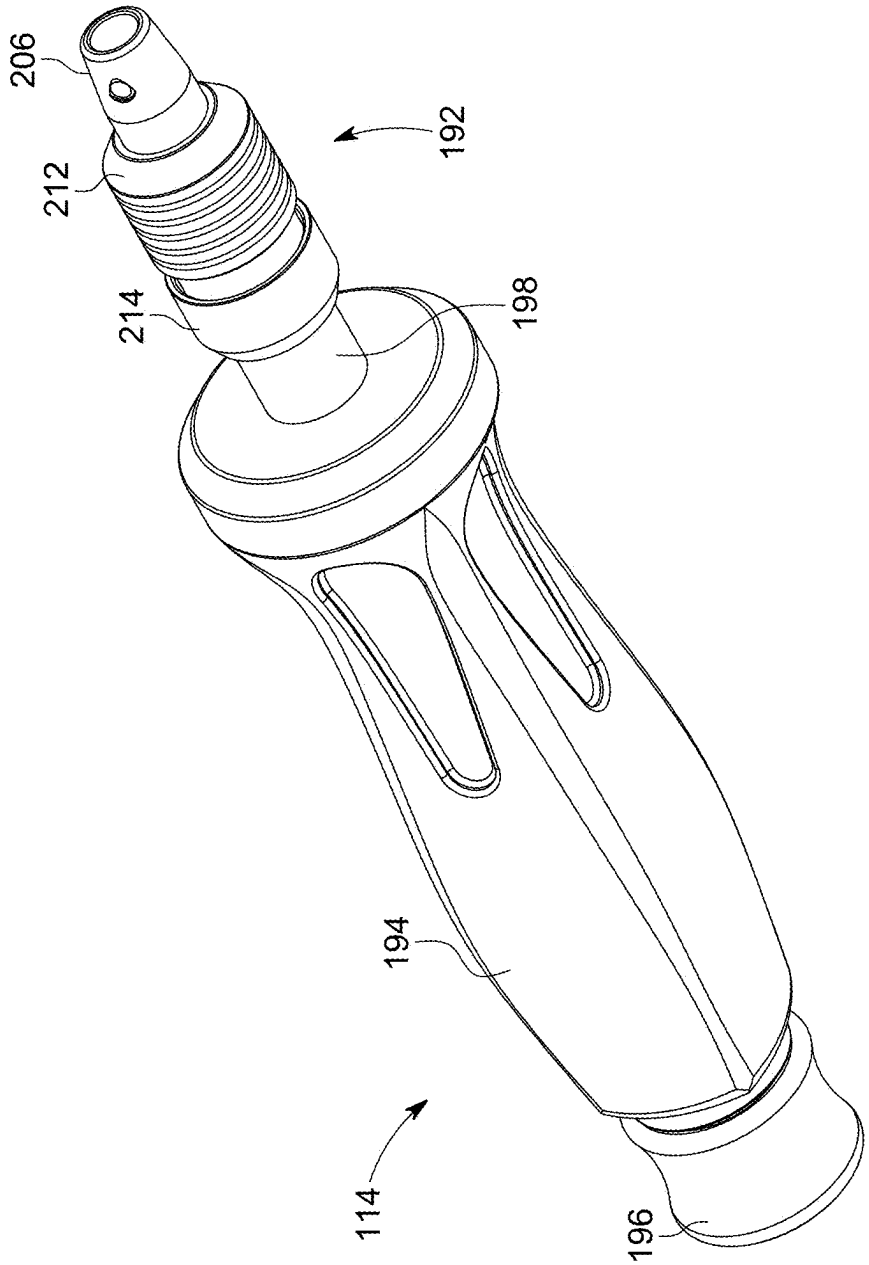


FIG. 15B

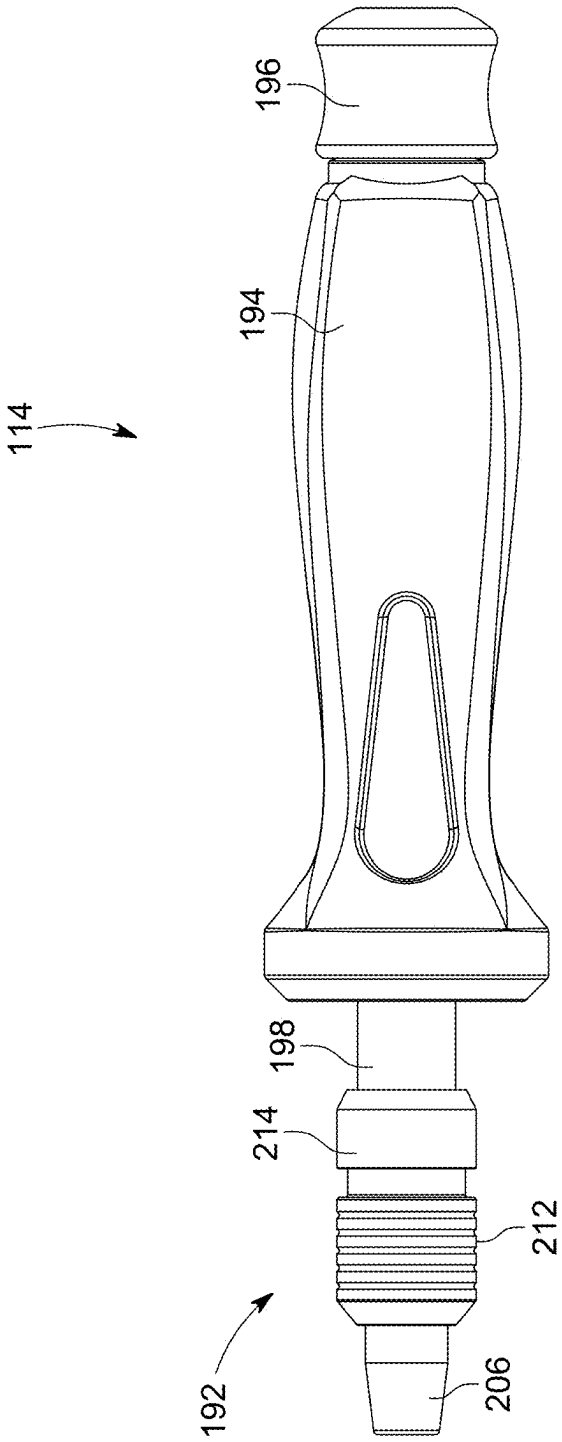


FIG. 15C

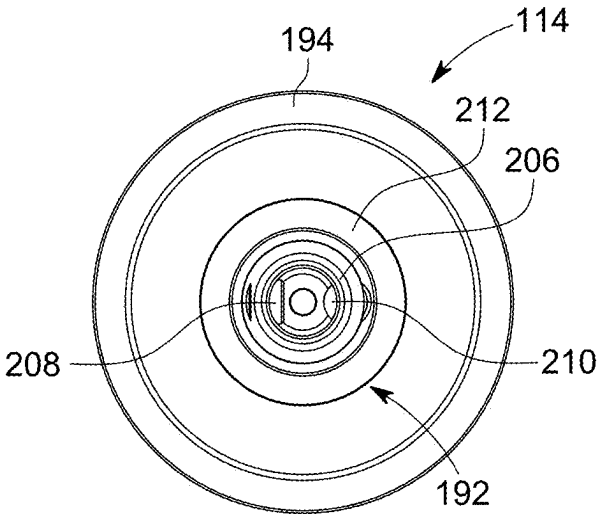


FIG. 15D

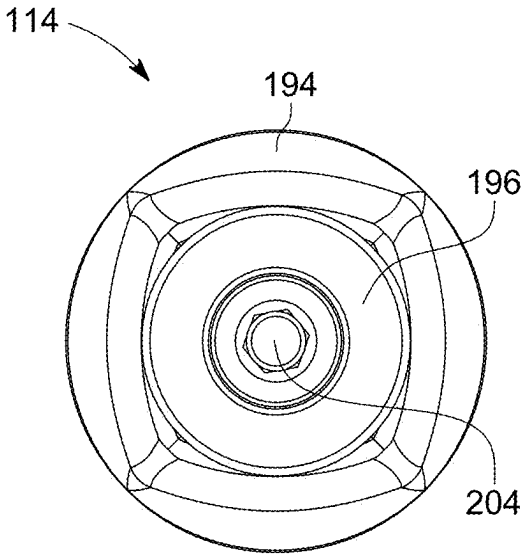


FIG. 15E

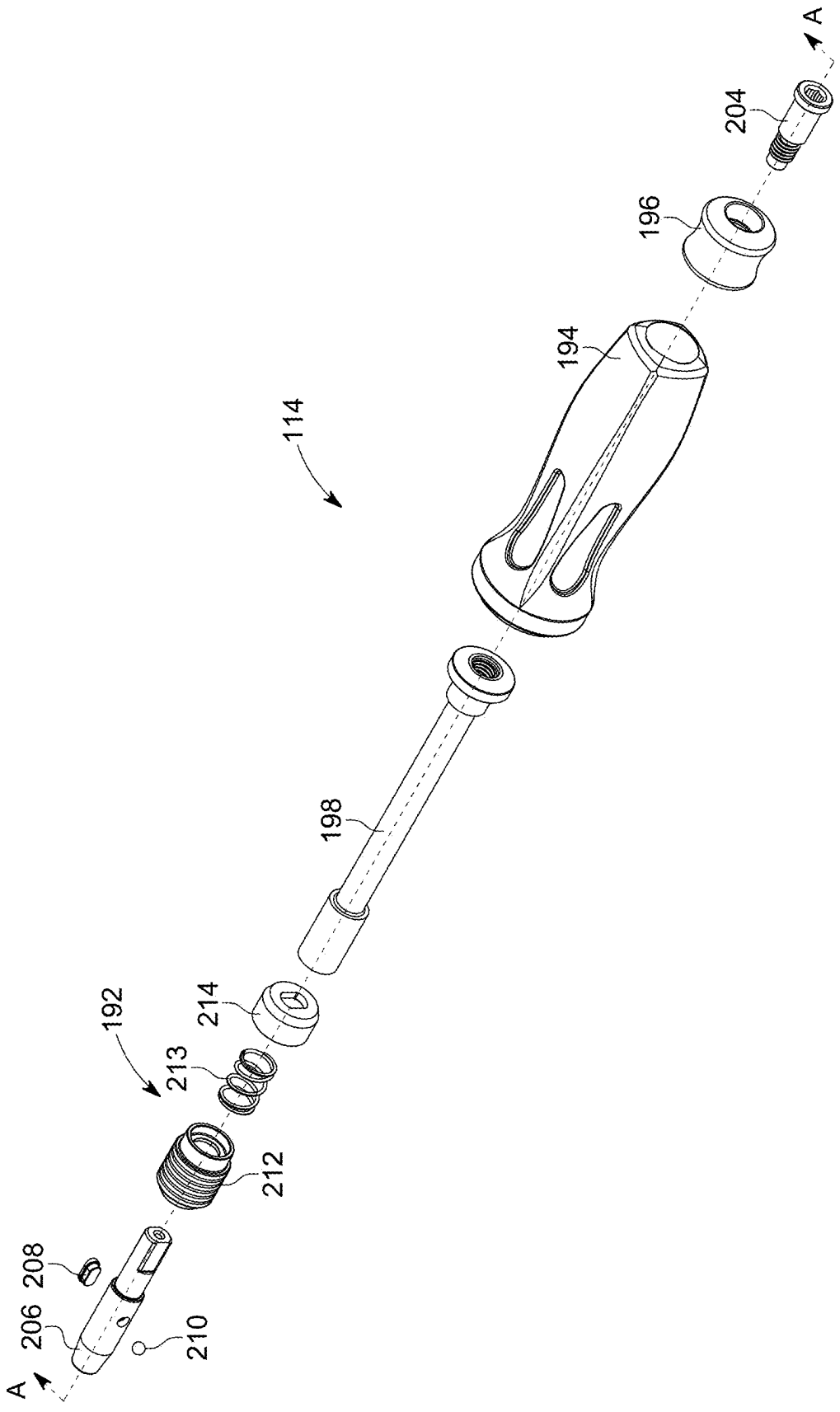


FIG. 16

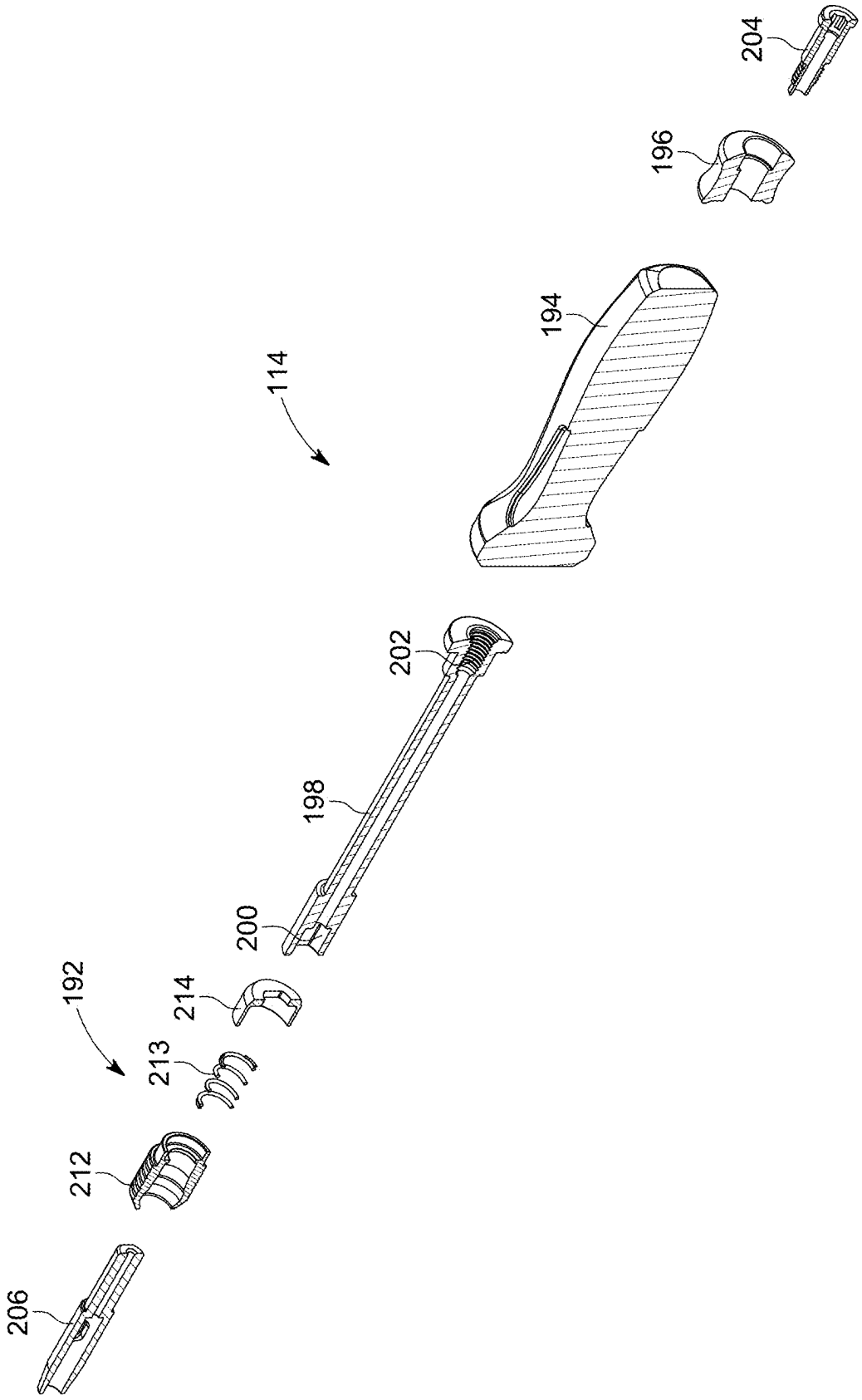


FIG. 17

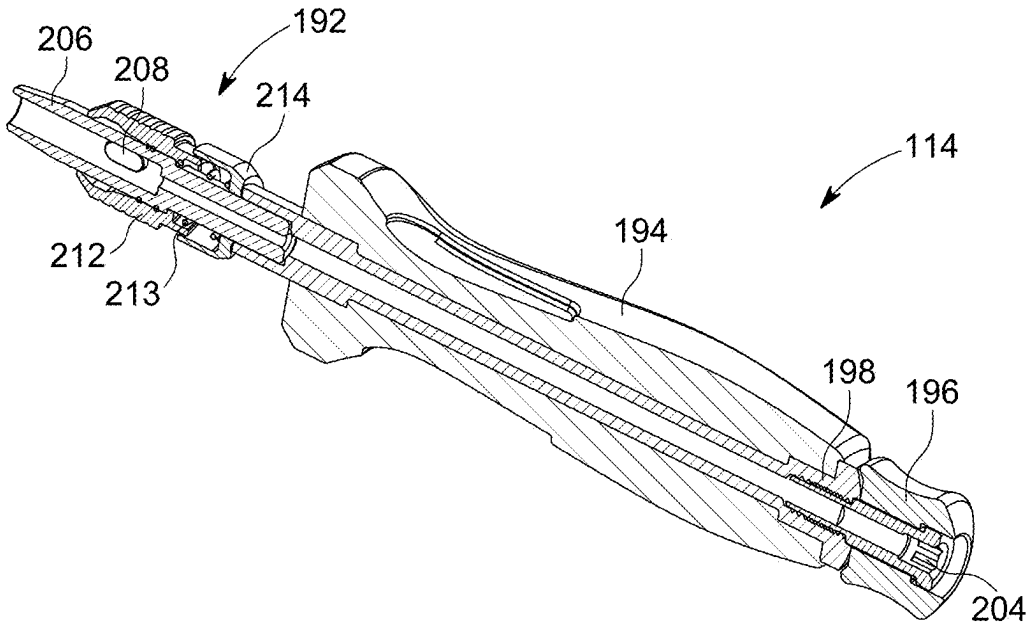


FIG. 18

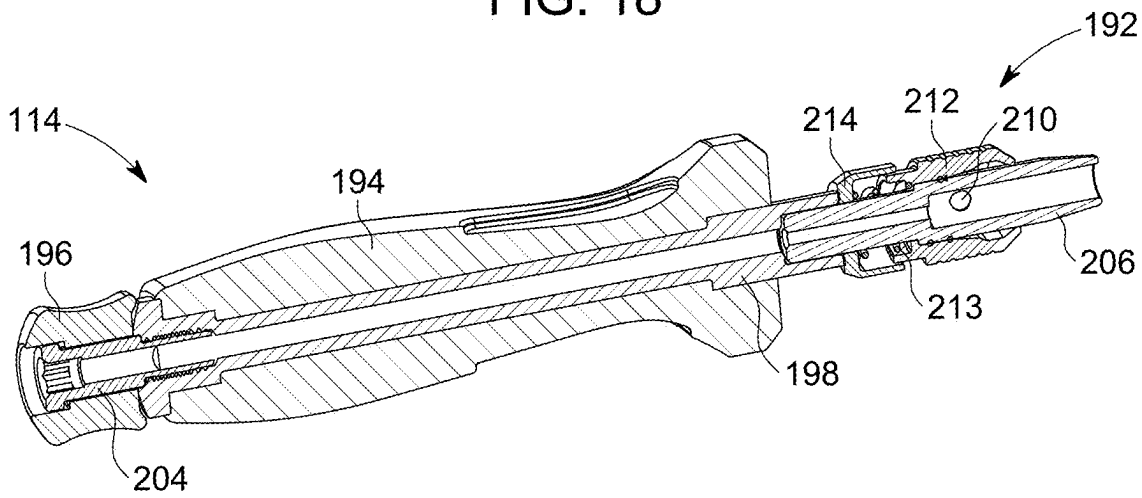


FIG. 19

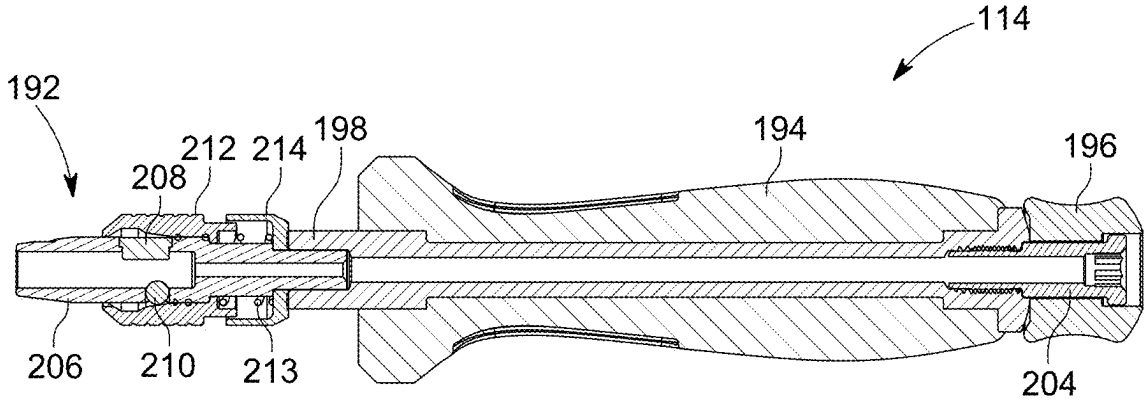


FIG. 20

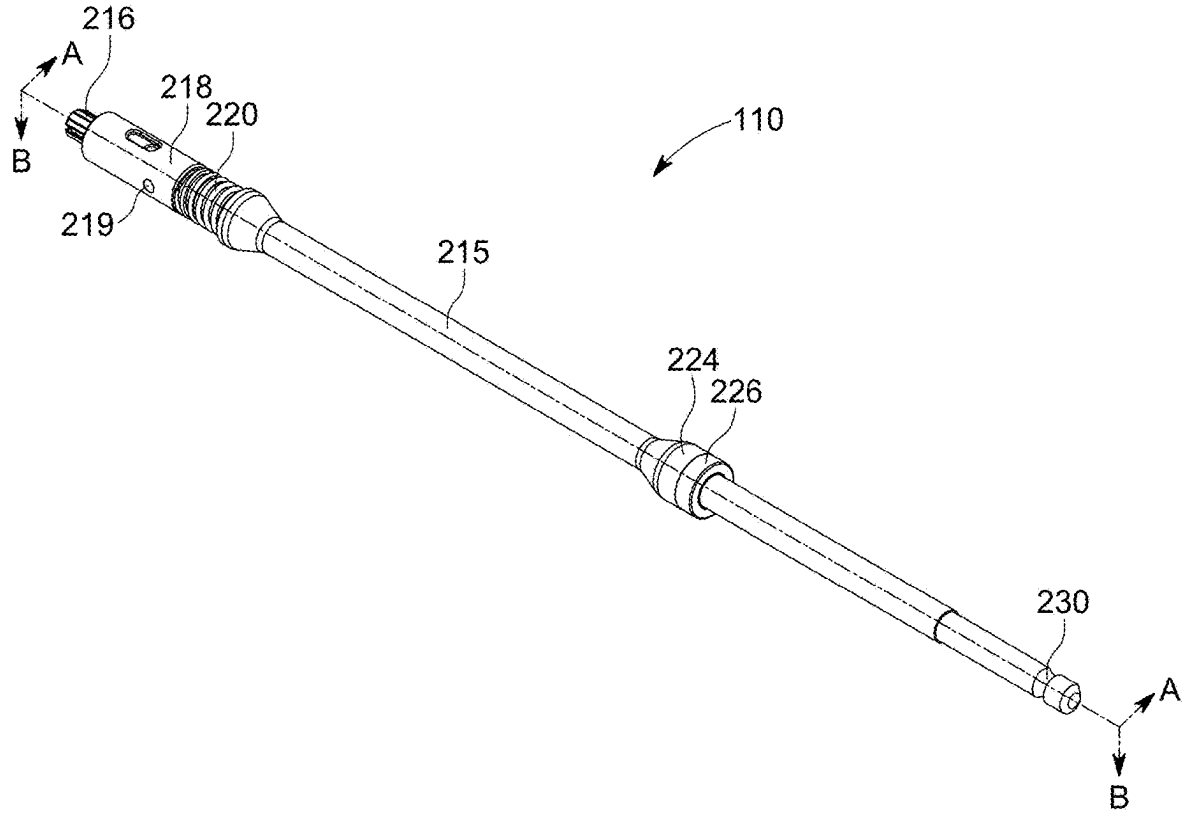


FIG. 21A

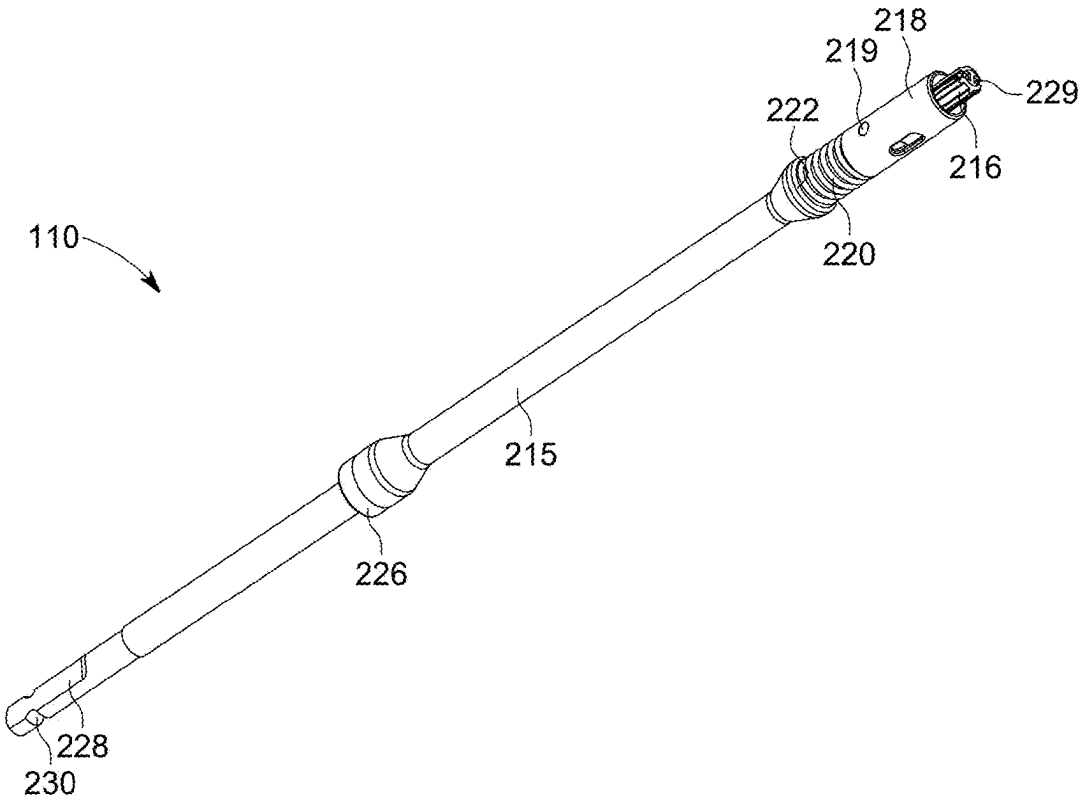


FIG. 21B

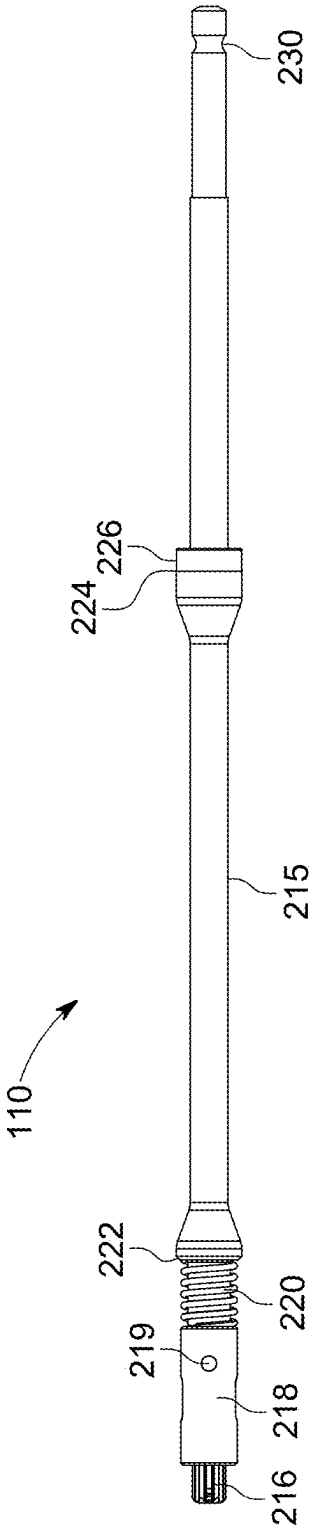


FIG. 21C

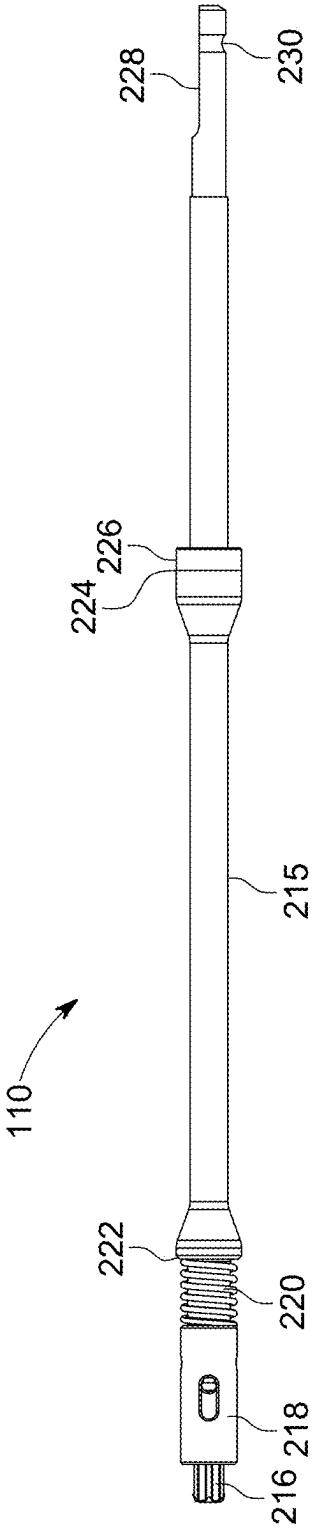


FIG. 21D

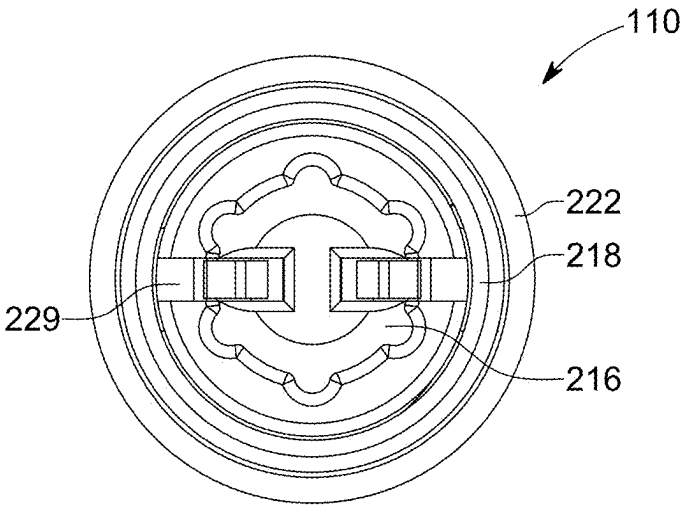


FIG. 21E

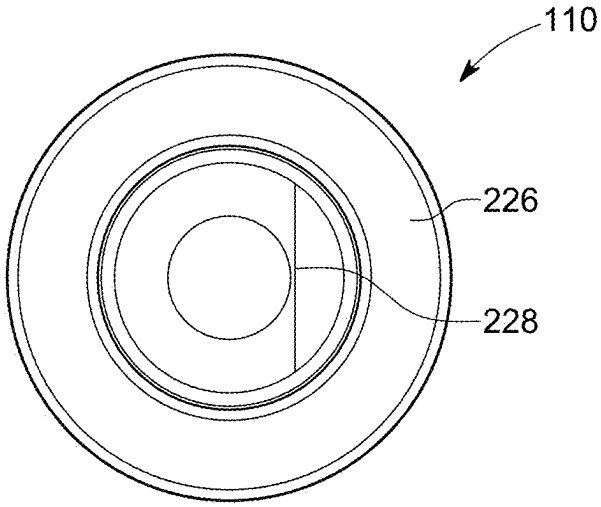


FIG. 21F

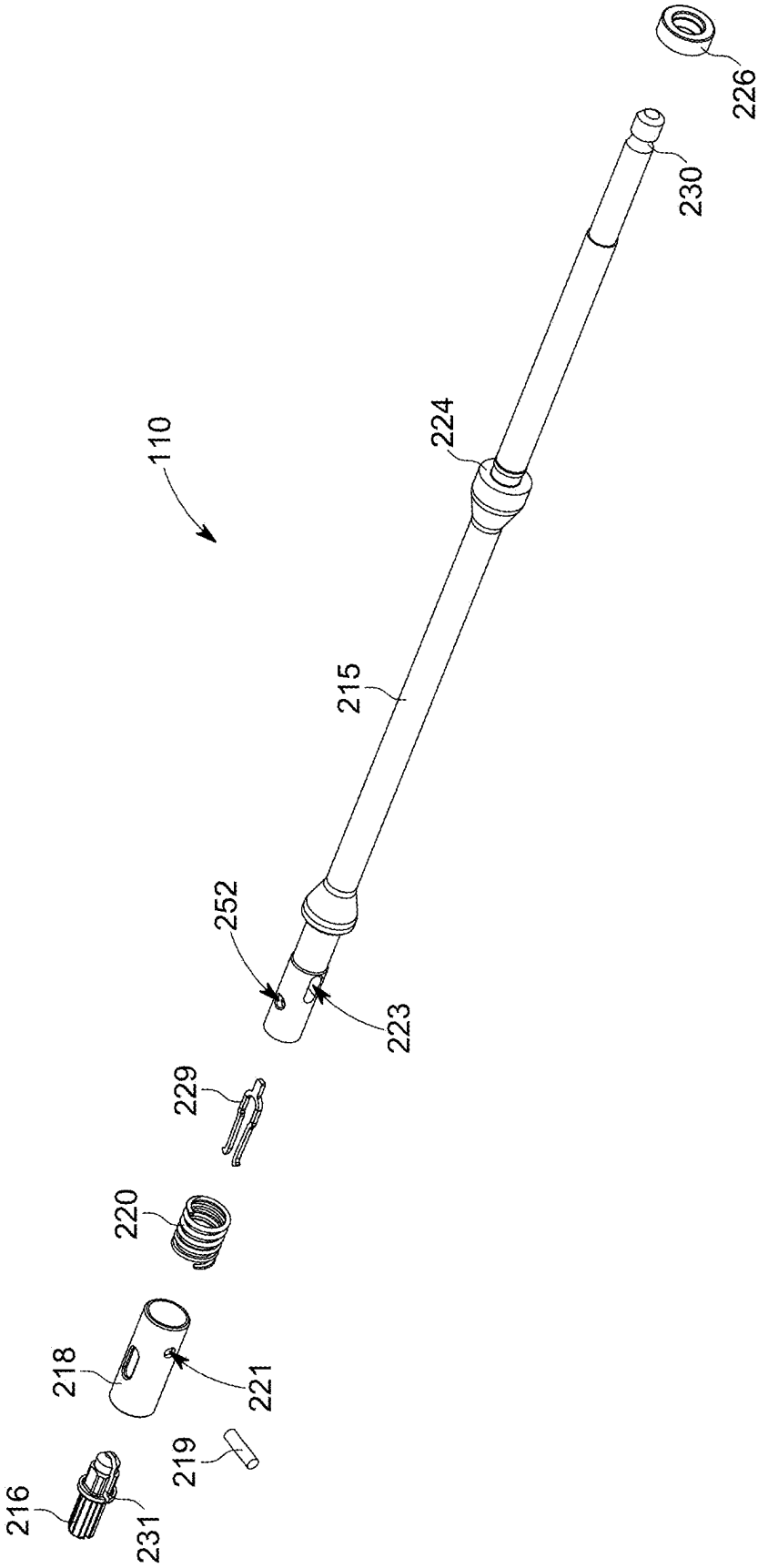


FIG. 22

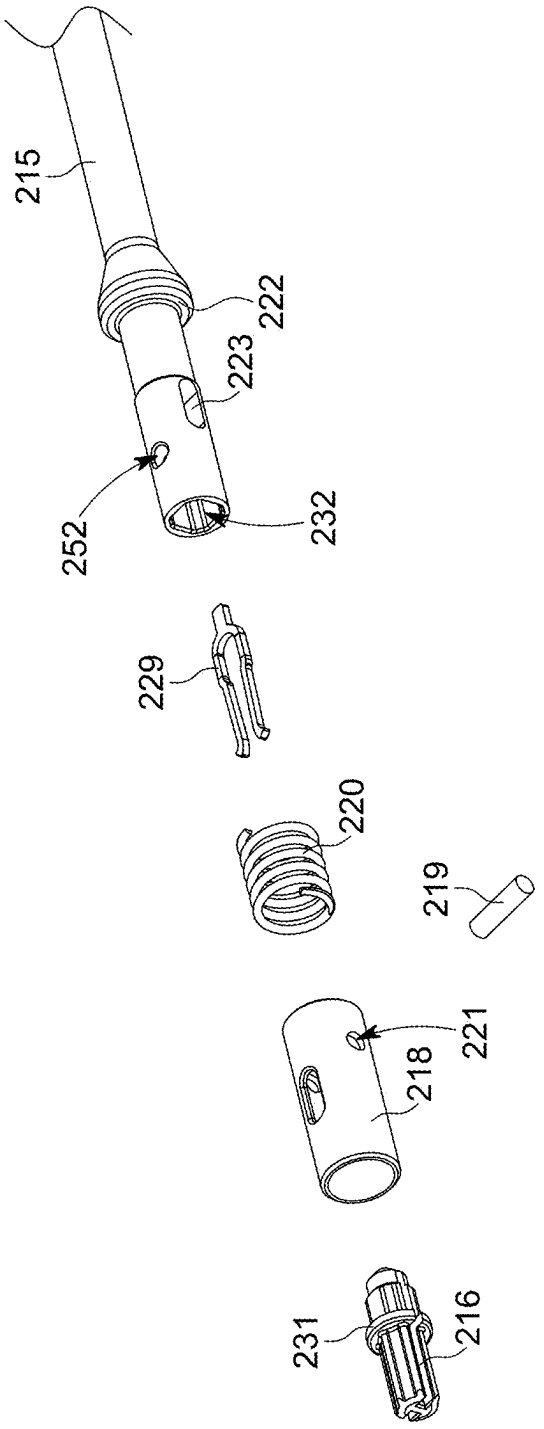


FIG. 23

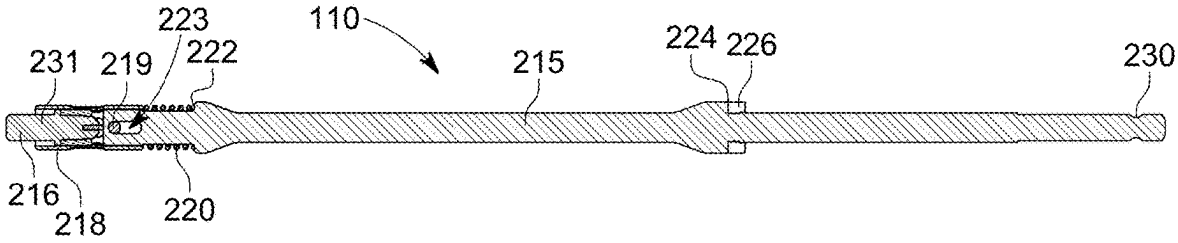


FIG. 24

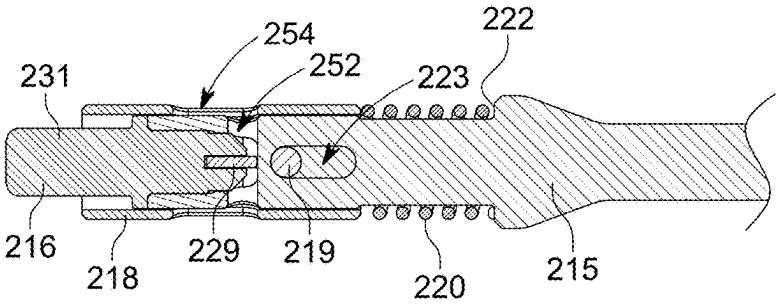


FIG. 25

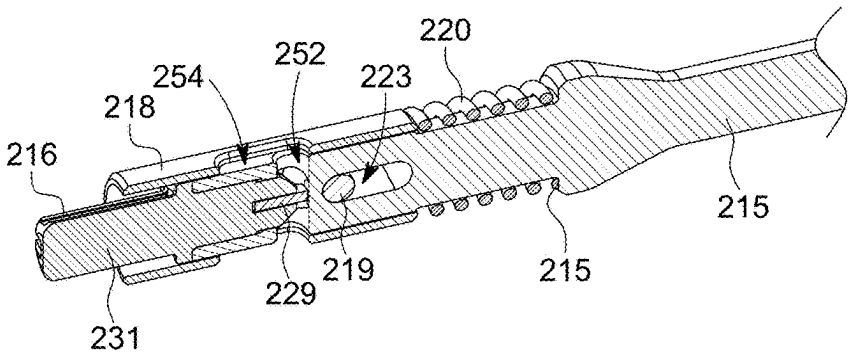


FIG. 26

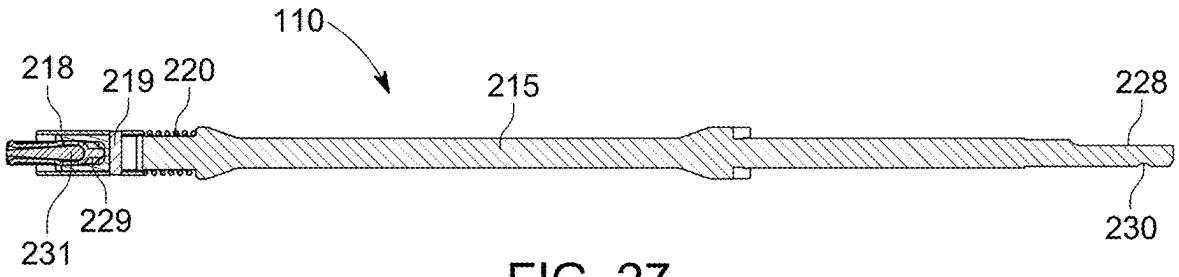


FIG. 27

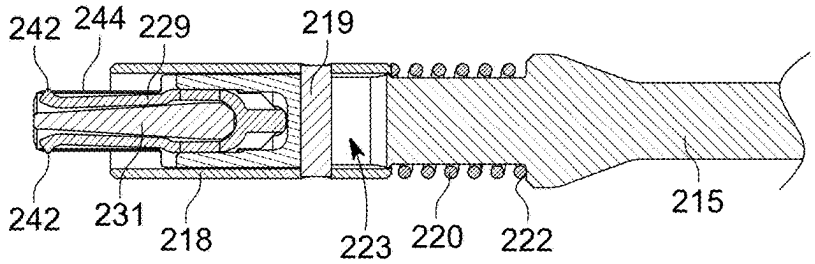


FIG. 28

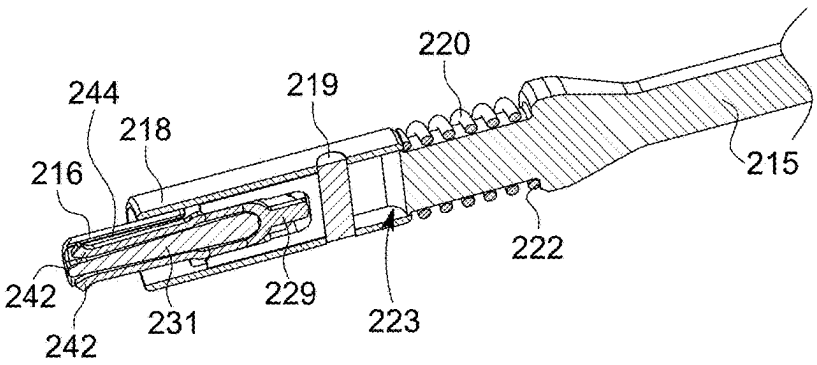


FIG. 29

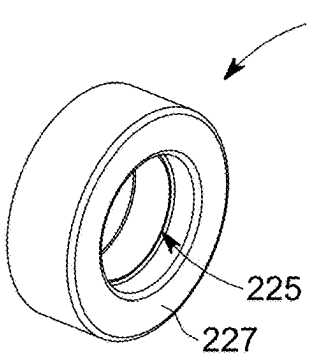


FIG. 30

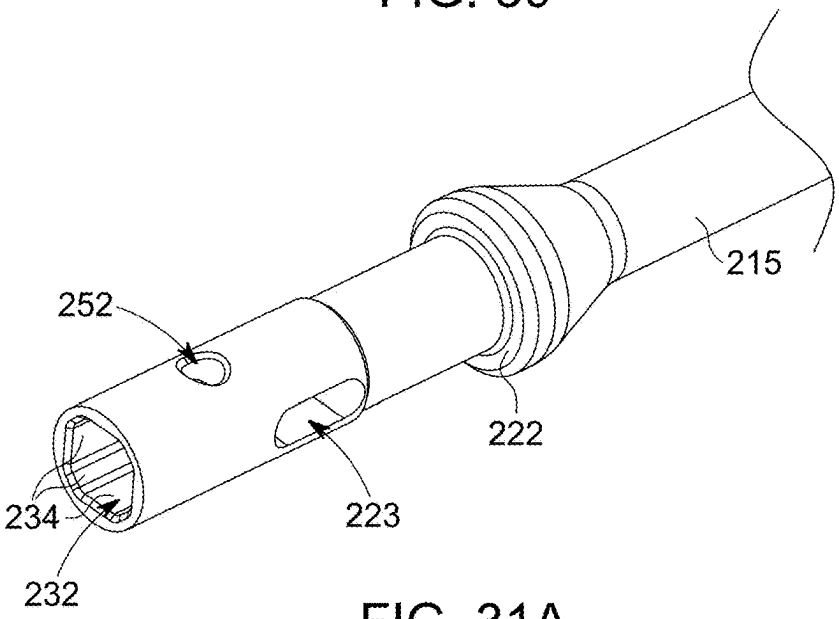


FIG. 31A

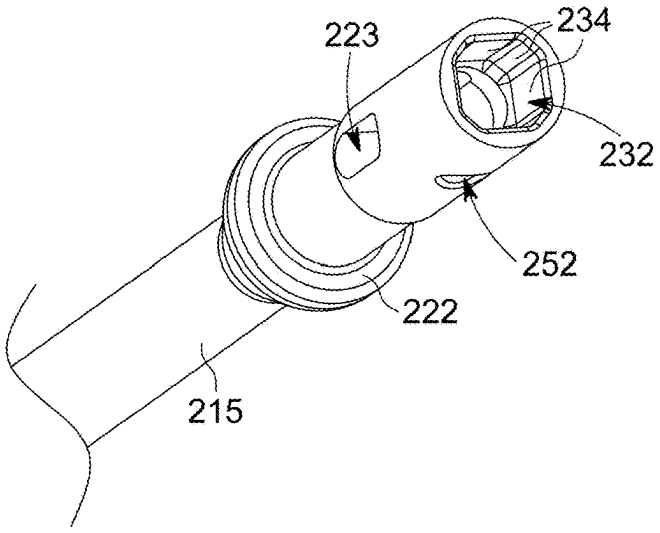


FIG. 31B

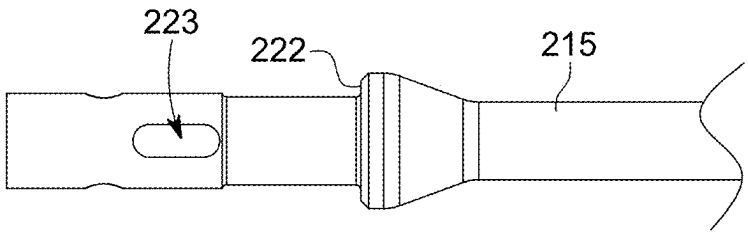


FIG. 31C

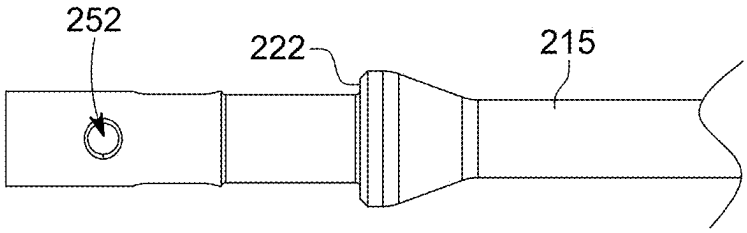


FIG. 31D

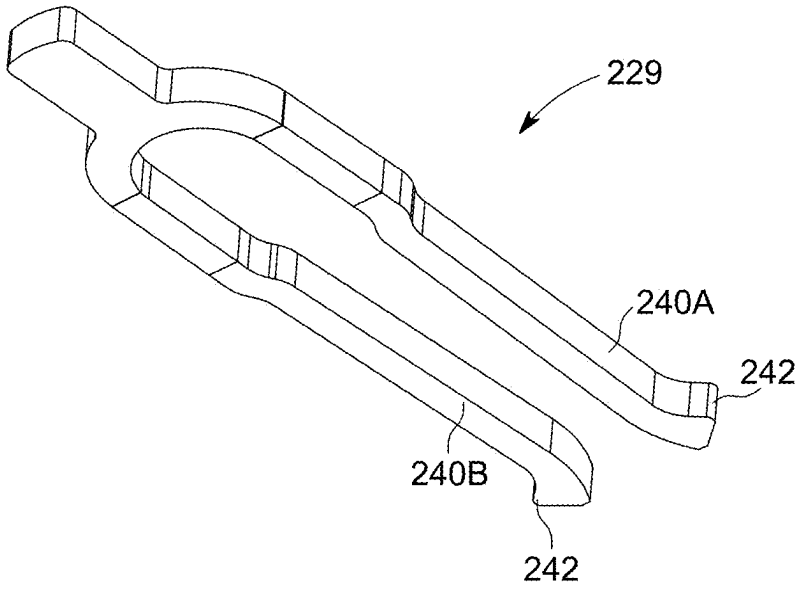


FIG. 32A

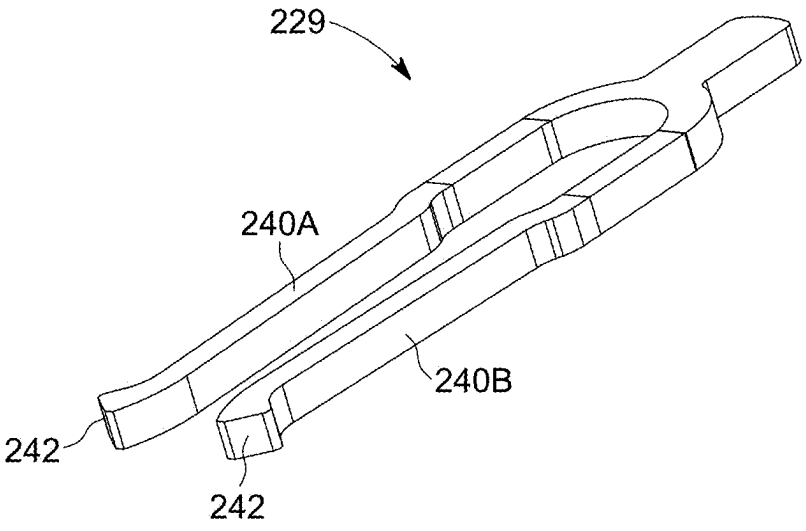


FIG. 32B

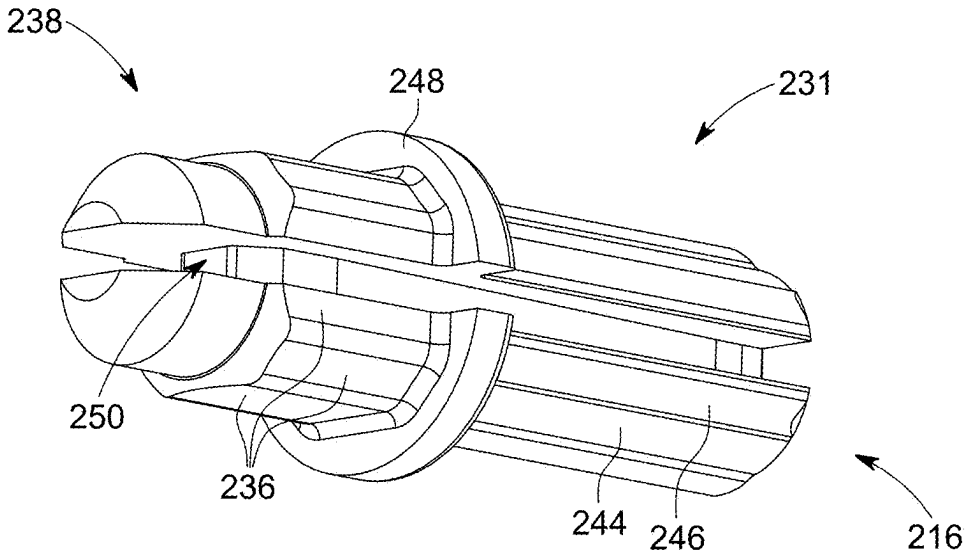


FIG. 33A

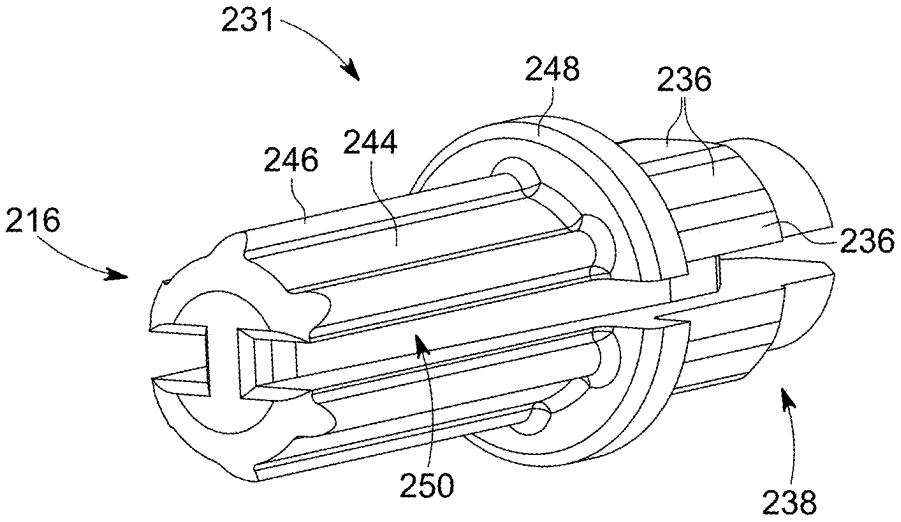


FIG. 33B

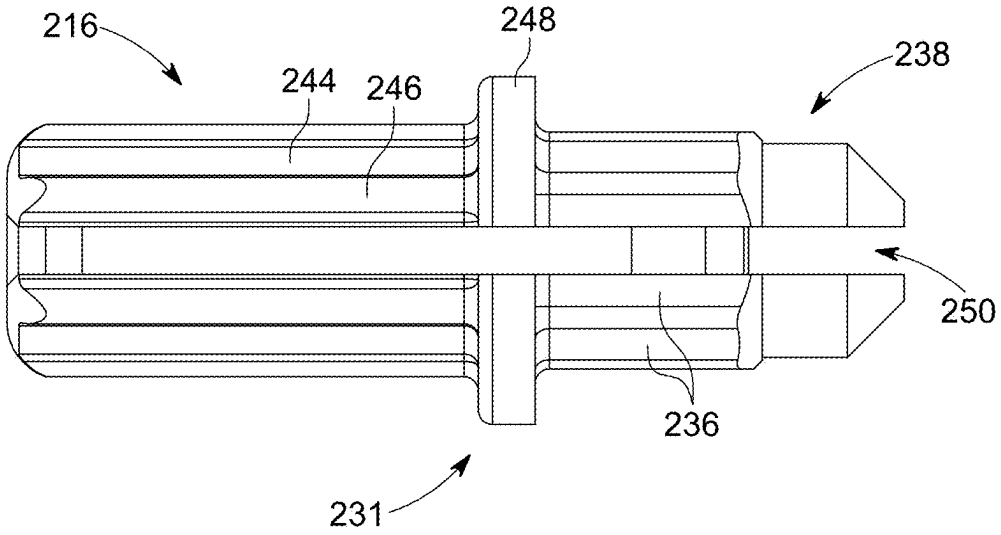


FIG. 33C

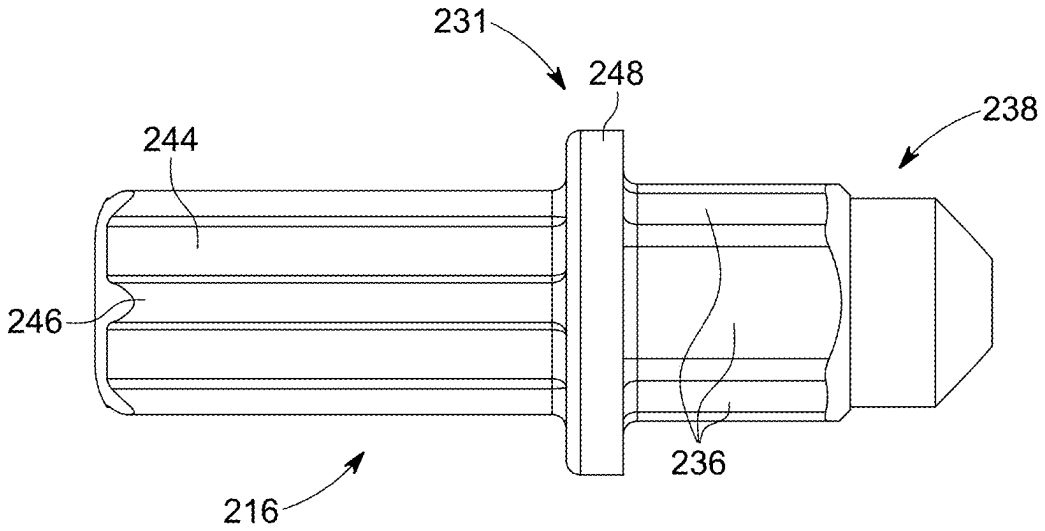


FIG. 33D

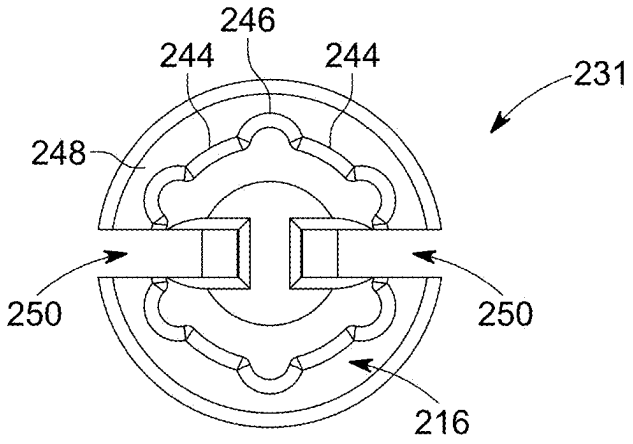


FIG. 33E

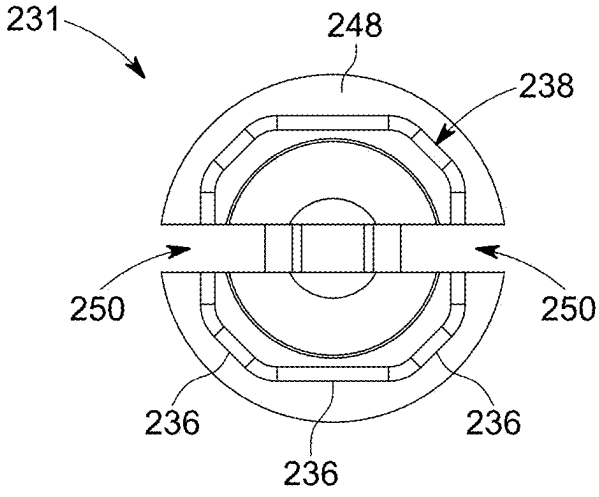


FIG. 33F

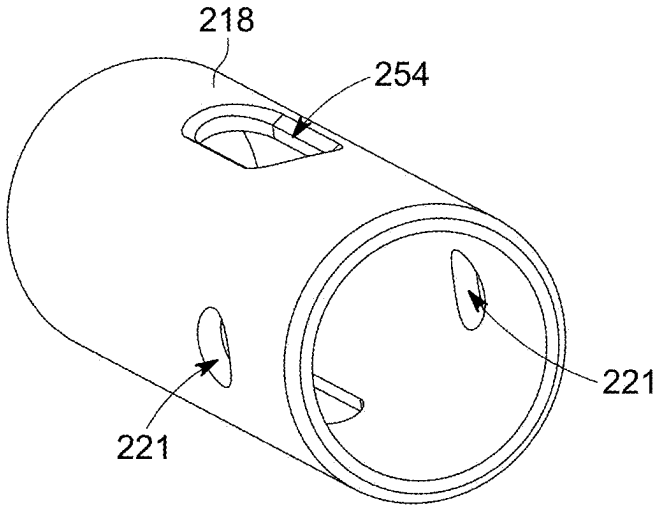


FIG. 34A

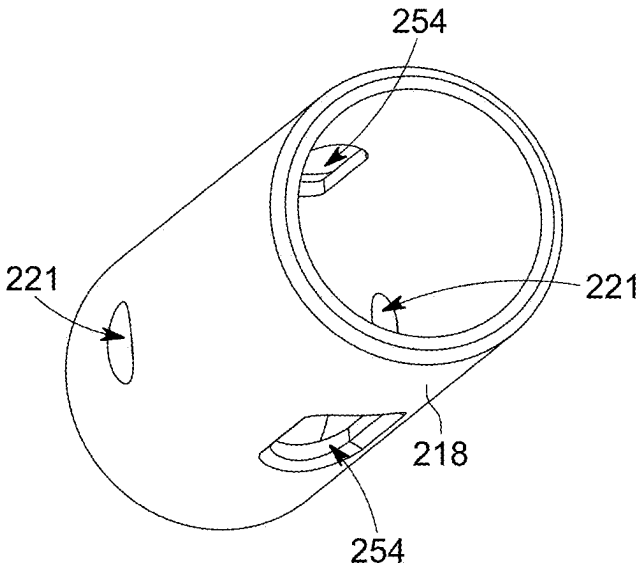


FIG. 34B

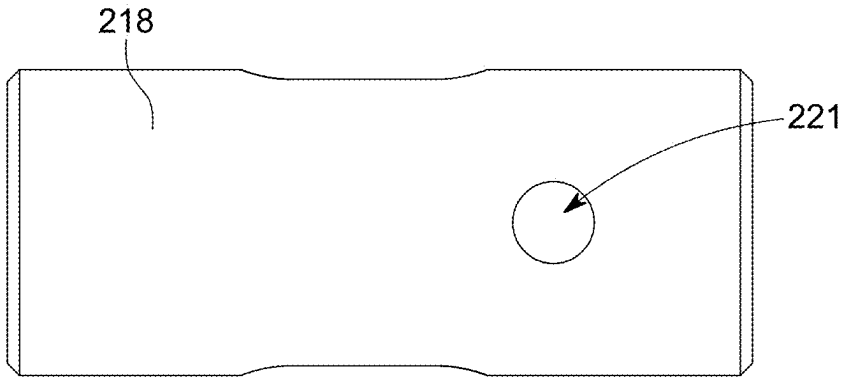


FIG. 34C

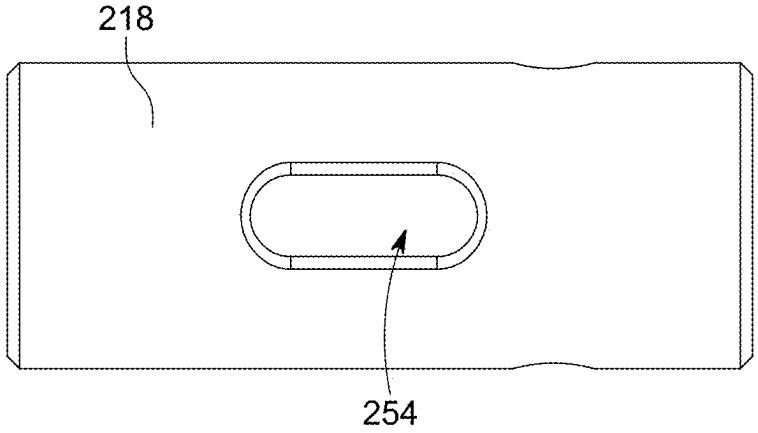


FIG. 34D

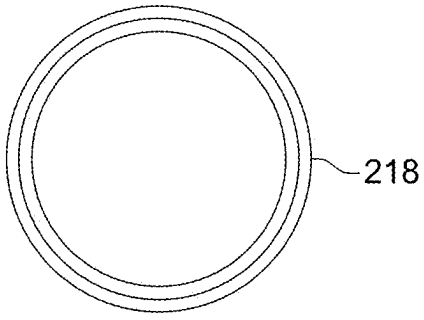


FIG. 34E

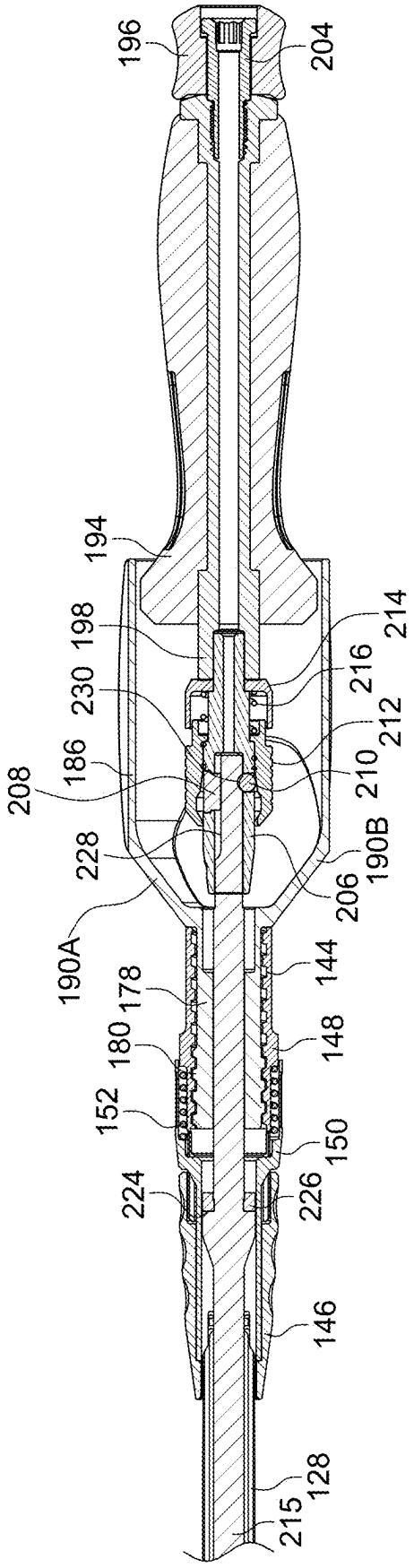

196
204
194
198
214
230
216
212
186
210
208
228
190B
206
190A
144
178
148
180
152
150
224
226
146
128
215

FIG. 35

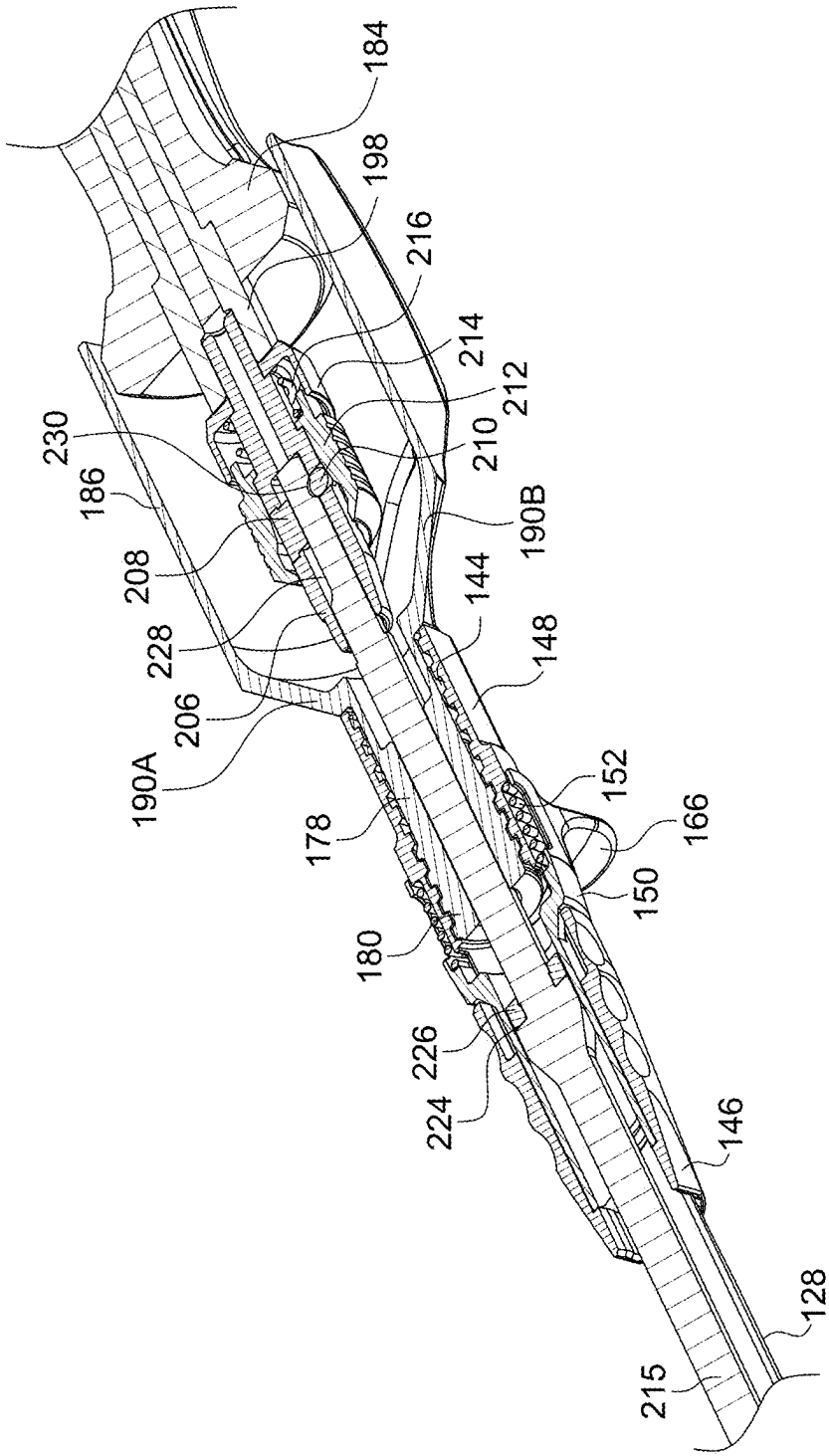

184
198
216
214
212
210
230
186
190B
208
144
228
148
206
152
190A
166
178
150
180
226
224
146
128
215

FIG. 36

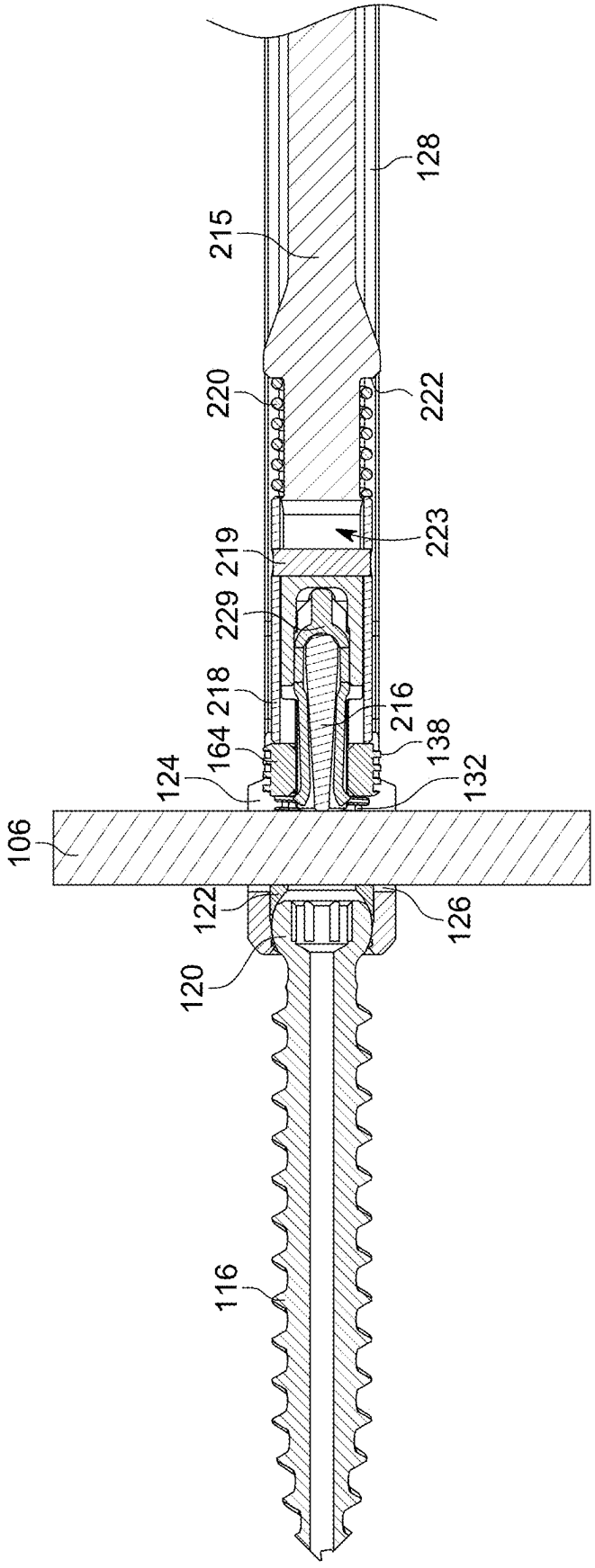

128
215
220
222
223
219
229
218
216
164
138
124
132
106
122
126
120
116

FIG. 37

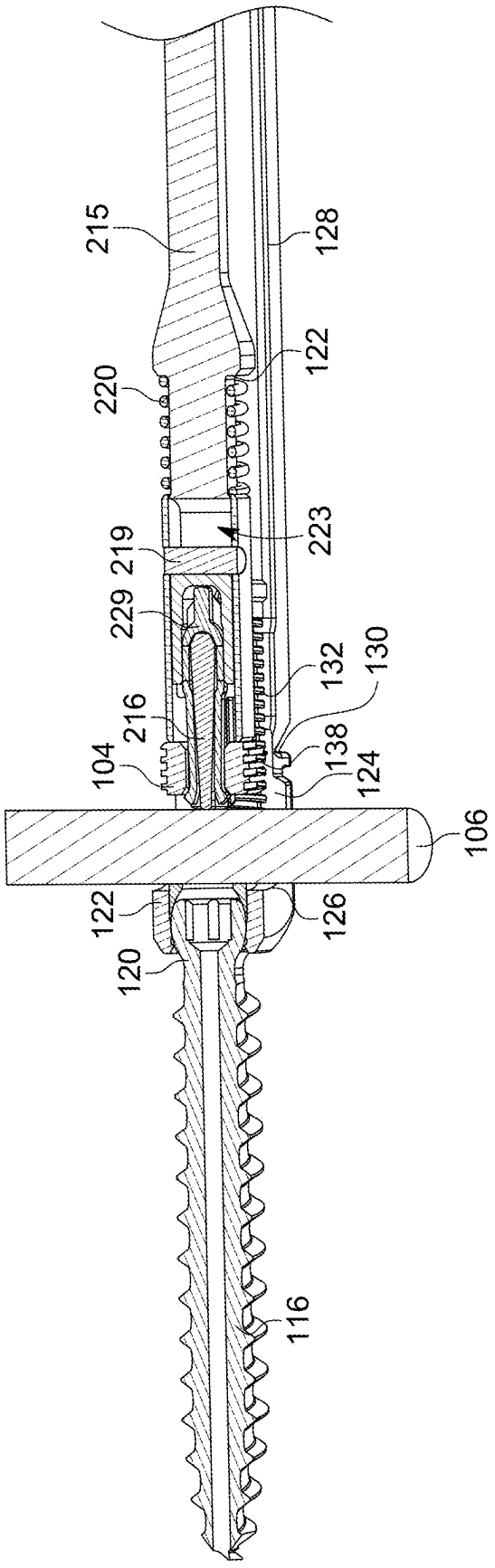

215
128
122
220
223
219
229
132
130
216
104
138
124
106
122
126
120
116

FIG. 38

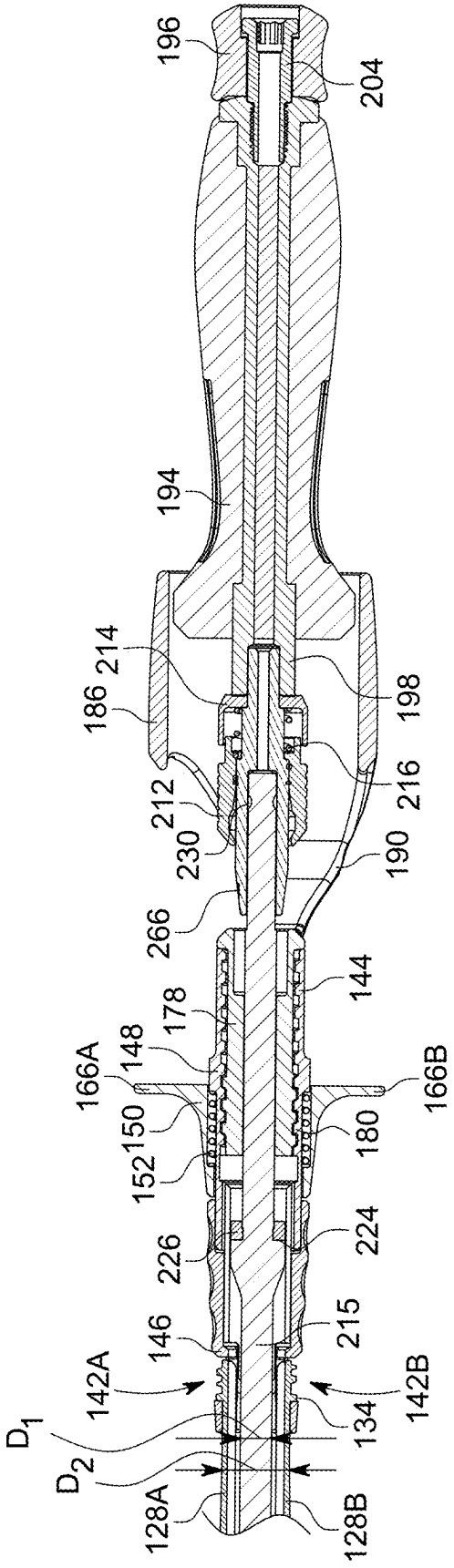

196
204
194
214
186
198
212
216
230
190
266
144
178
148
166A
166B
150
180
152
226
224
146
215
142A
142B
134
D_1
D_2
128A
128B

FIG. 39

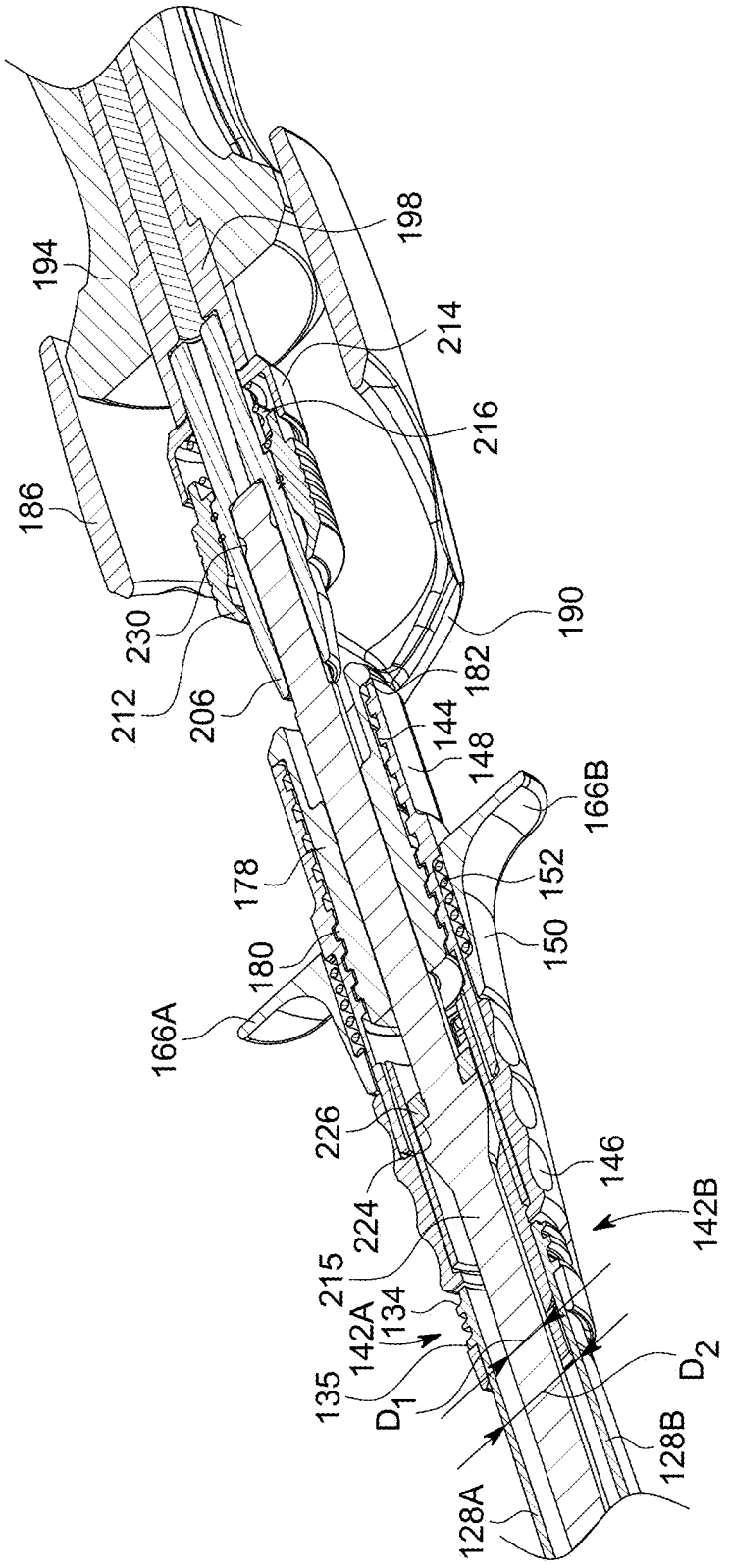

194
198
214
216
186
230
212
206
190
182
144
148
166B
178
152
150
180
166A
226
146
142B
224
215
134
142A
135
D_1
D_2
128B
128A

FIG. 40

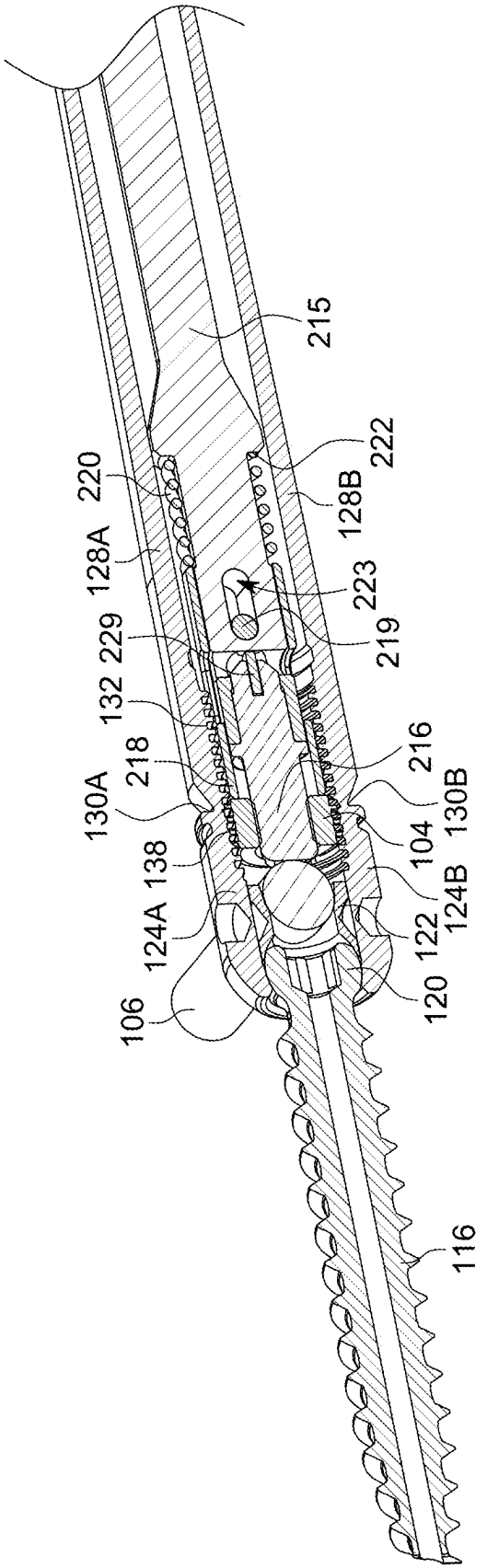

215
222
220
128B
128A
223
229
219
132
216
218
130B
130A
104
138
124B
124A
122
120
106
116

FIG. 41

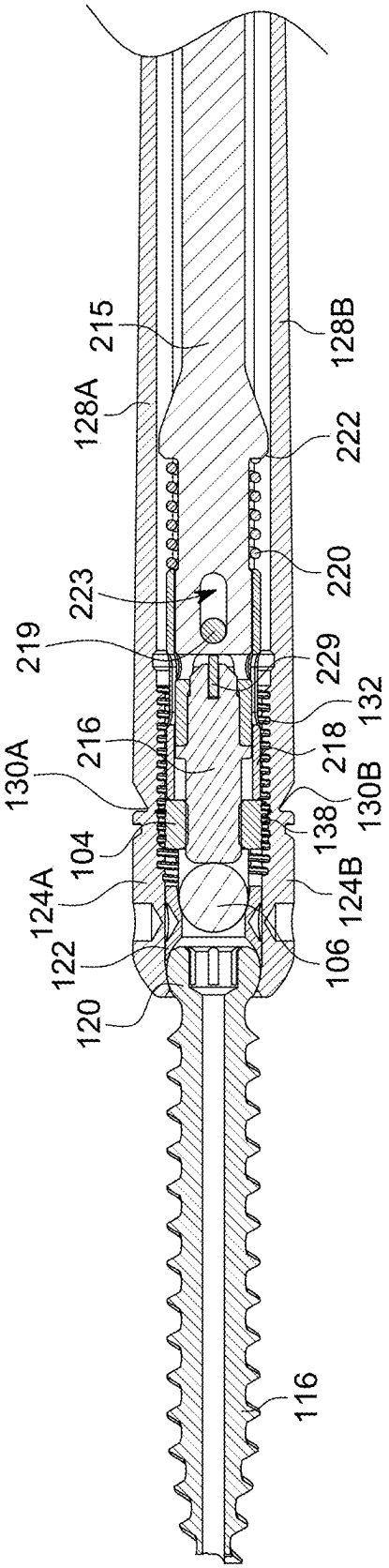

215
128A
128B
222
220
223
219
229
132
216
218
130A
130B
138
104
124A
124B
122
106
120
116

FIG. 42

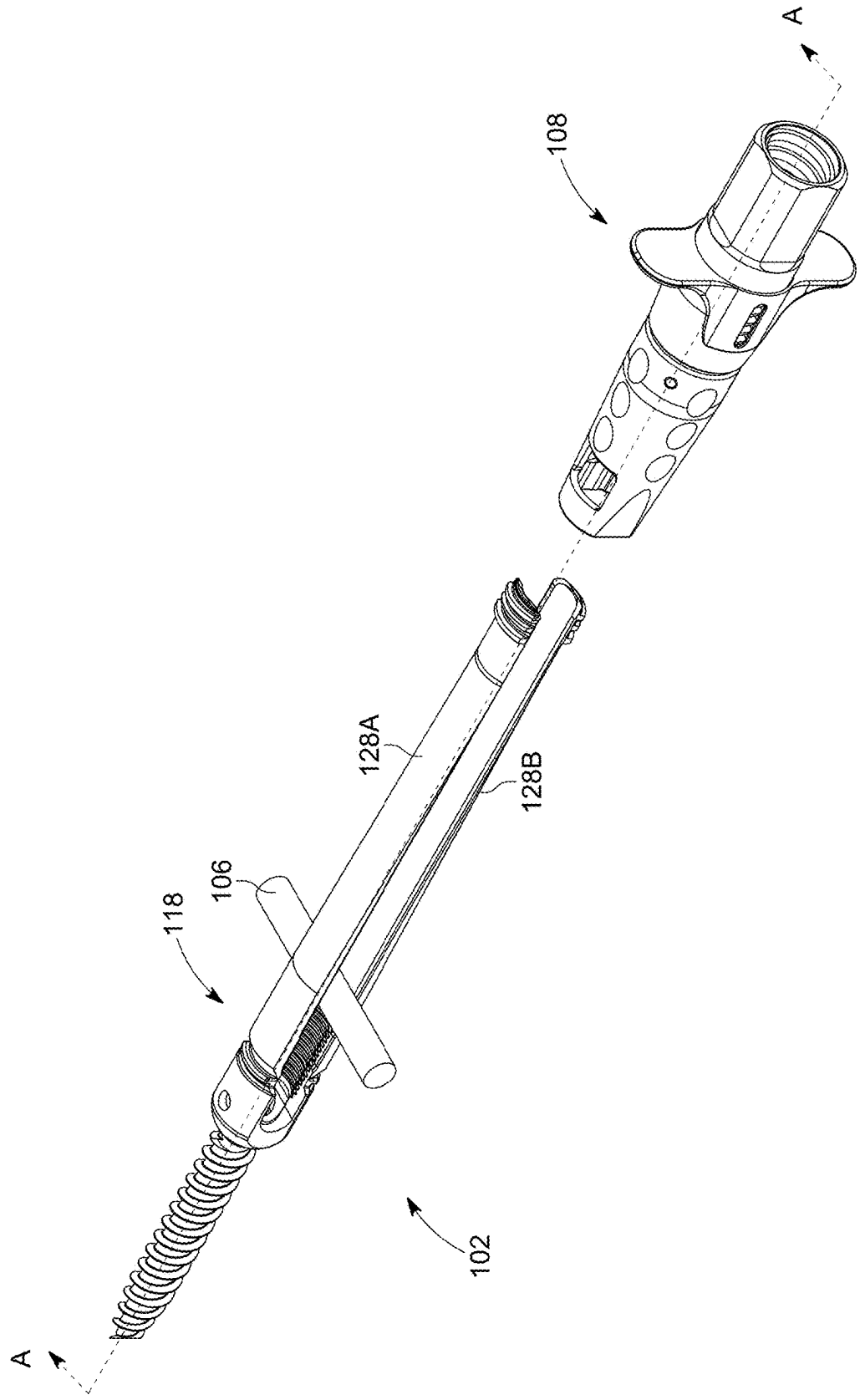


FIG. 43

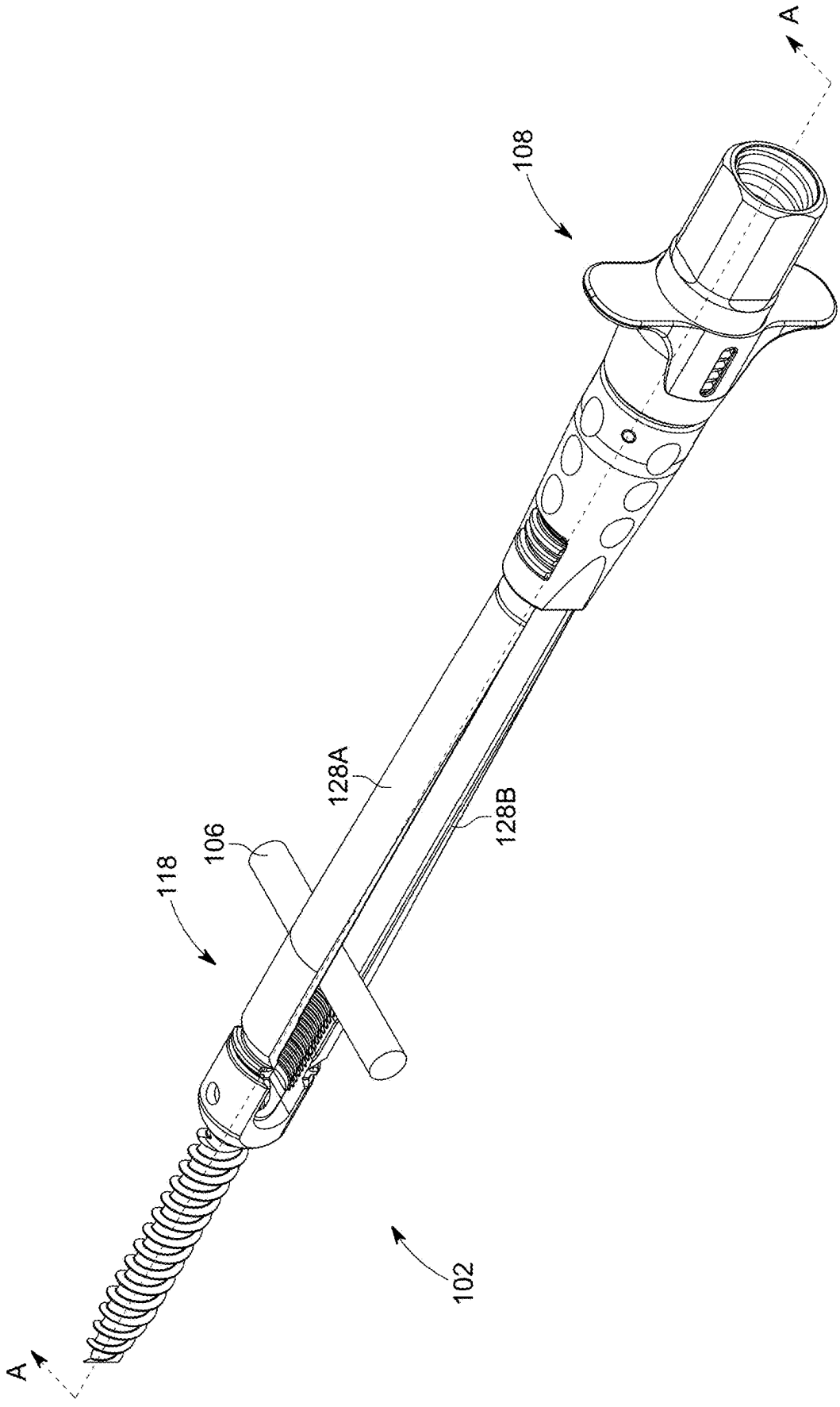


FIG. 44

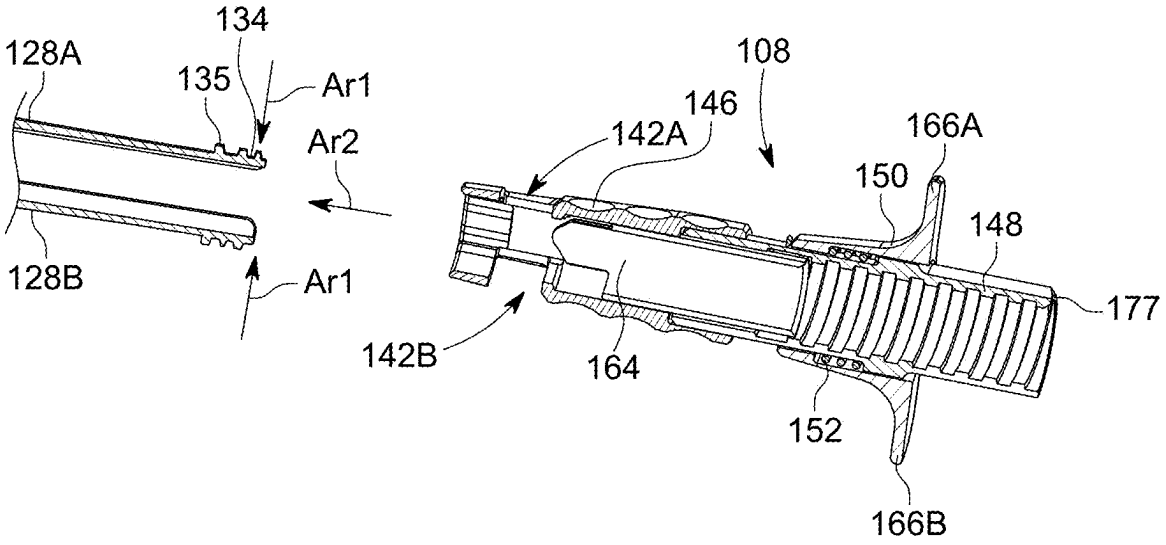

134
128A
135
Ar1
108
146
142A
166A
Ar2
150
148
128B
Ar1
177
142B
164
152
166B

FIG. 45

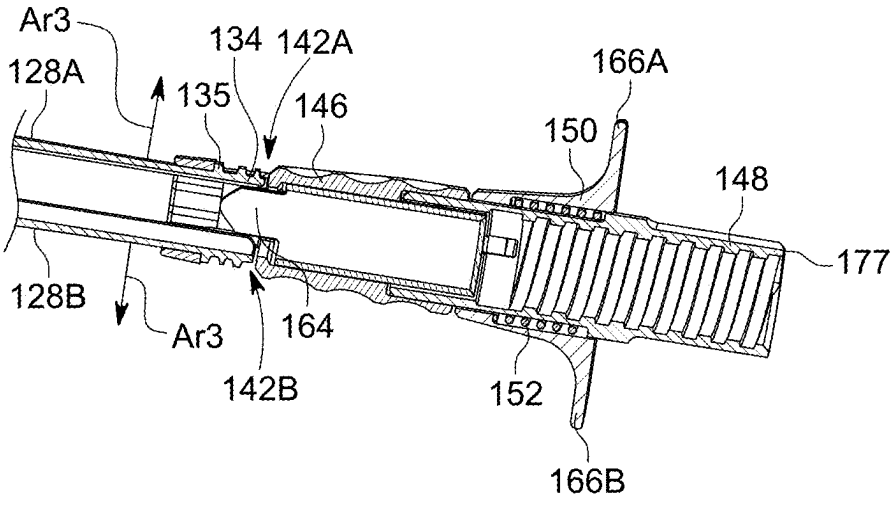

Ar3
134
142A
166A
128A
135
146
150
148
177
128B
Ar3
164
142B
152
166B

FIG. 46

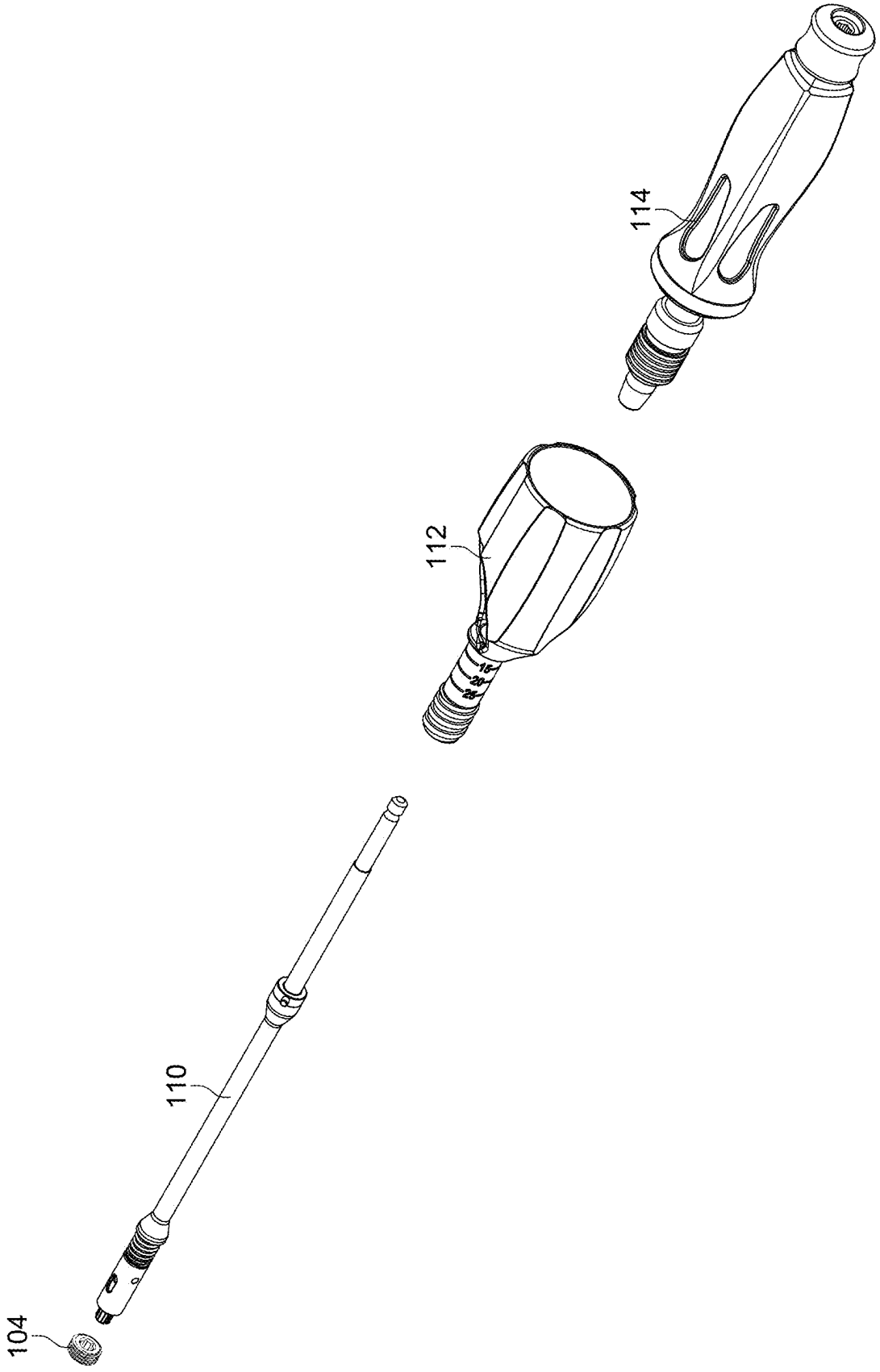


FIG. 47

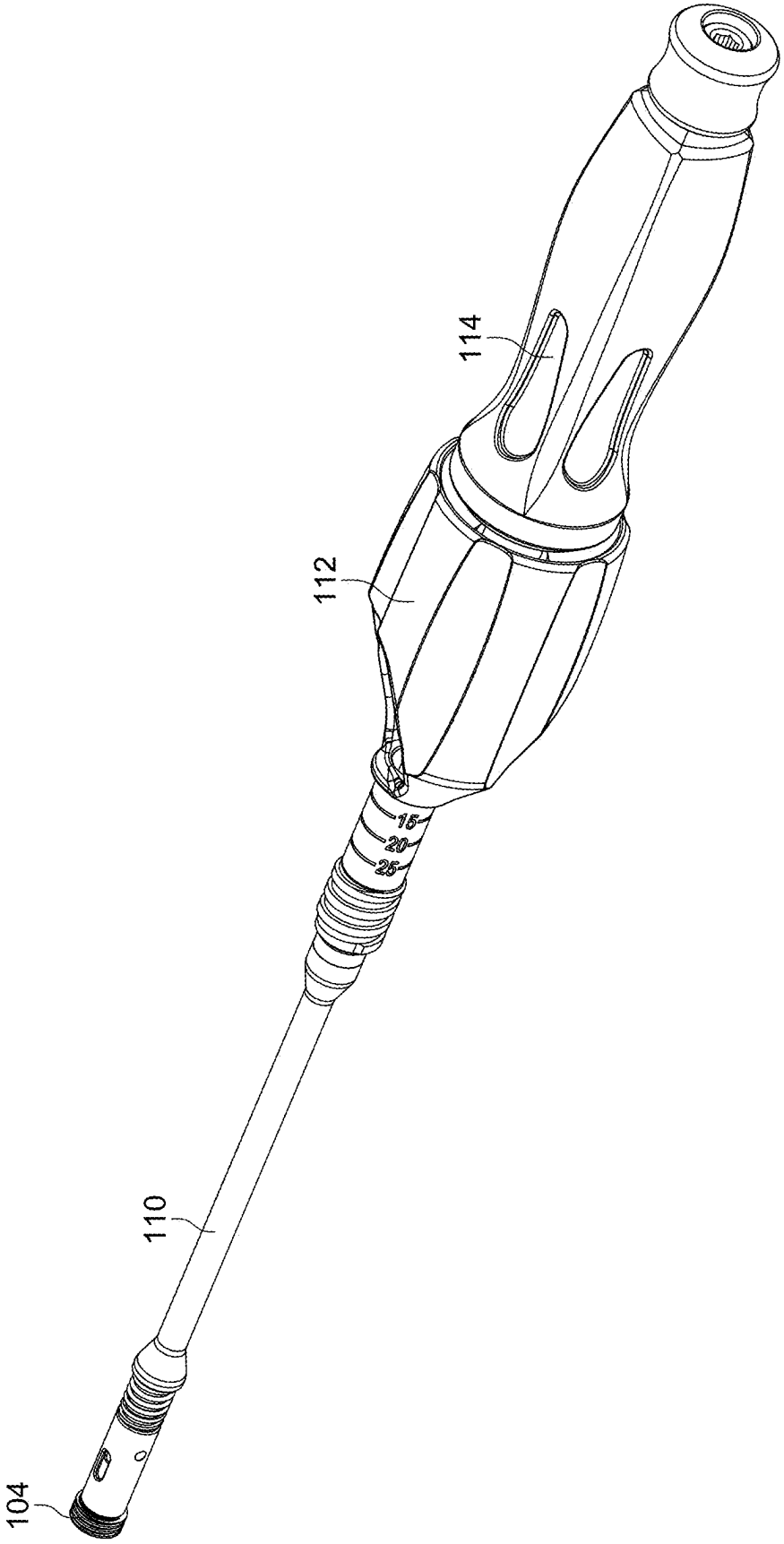


FIG. 48

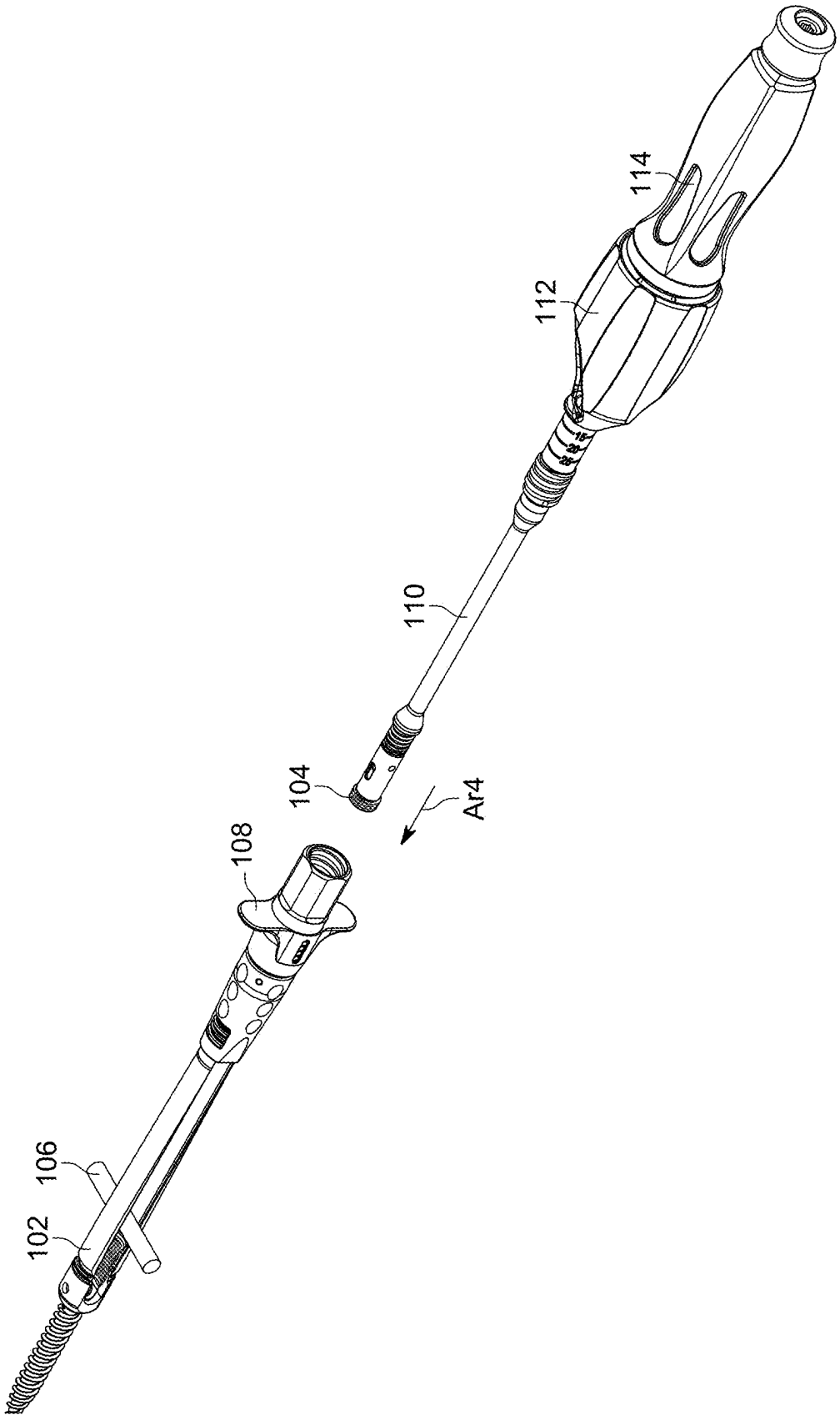


FIG. 49

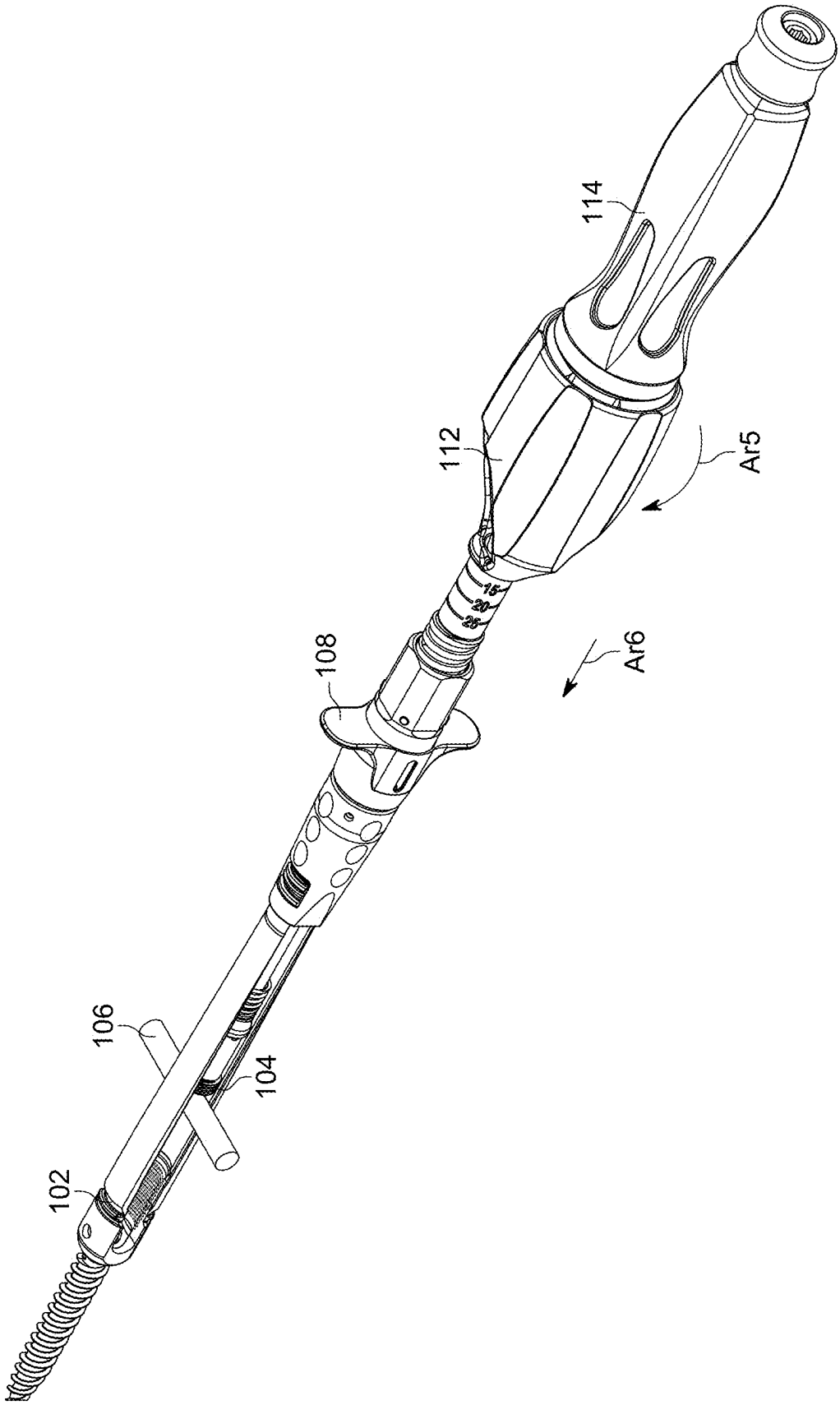


FIG. 50

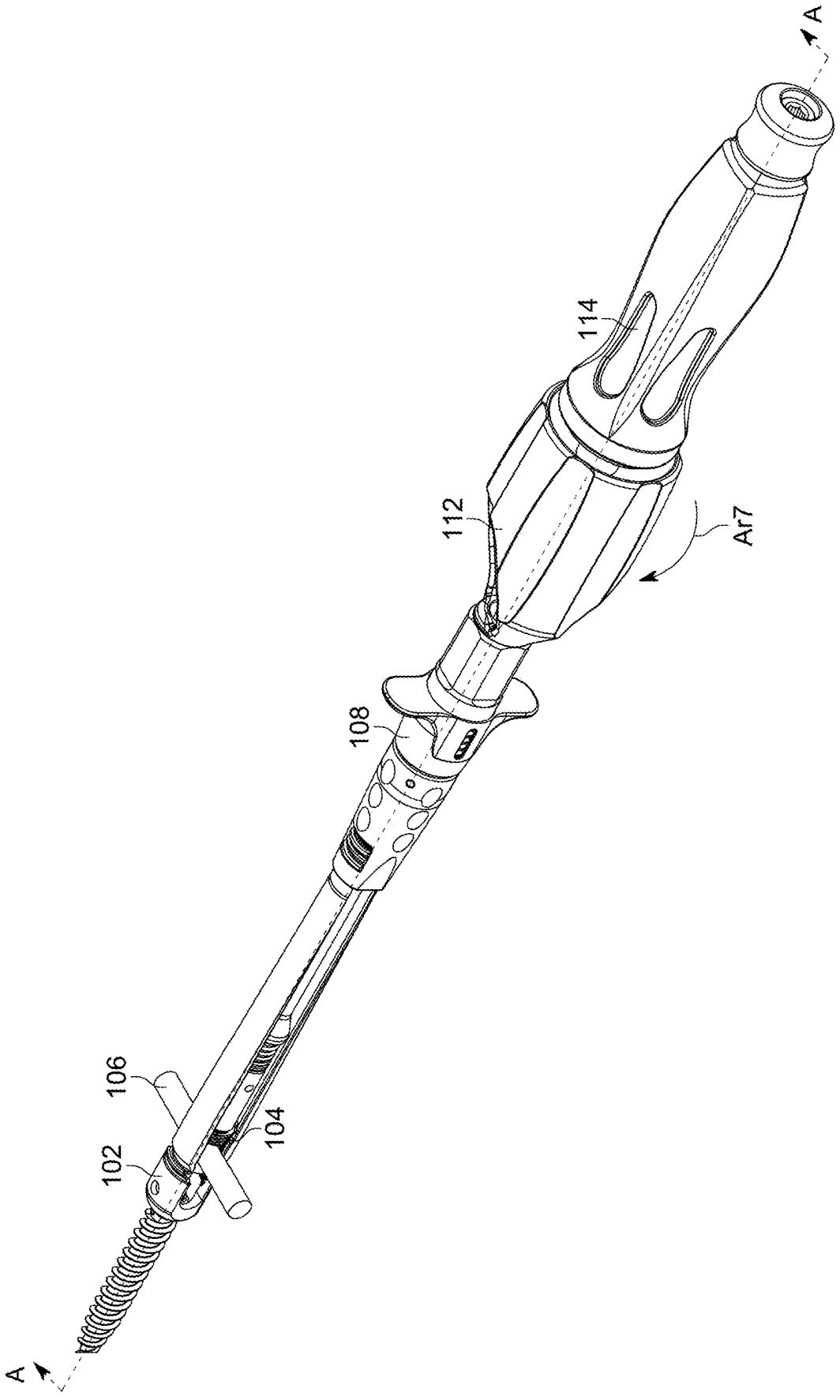


FIG. 51

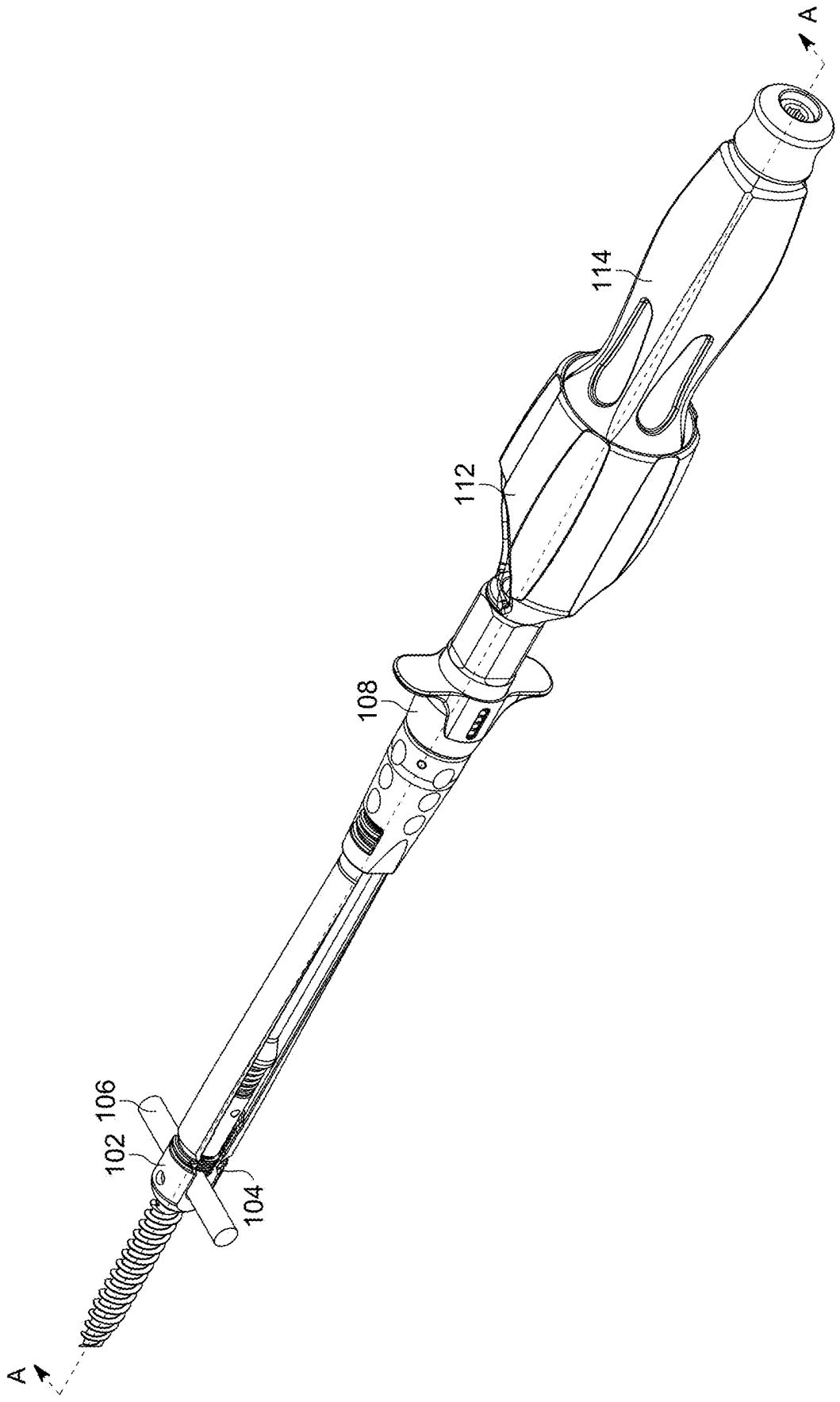


FIG. 52

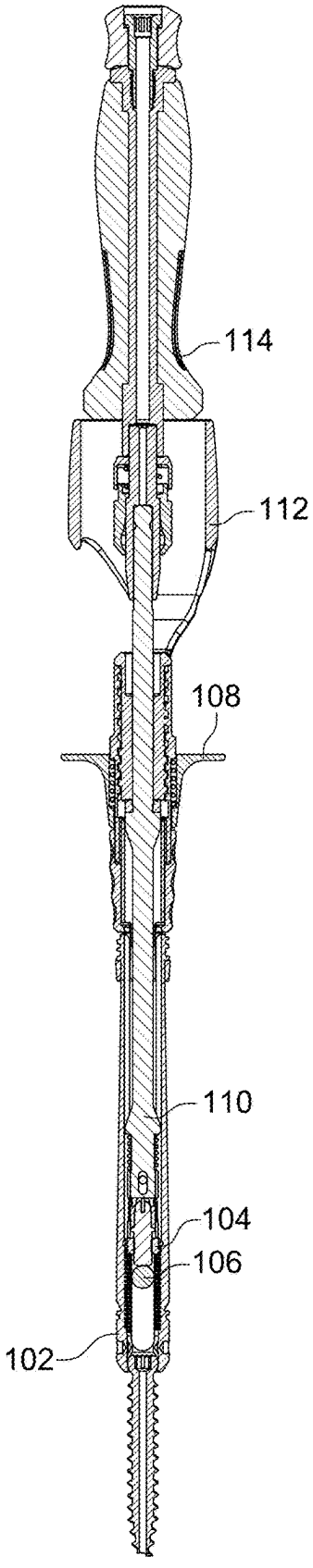


FIG. 53

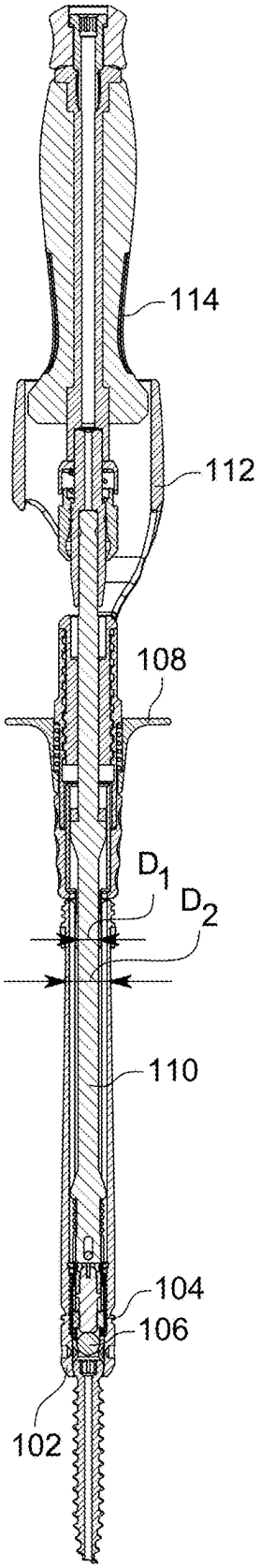


FIG. 54

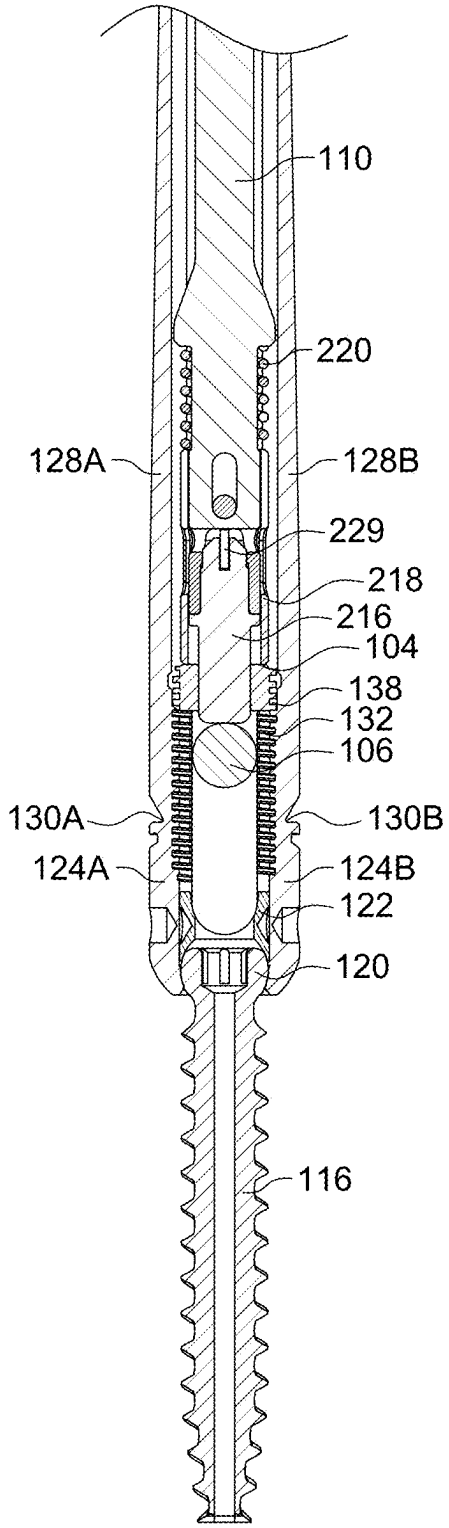

110
220
128A
128B
229
218
216
104
138
132
106
130A
130B
124A
124B
122
120
116

FIG. 55

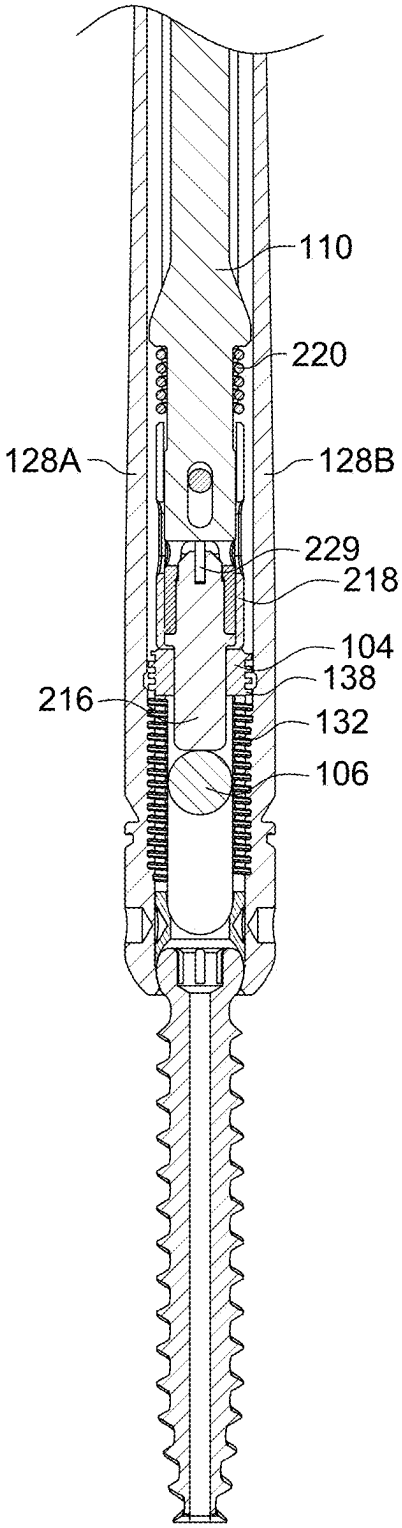

110
220
128A
128B
229
218
104
138
216
132
106

FIG. 56

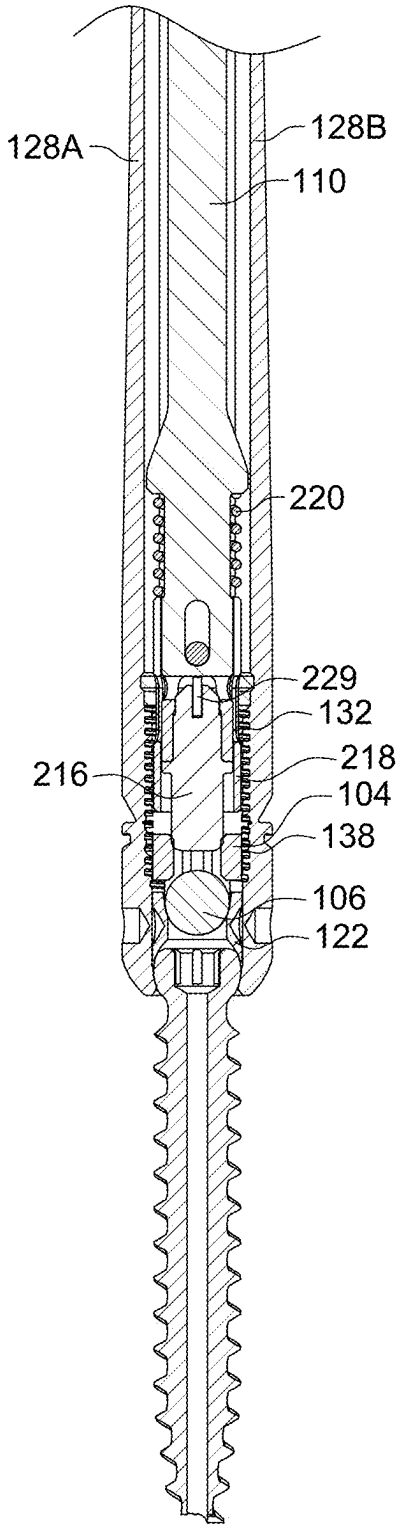


FIG. 57

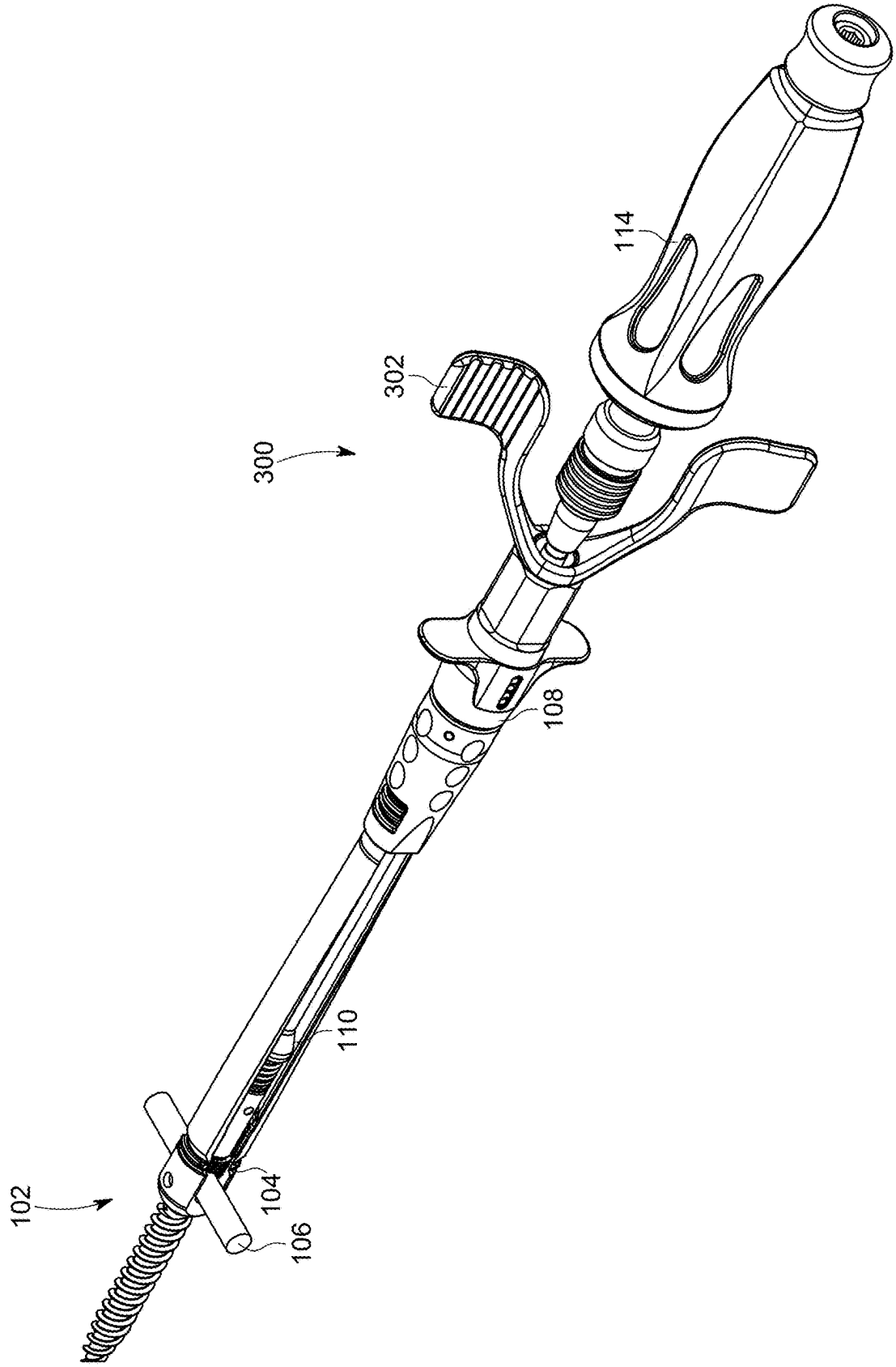


FIG. 58A

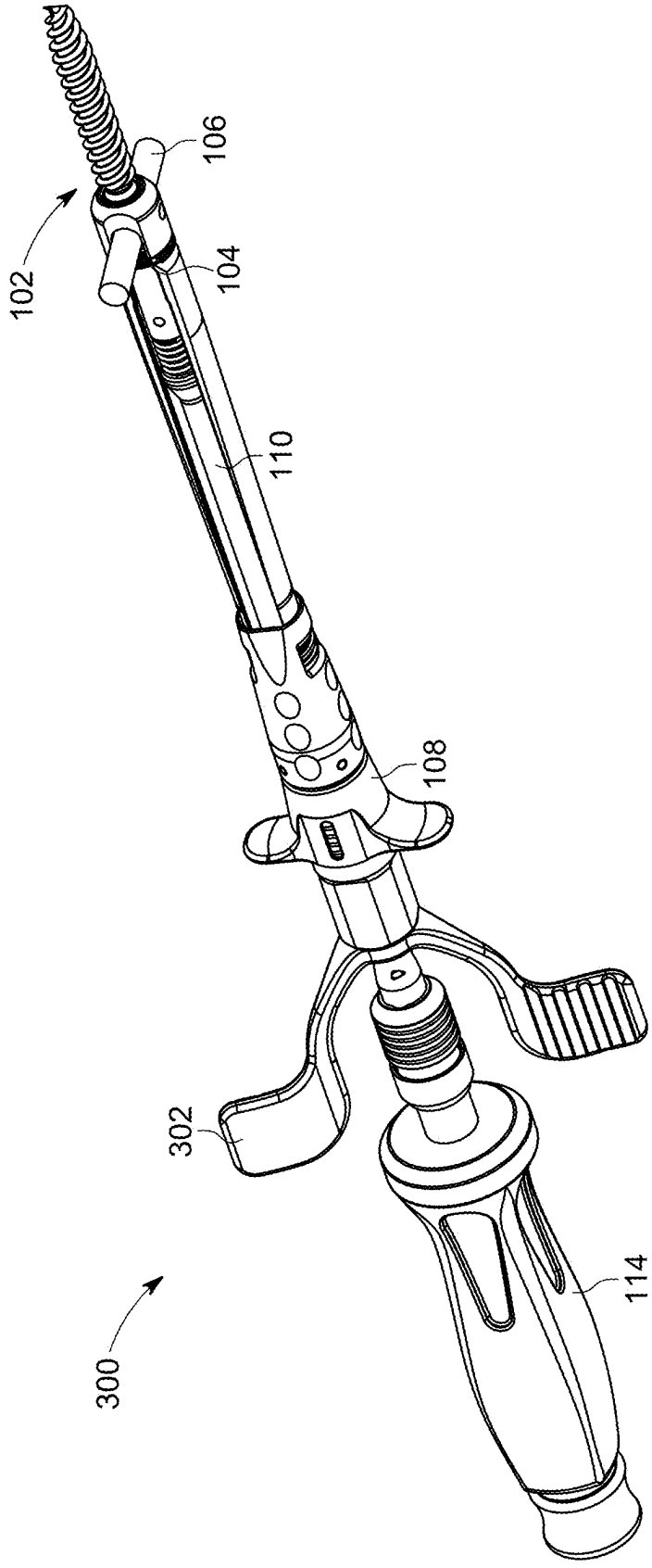


FIG. 58B

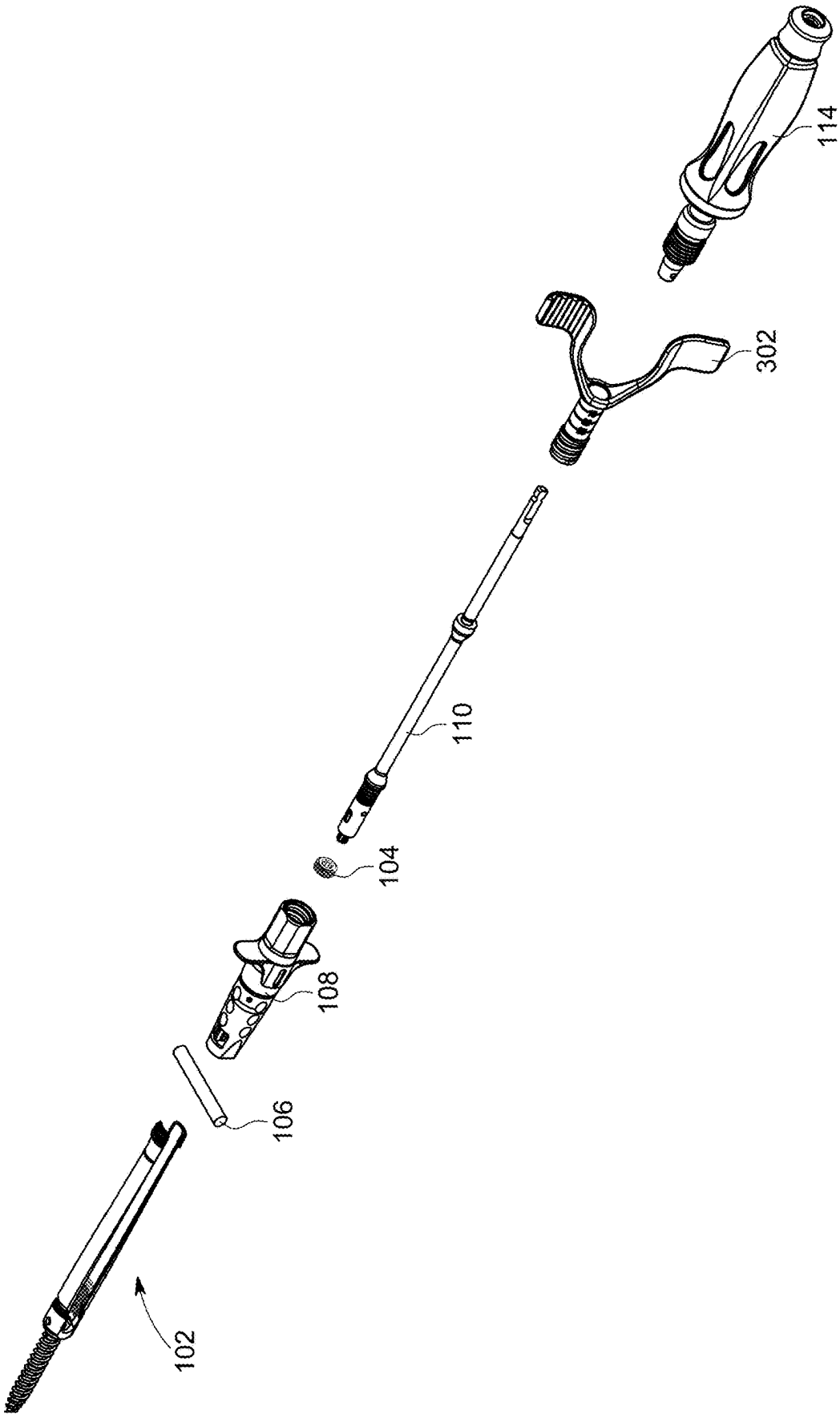


FIG. 59

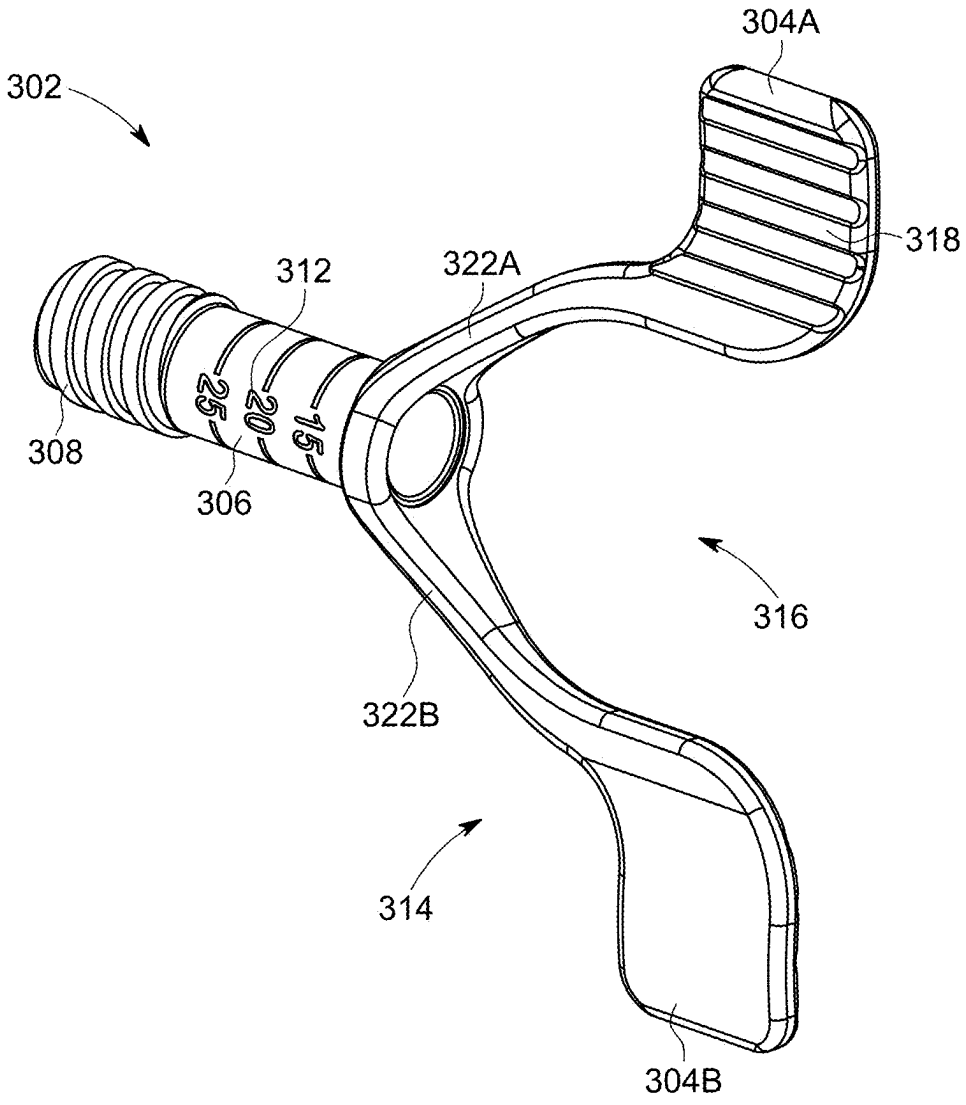


FIG. 60A

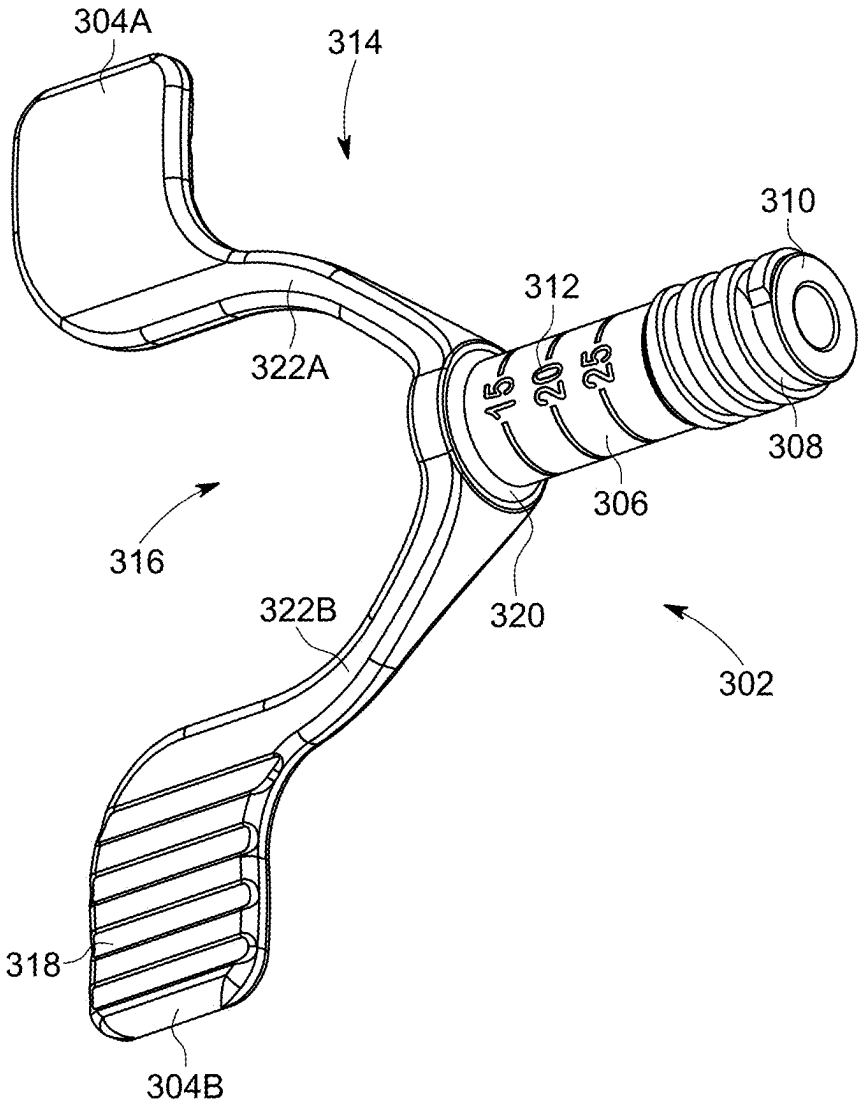


FIG. 60B

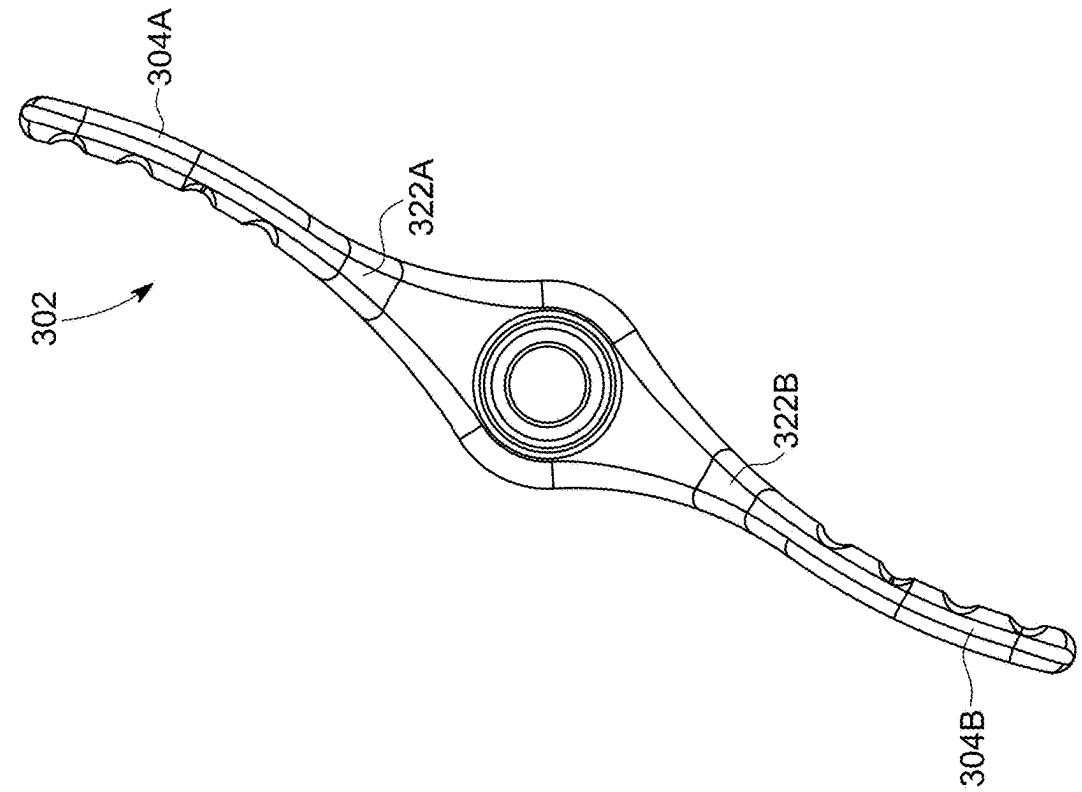


FIG. 60D

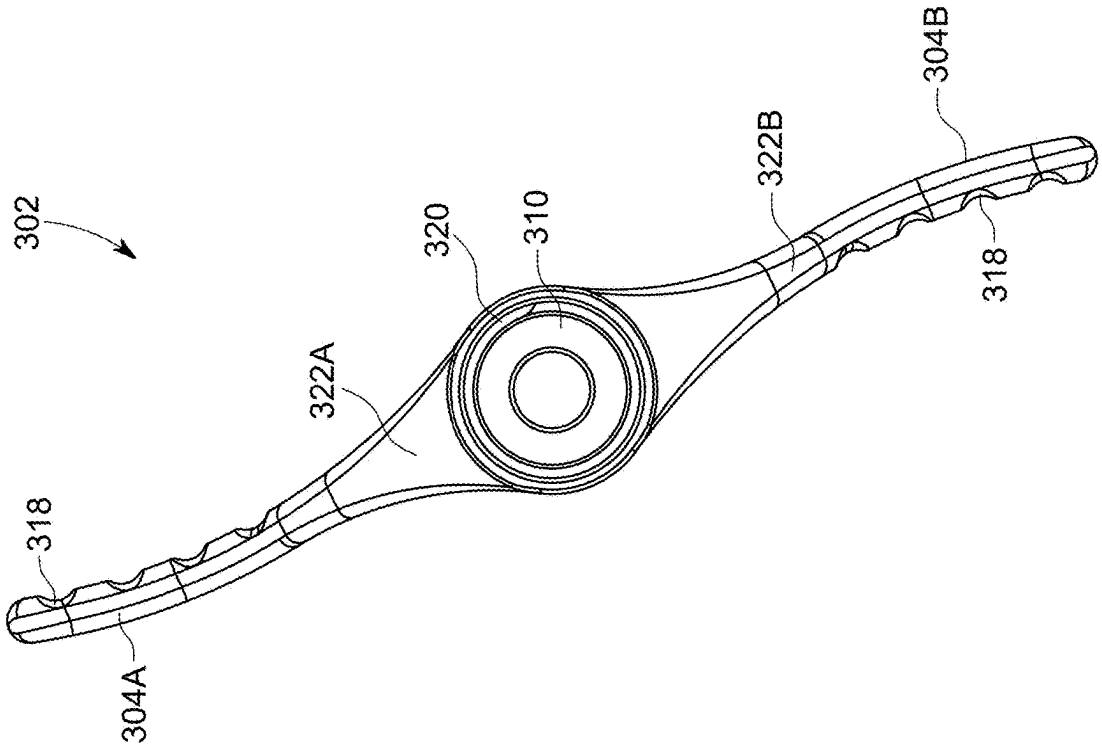


FIG. 60C

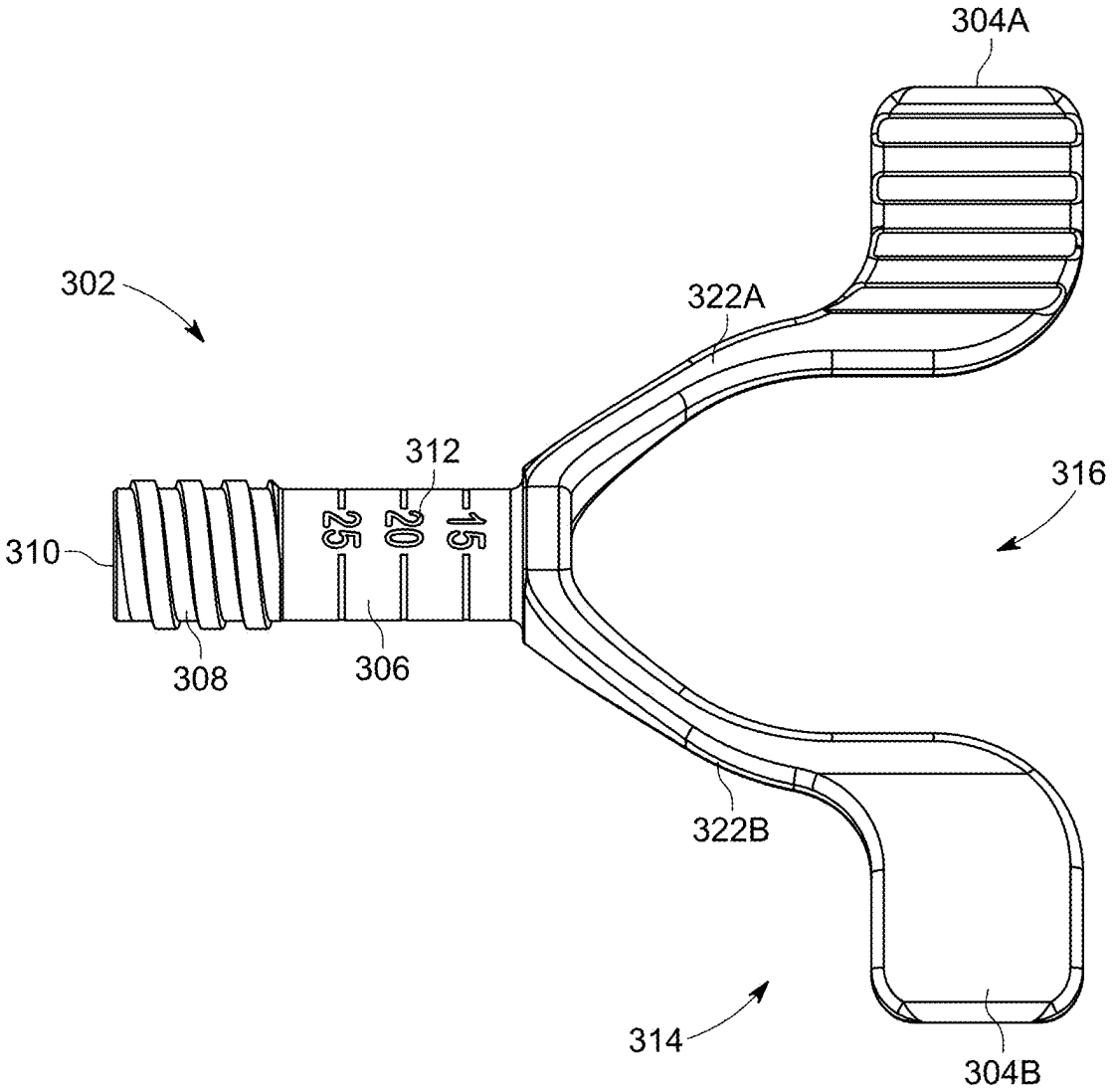


FIG. 60E

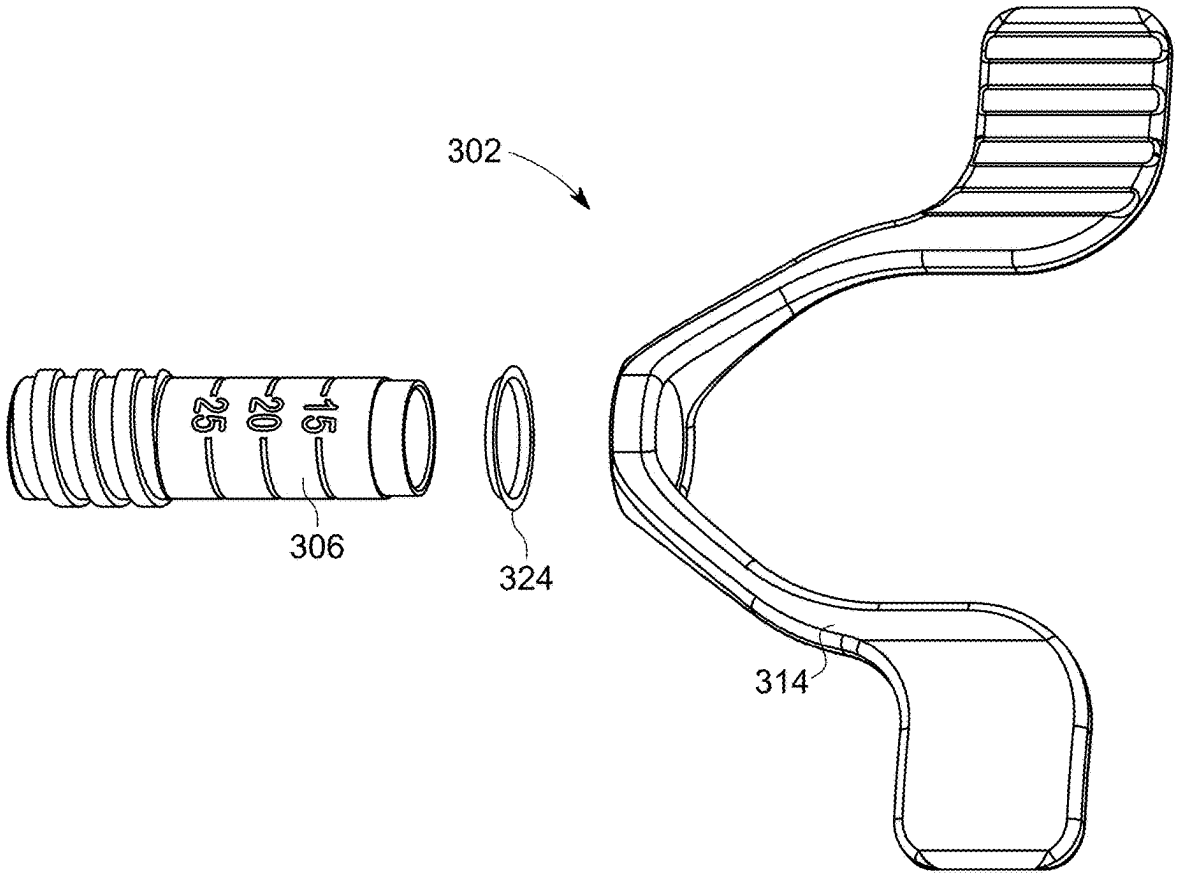


FIG. 61

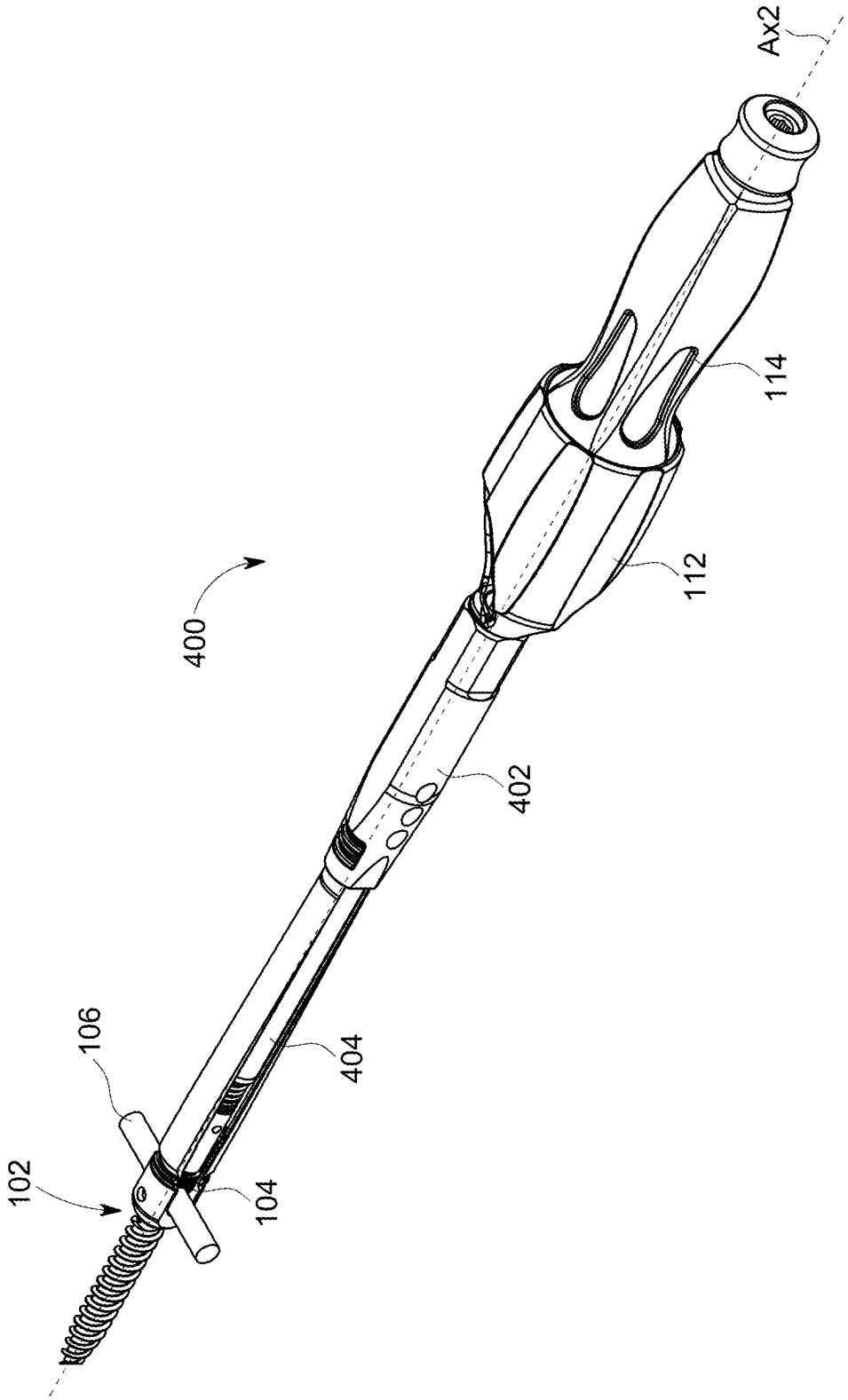


FIG. 62A

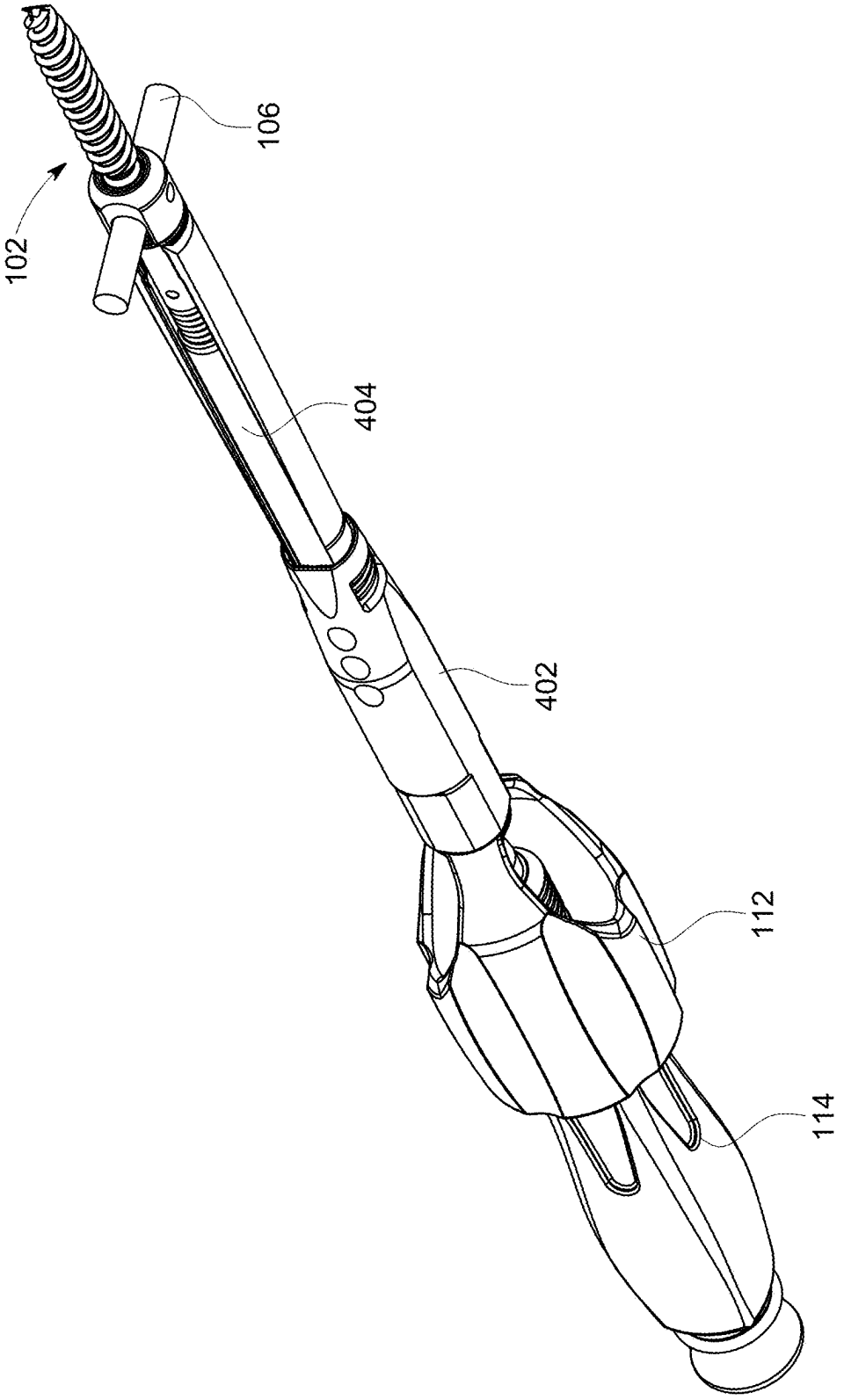


FIG. 62B

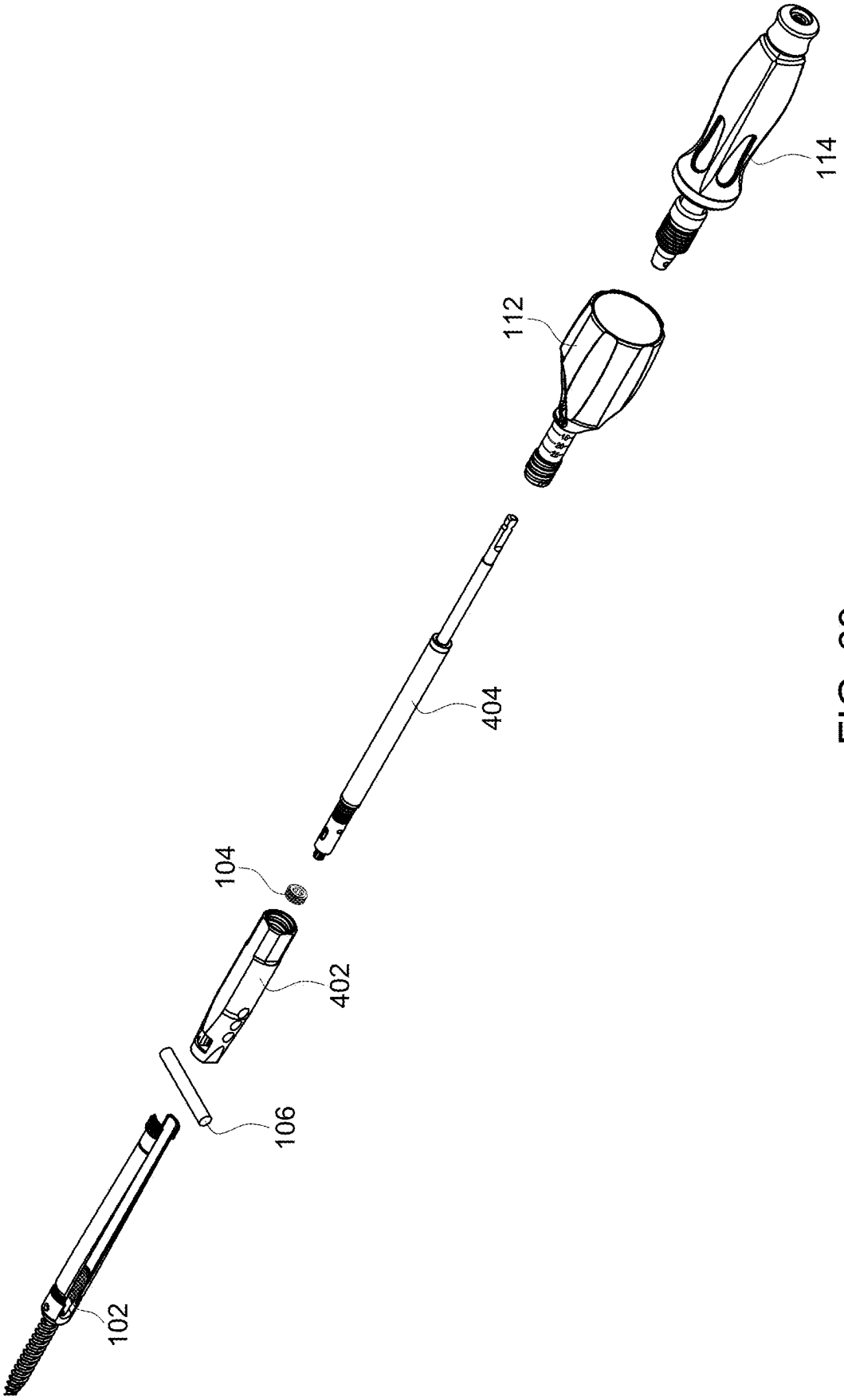


FIG. 63

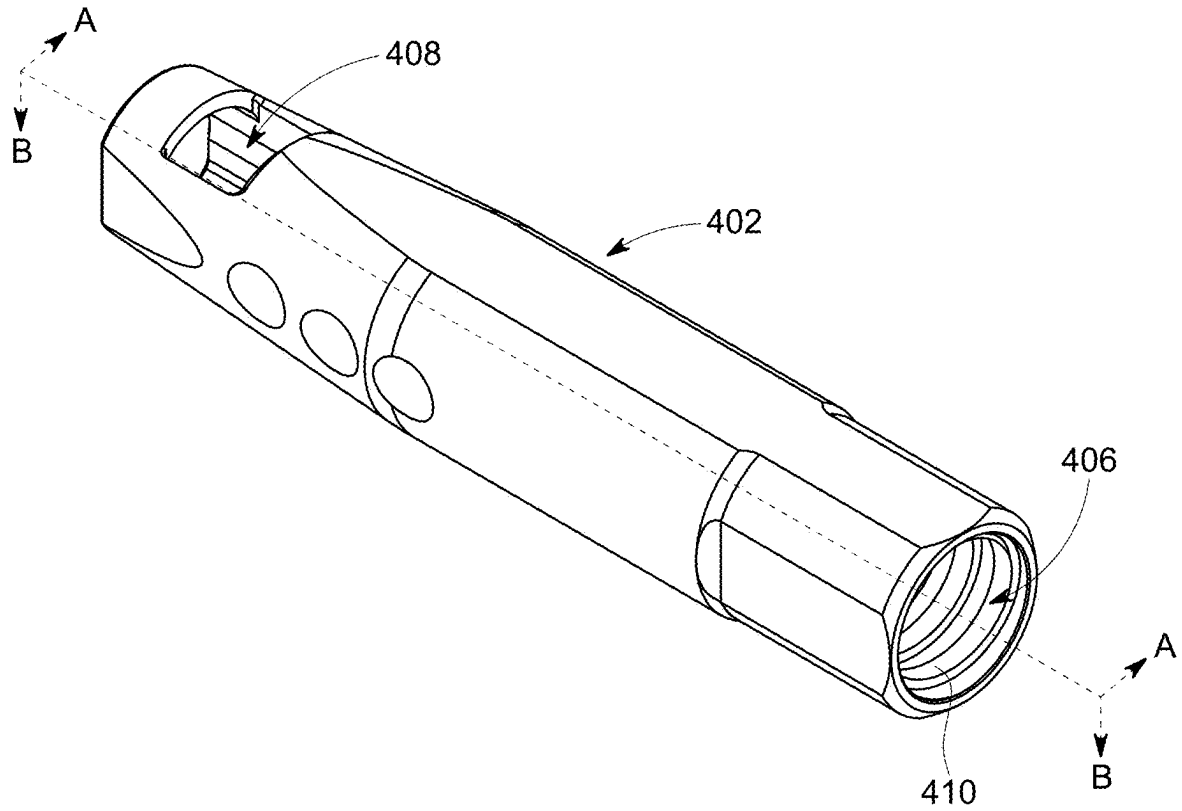


FIG. 64A

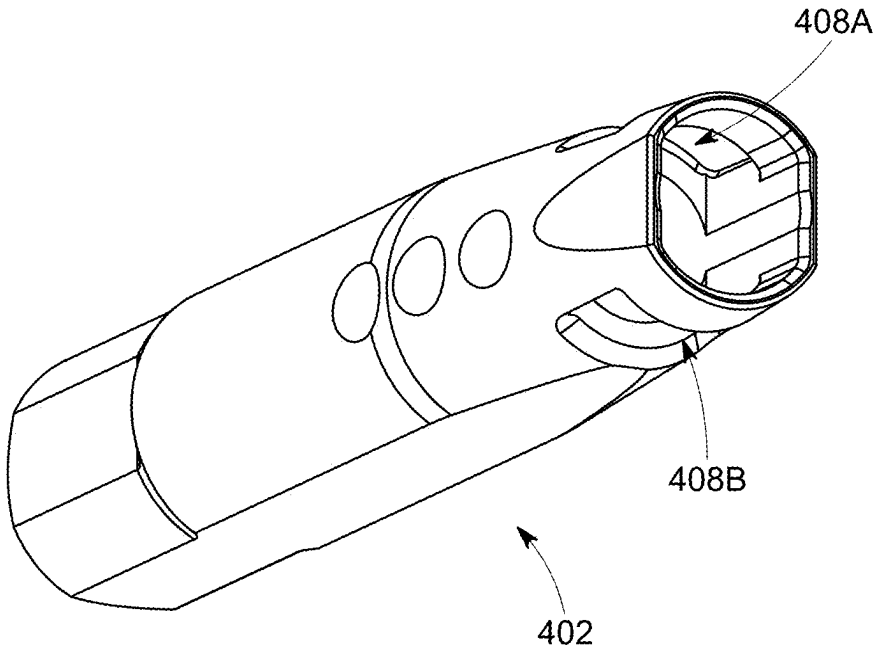


FIG. 64B

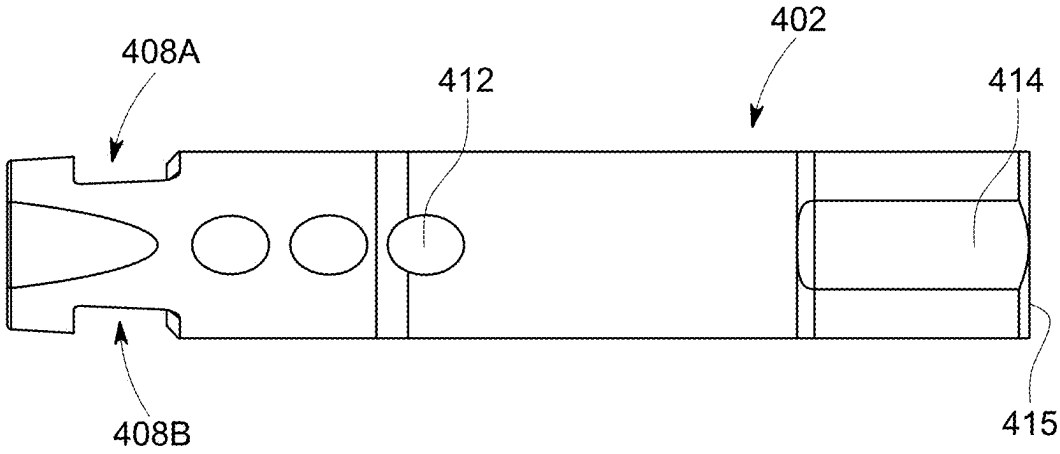


FIG. 64C

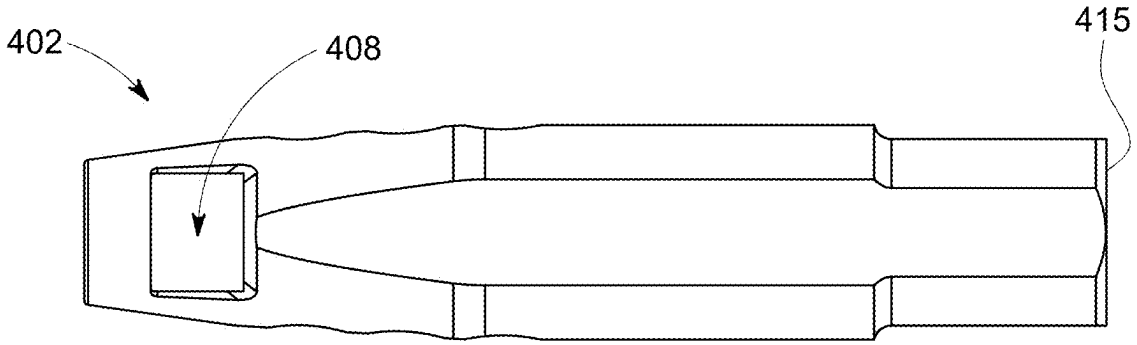


FIG. 64D

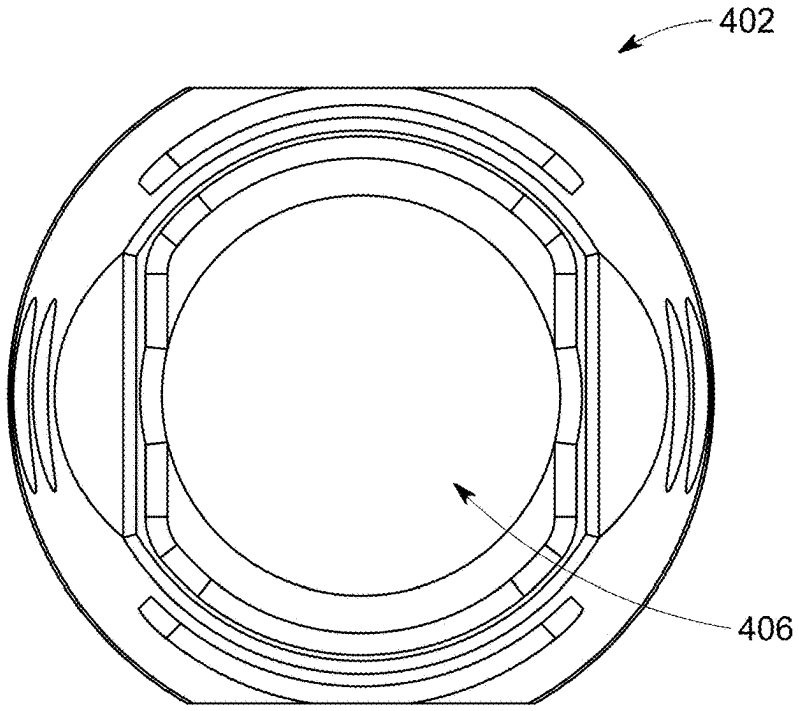


FIG. 64E

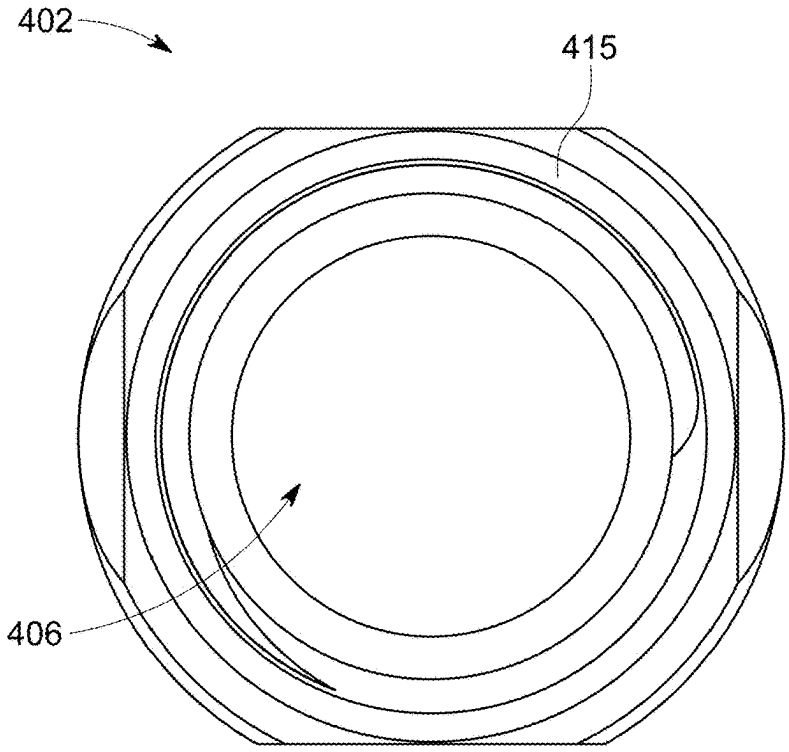


FIG. 64F

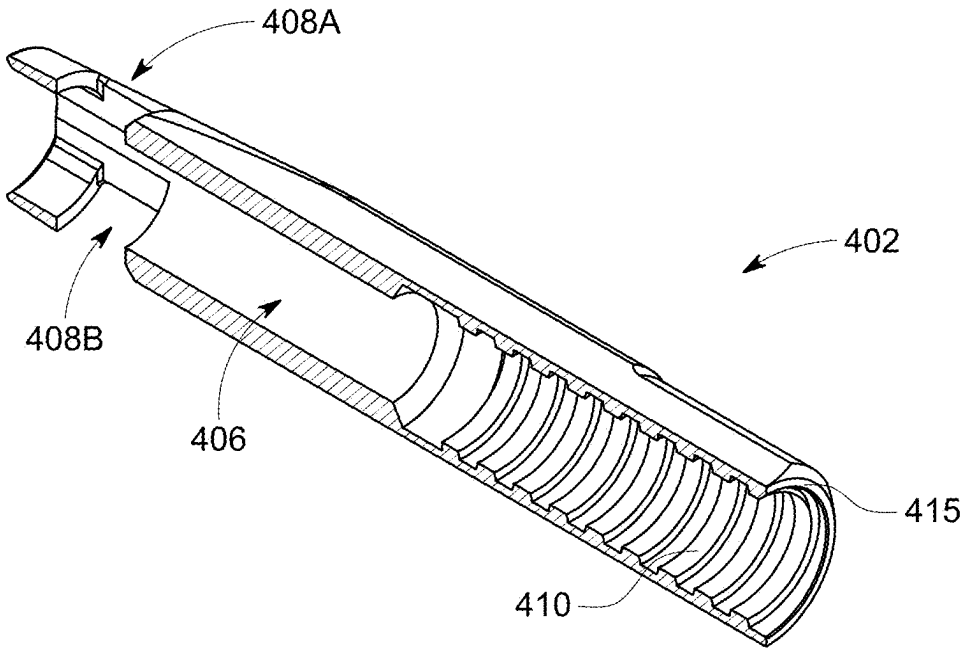


FIG. 65

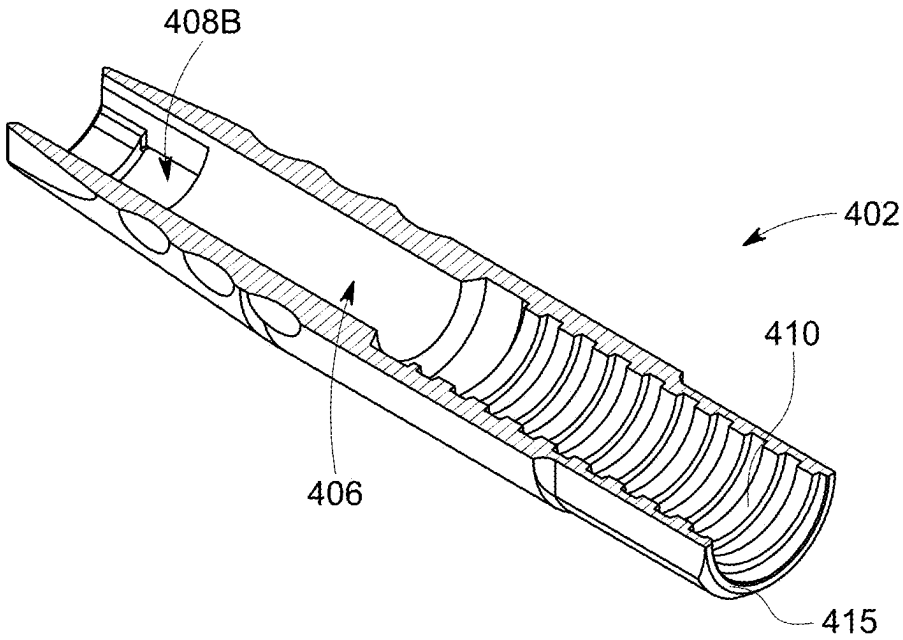


FIG. 66

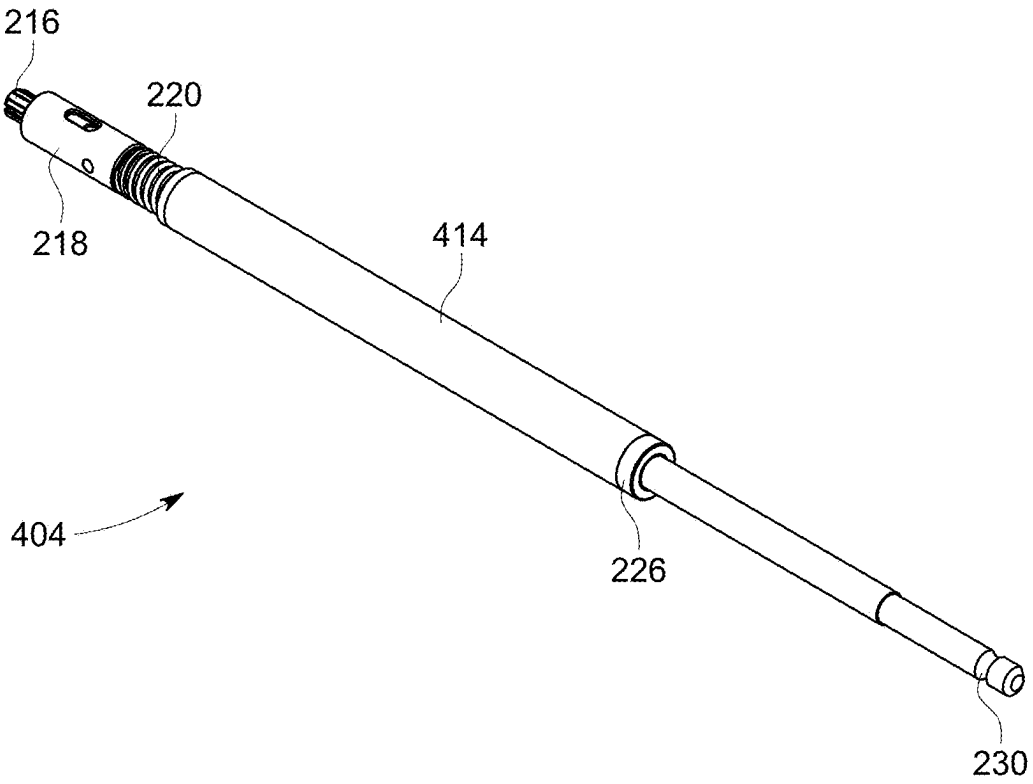


FIG. 67A

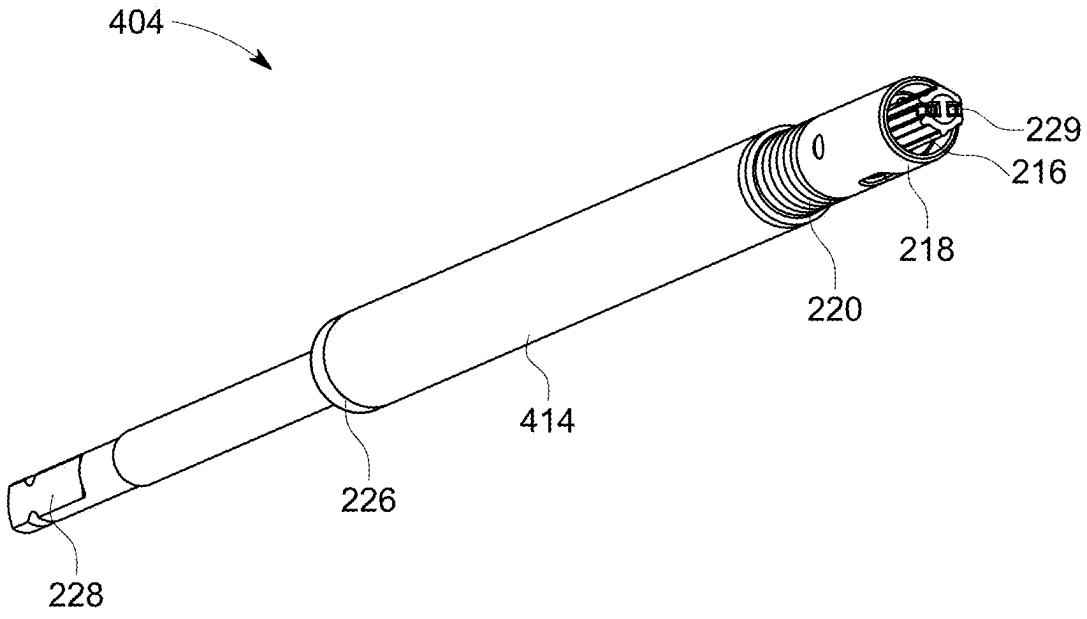


FIG. 67B

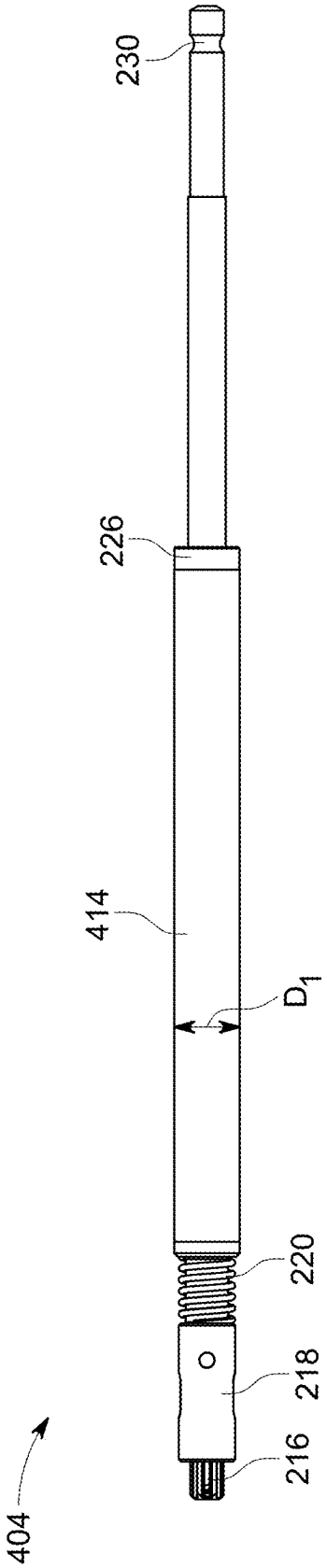


FIG. 67C

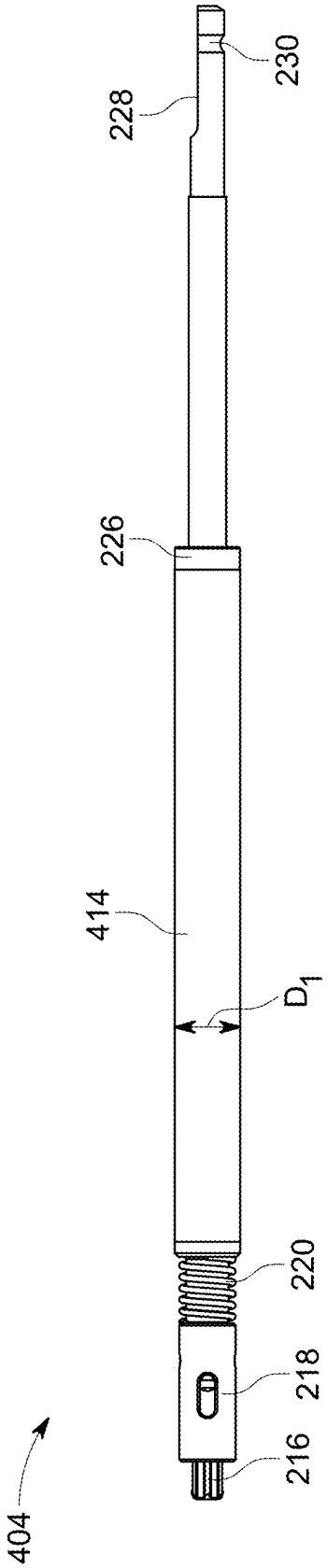


FIG. 67D

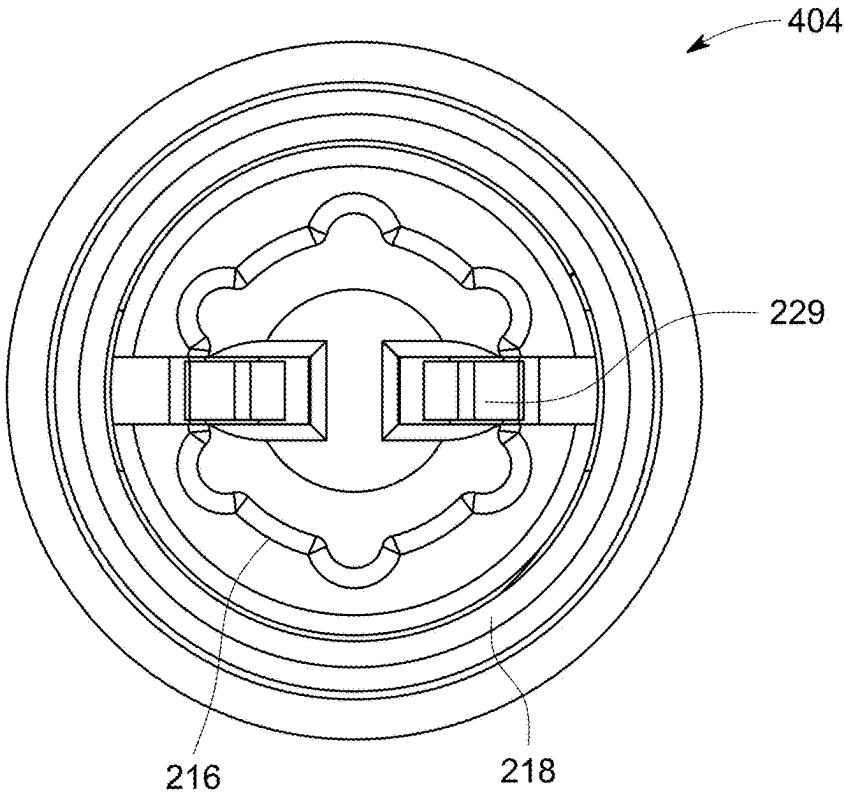


FIG. 67E

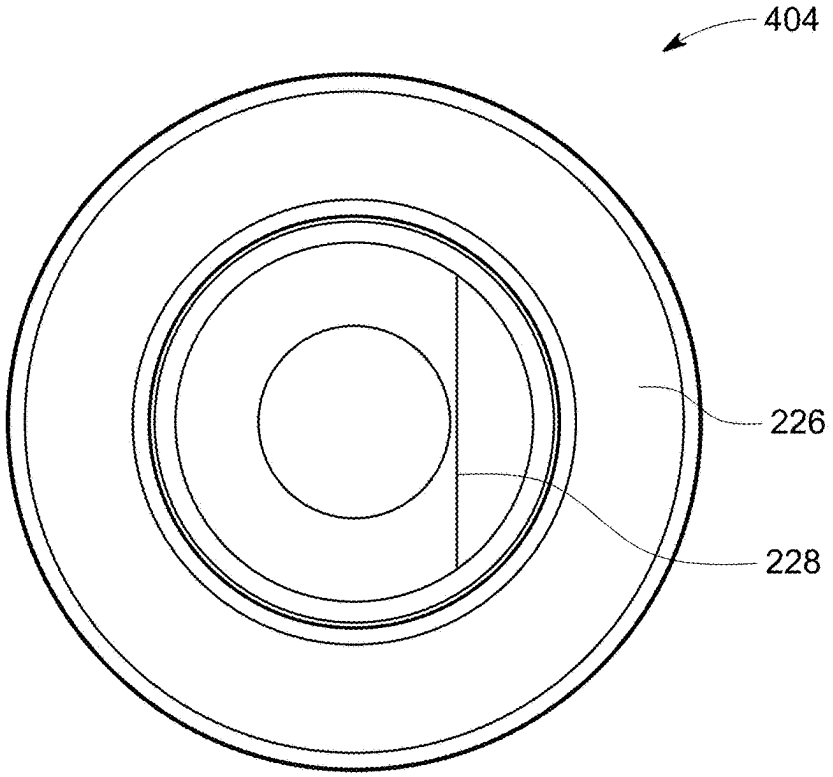


FIG. 67F

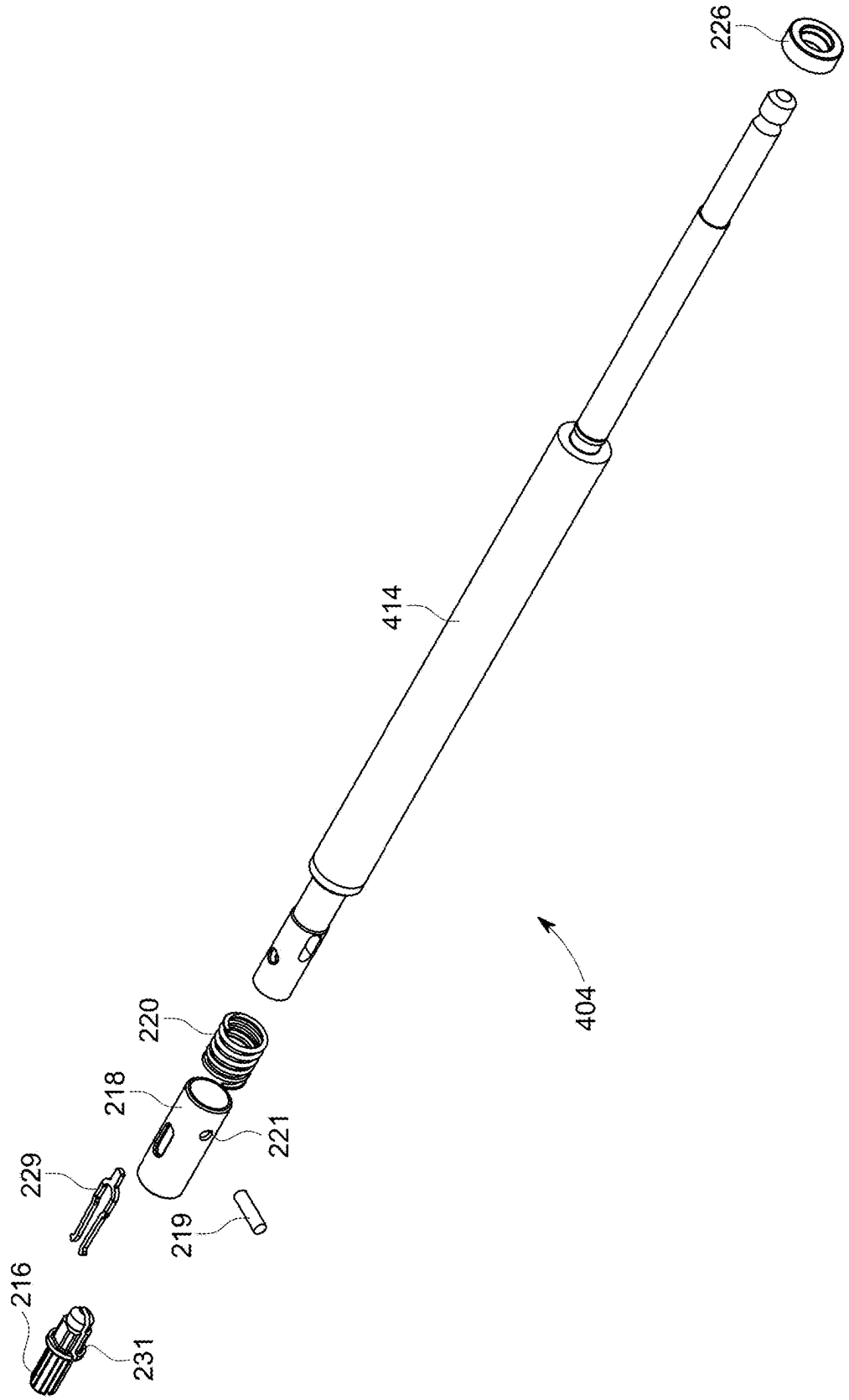


FIG. 68

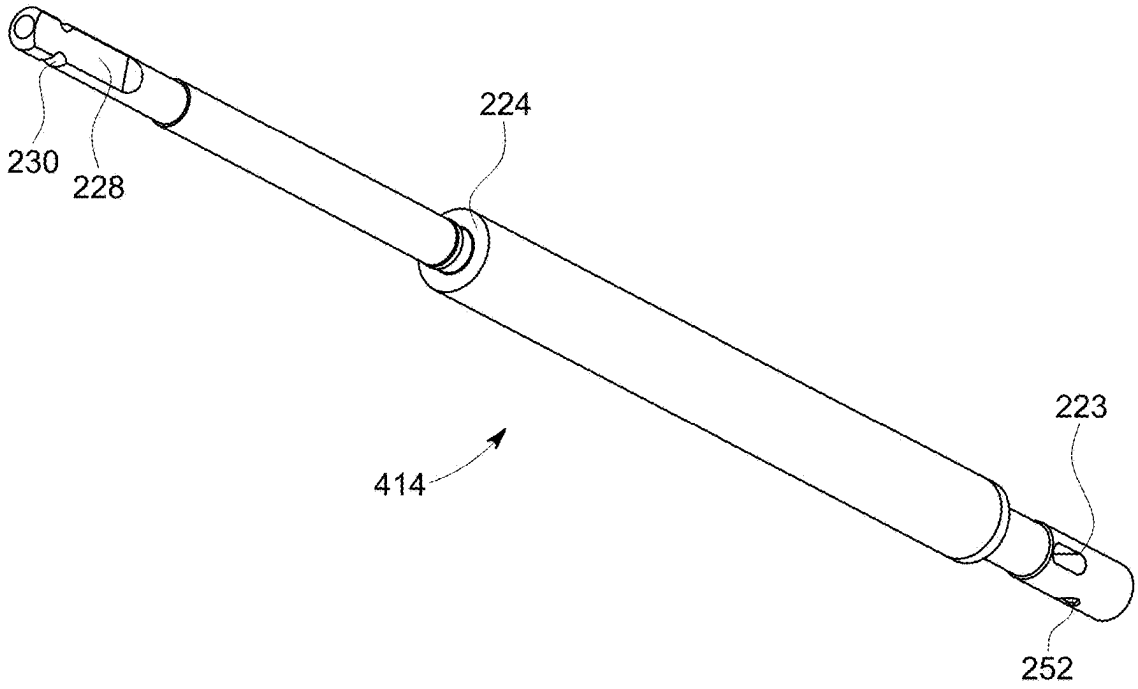


FIG. 69A

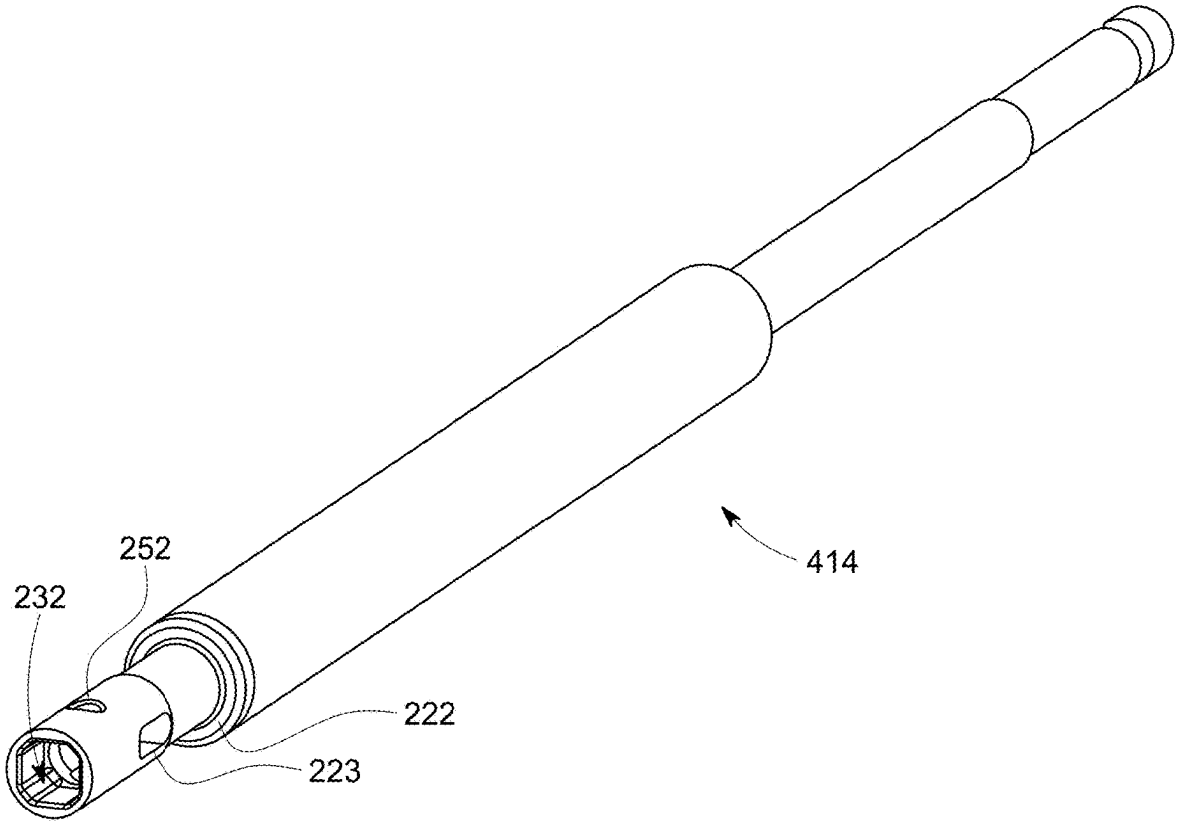


FIG. 69B

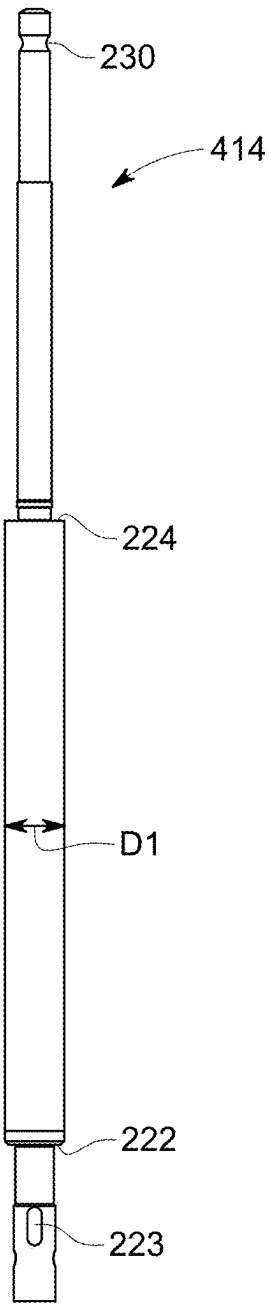


FIG. 69C

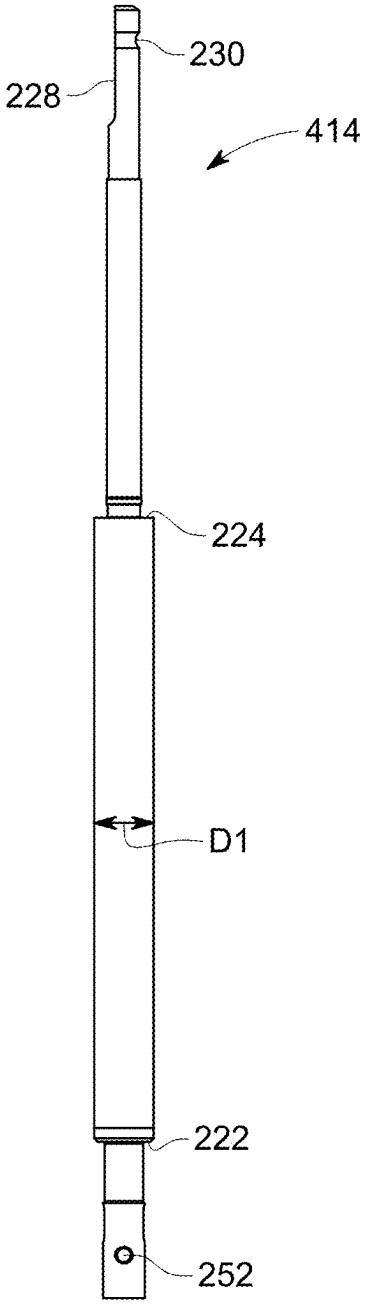


FIG. 69D

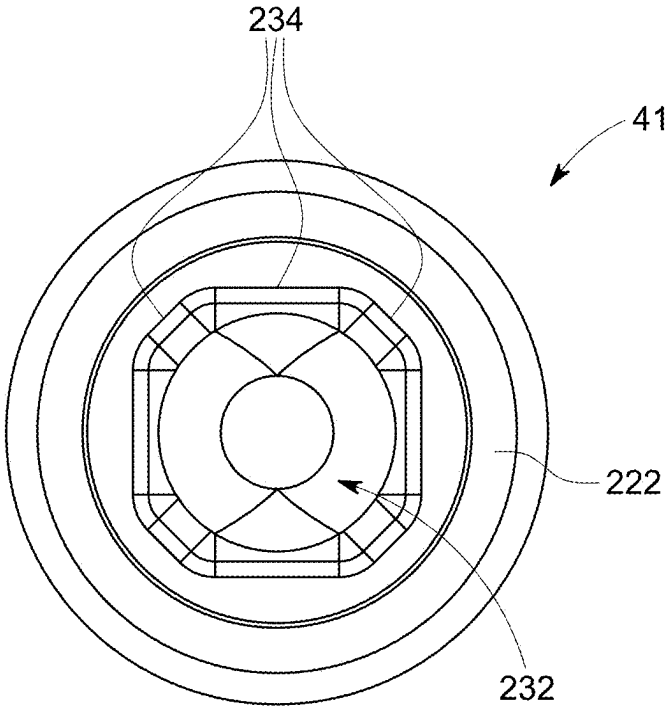


FIG. 69E

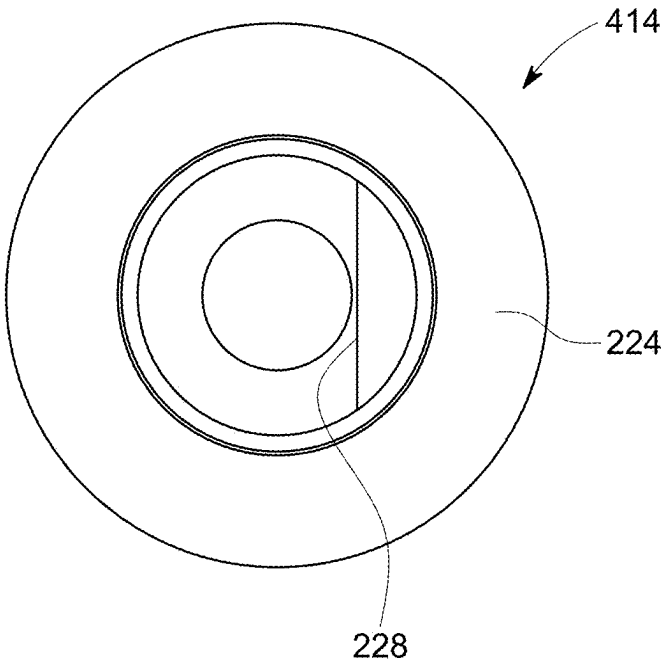


FIG. 69F

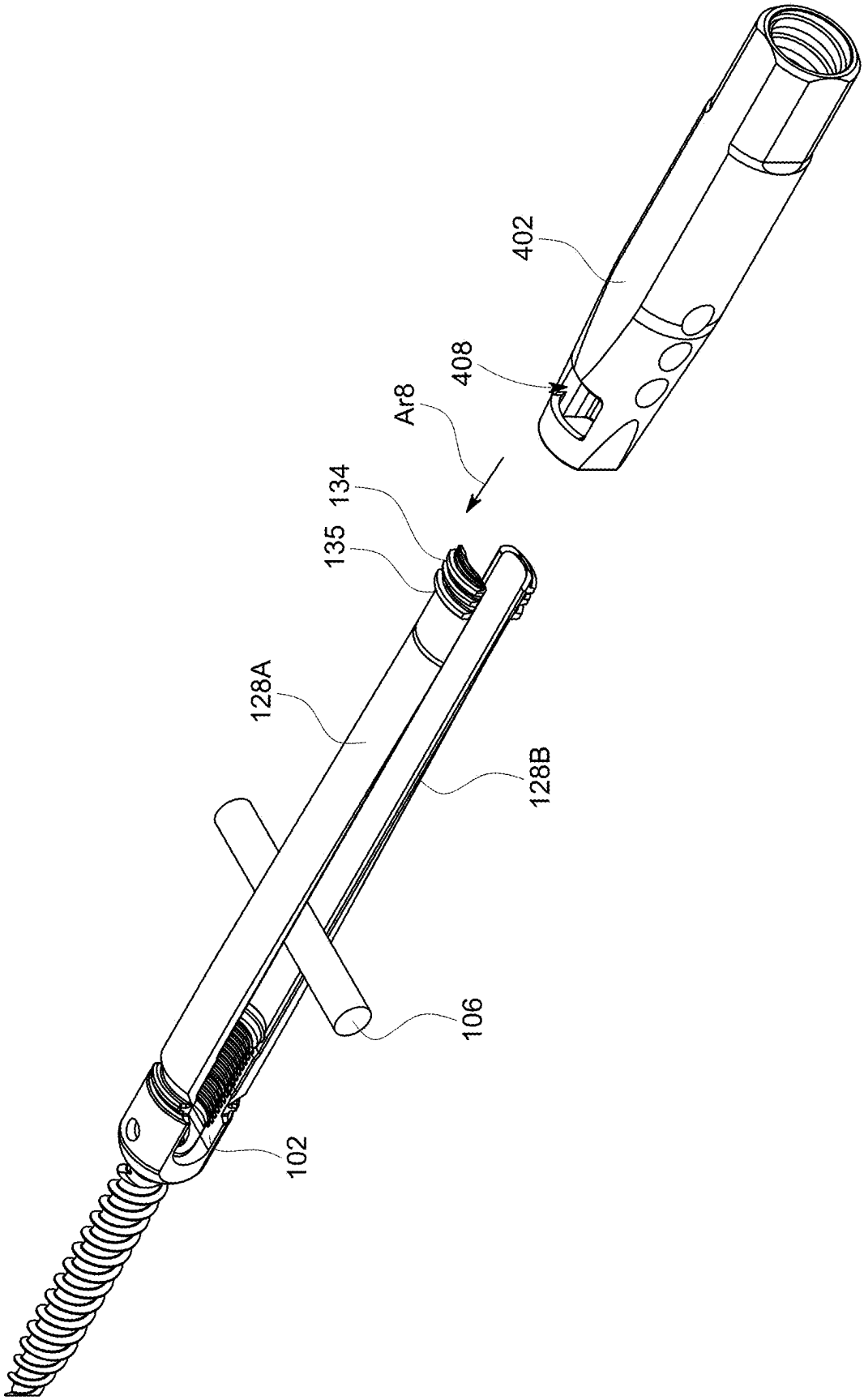


FIG. 70

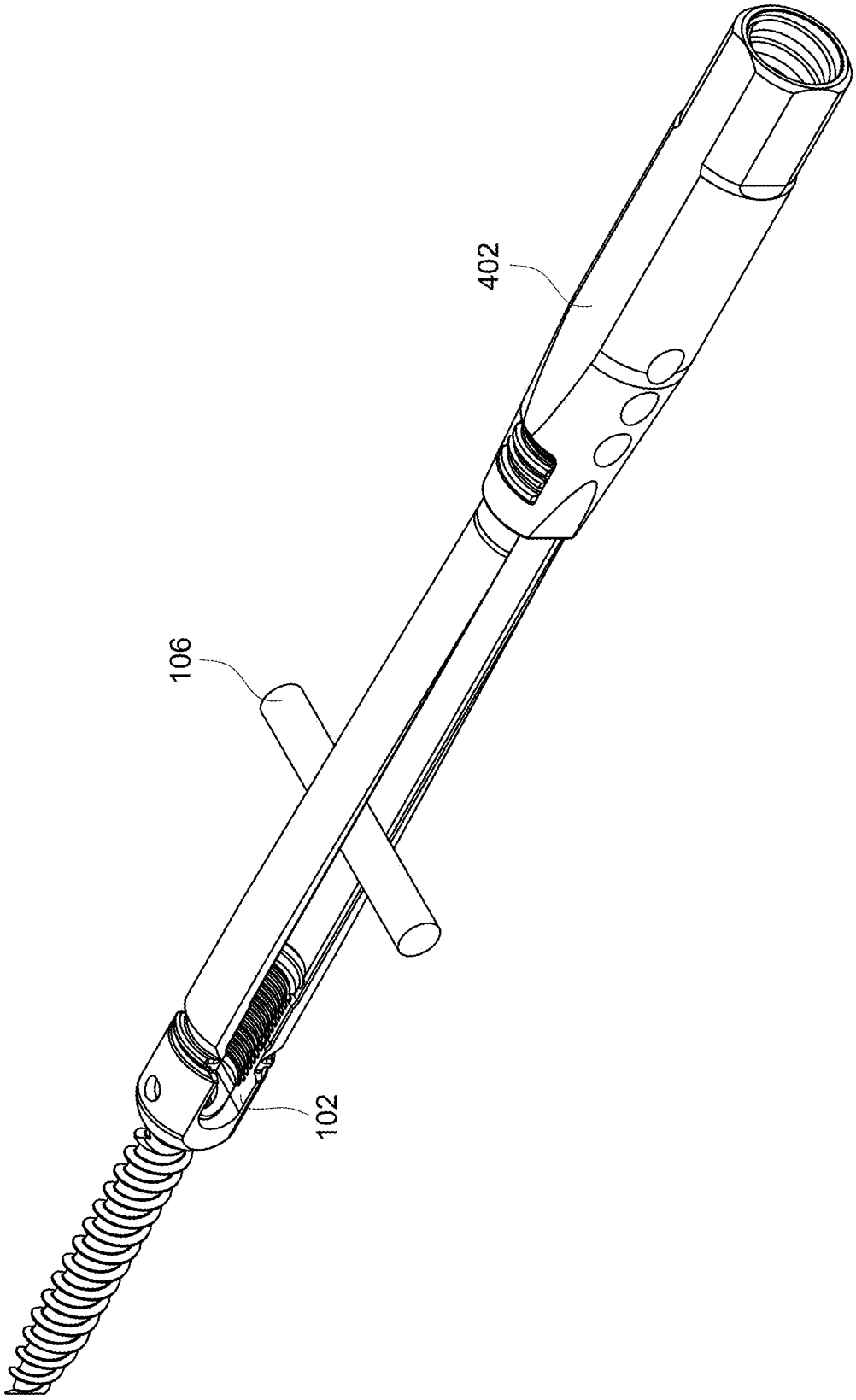


FIG. 71

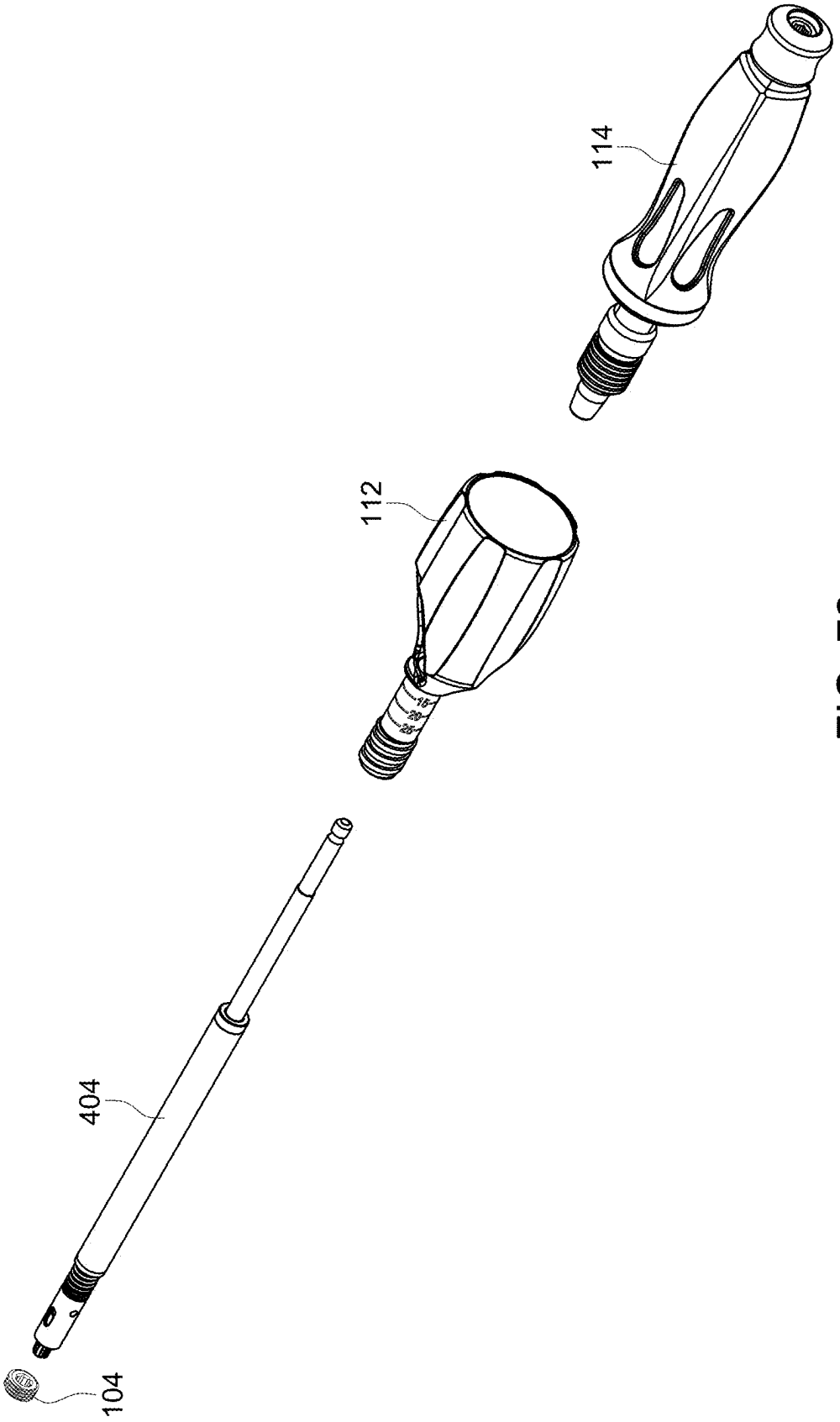


FIG. 72

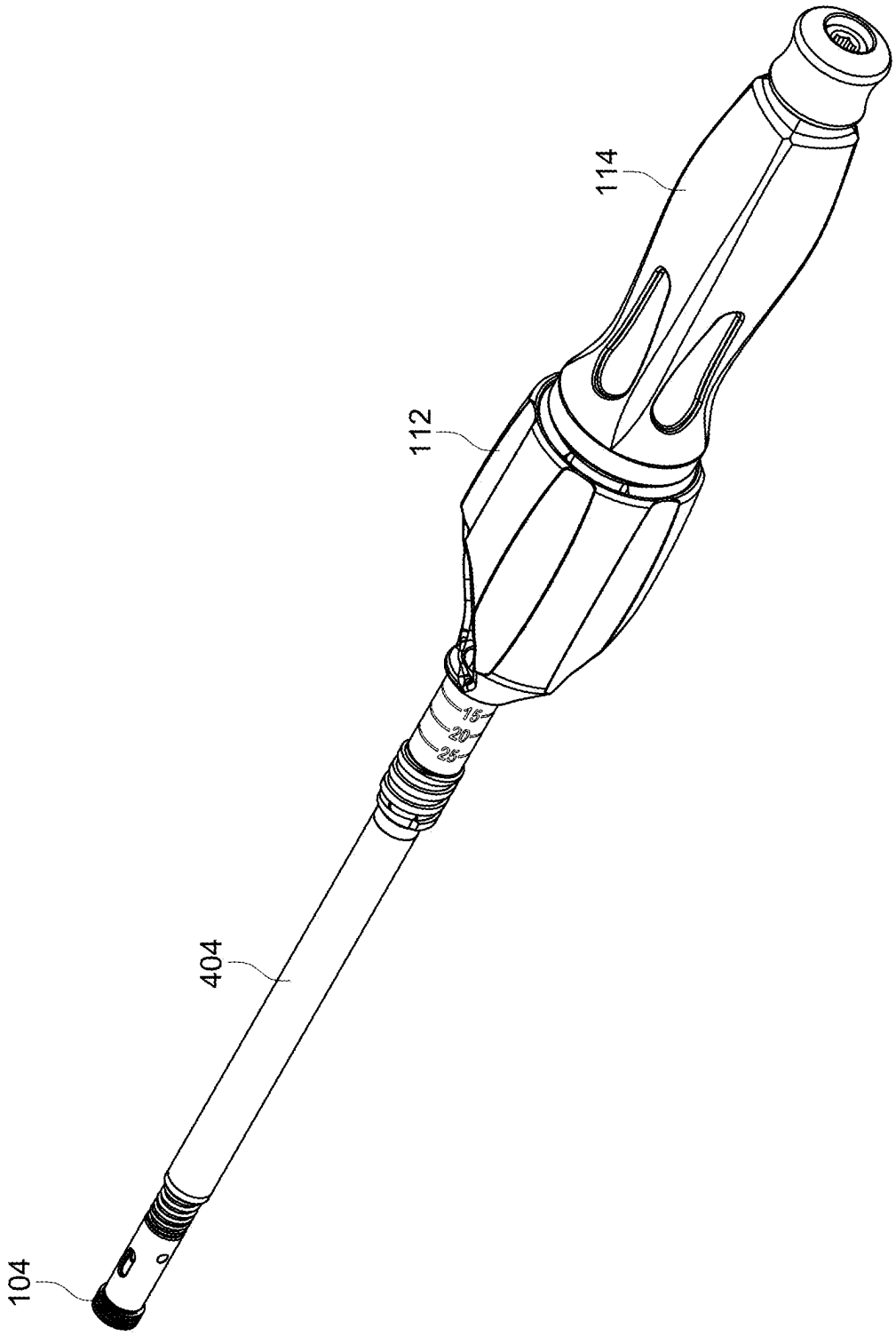


FIG. 73

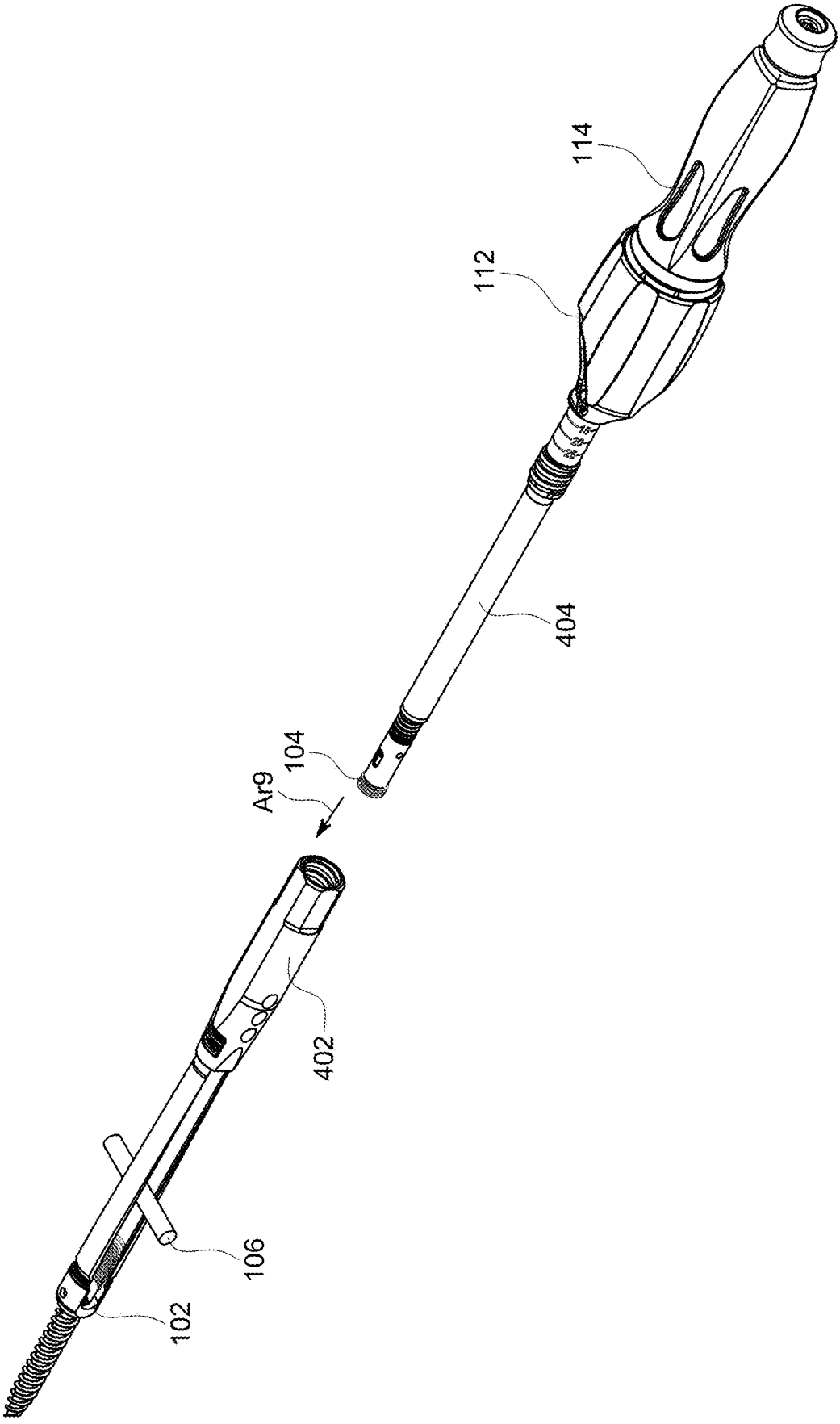


FIG. 74

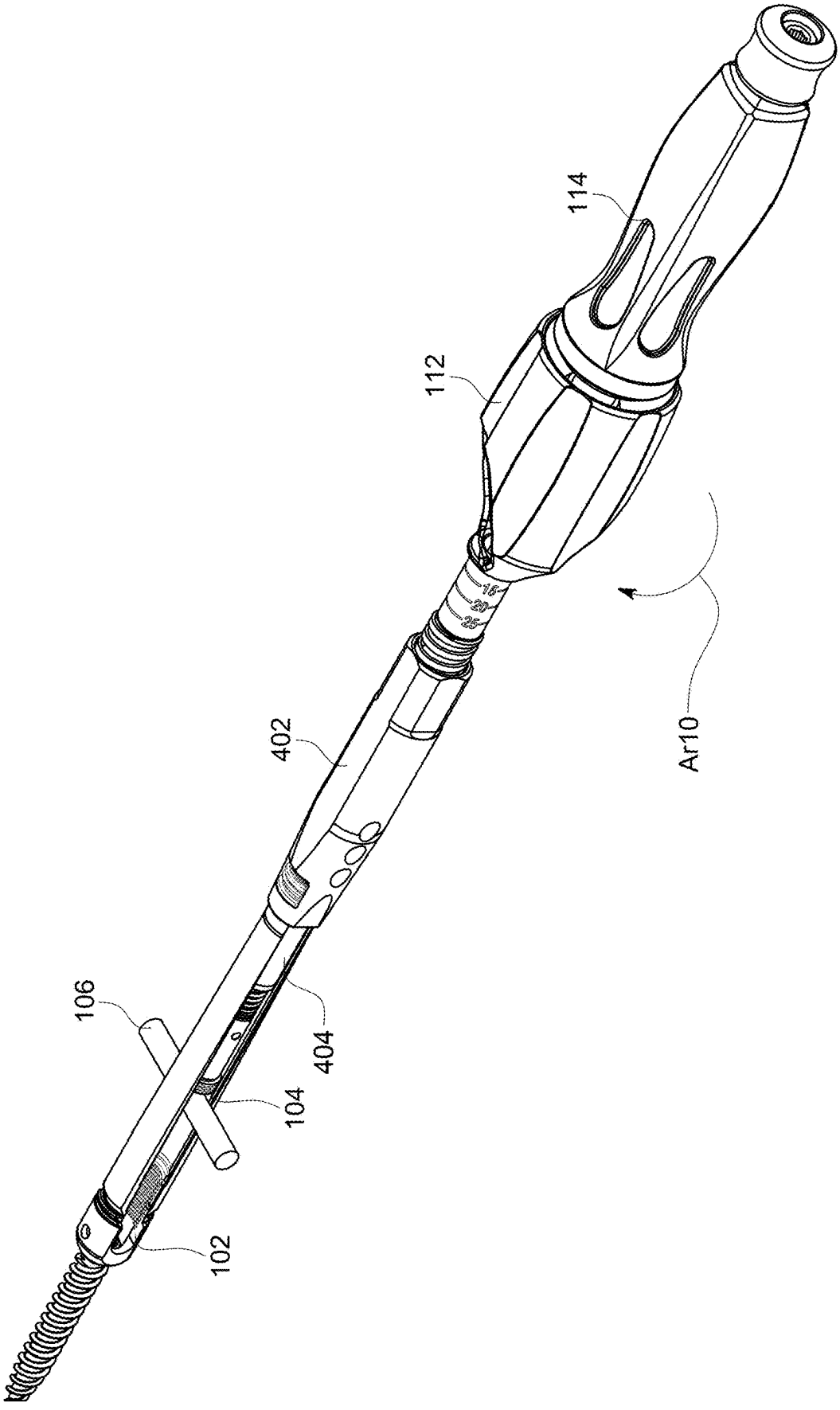


FIG. 75

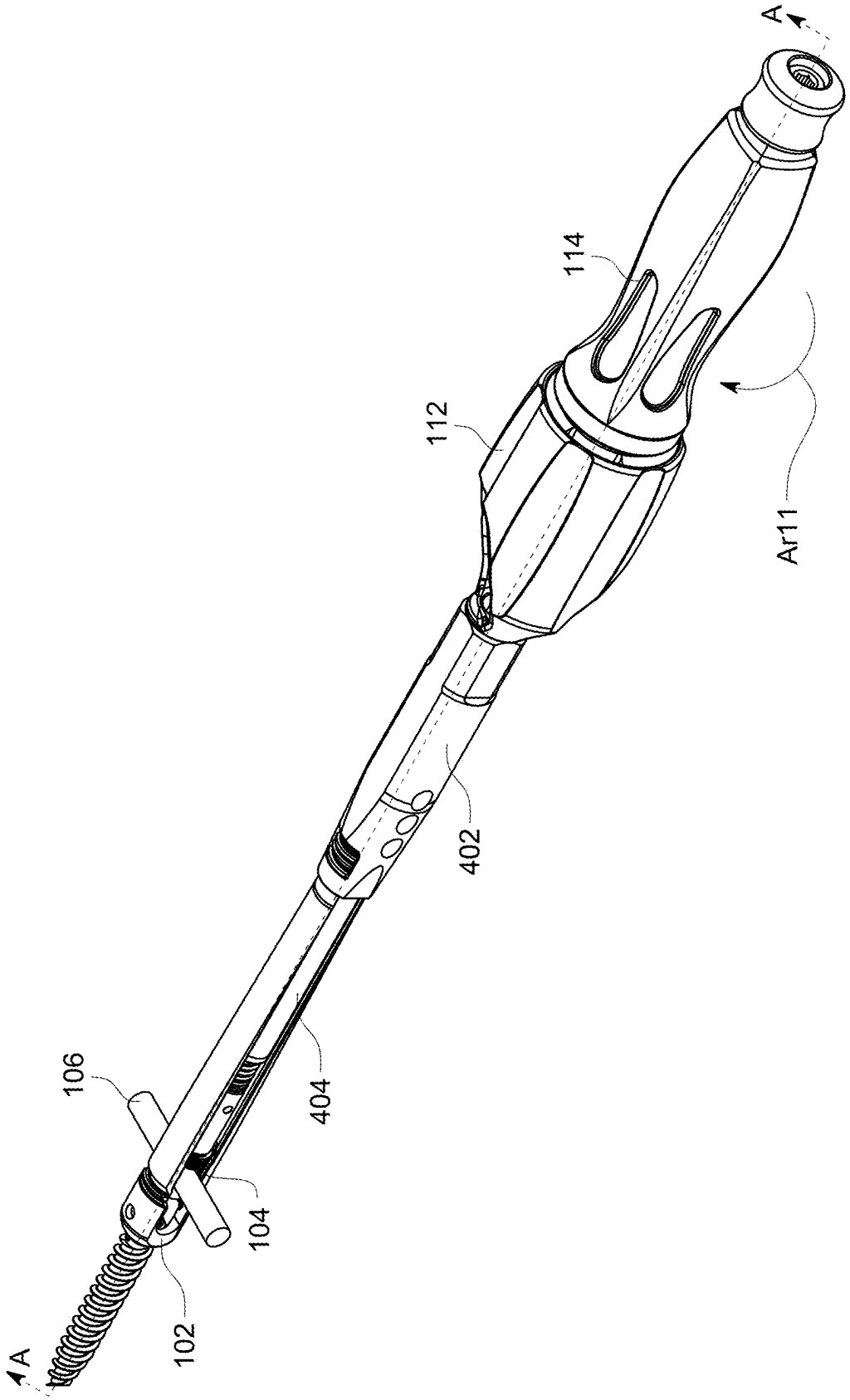


FIG. 76

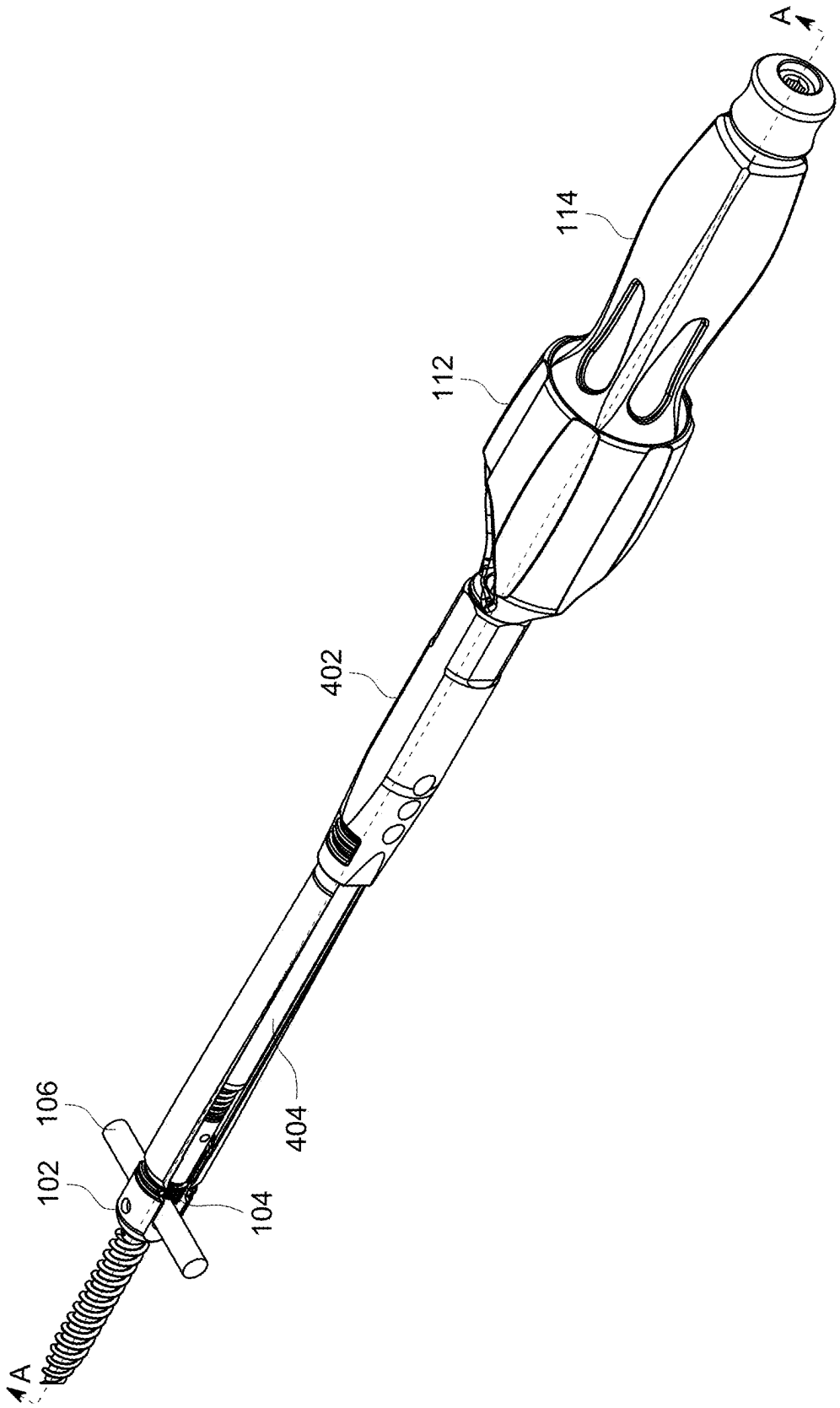


FIG. 77

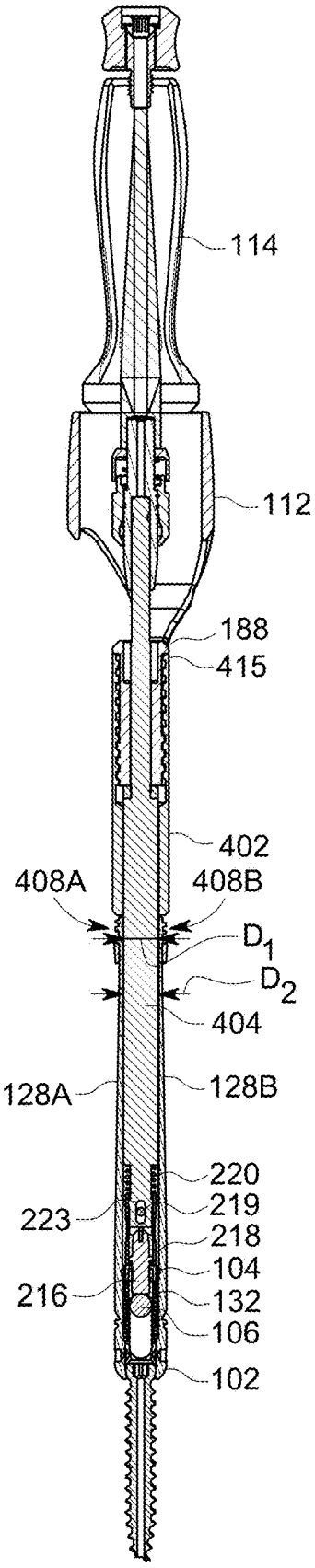

114
112
188
415
402
408A
408B
D1
D2
404
128A
128B
220
223
219
218
104
216
132
106
102

FIG. 78

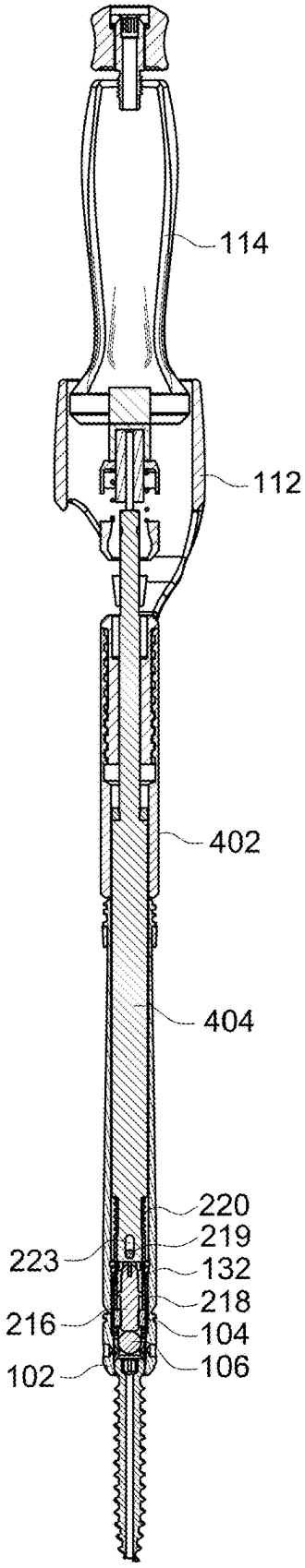

114
112
402
404
220
223
219
132
218
216
104
102
106

FIG. 79

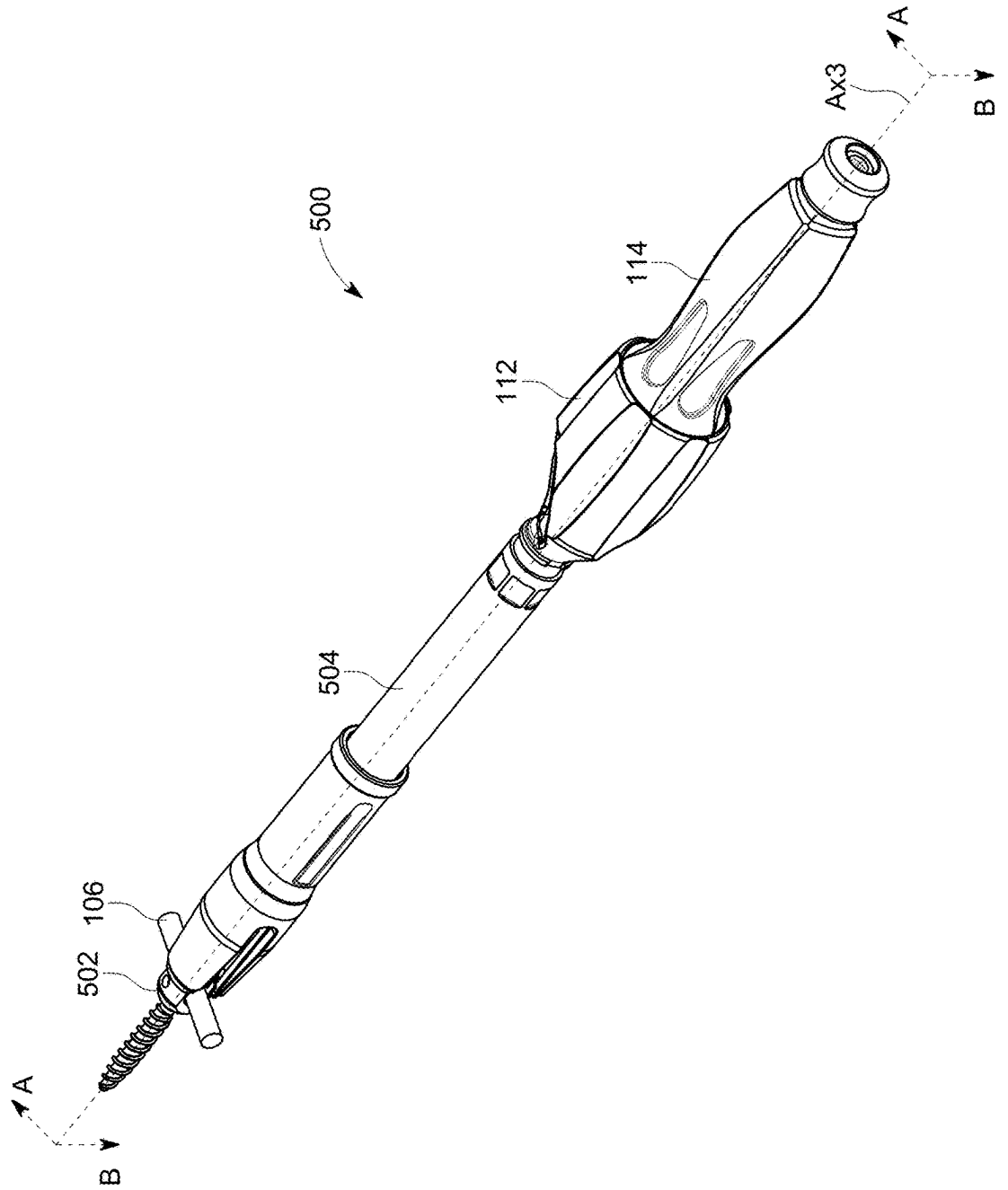


FIG. 80A

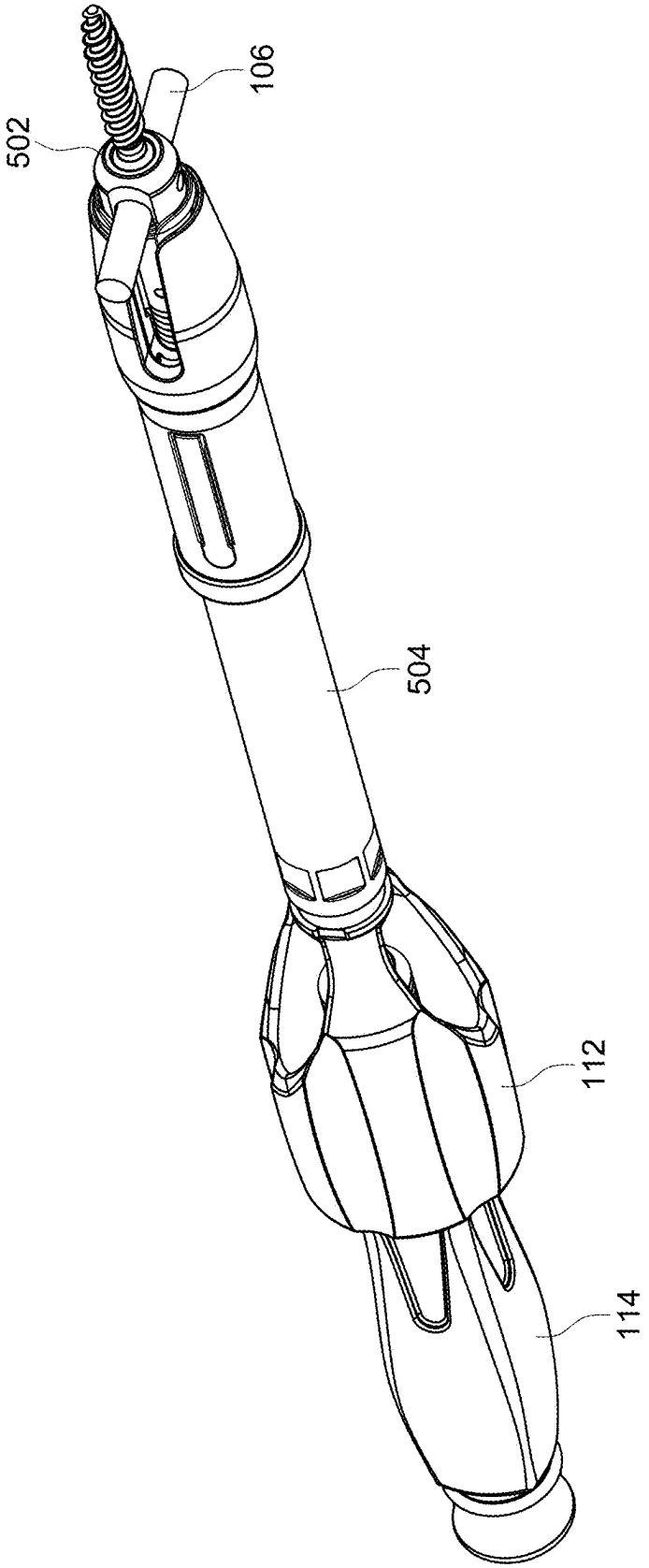


FIG. 80B

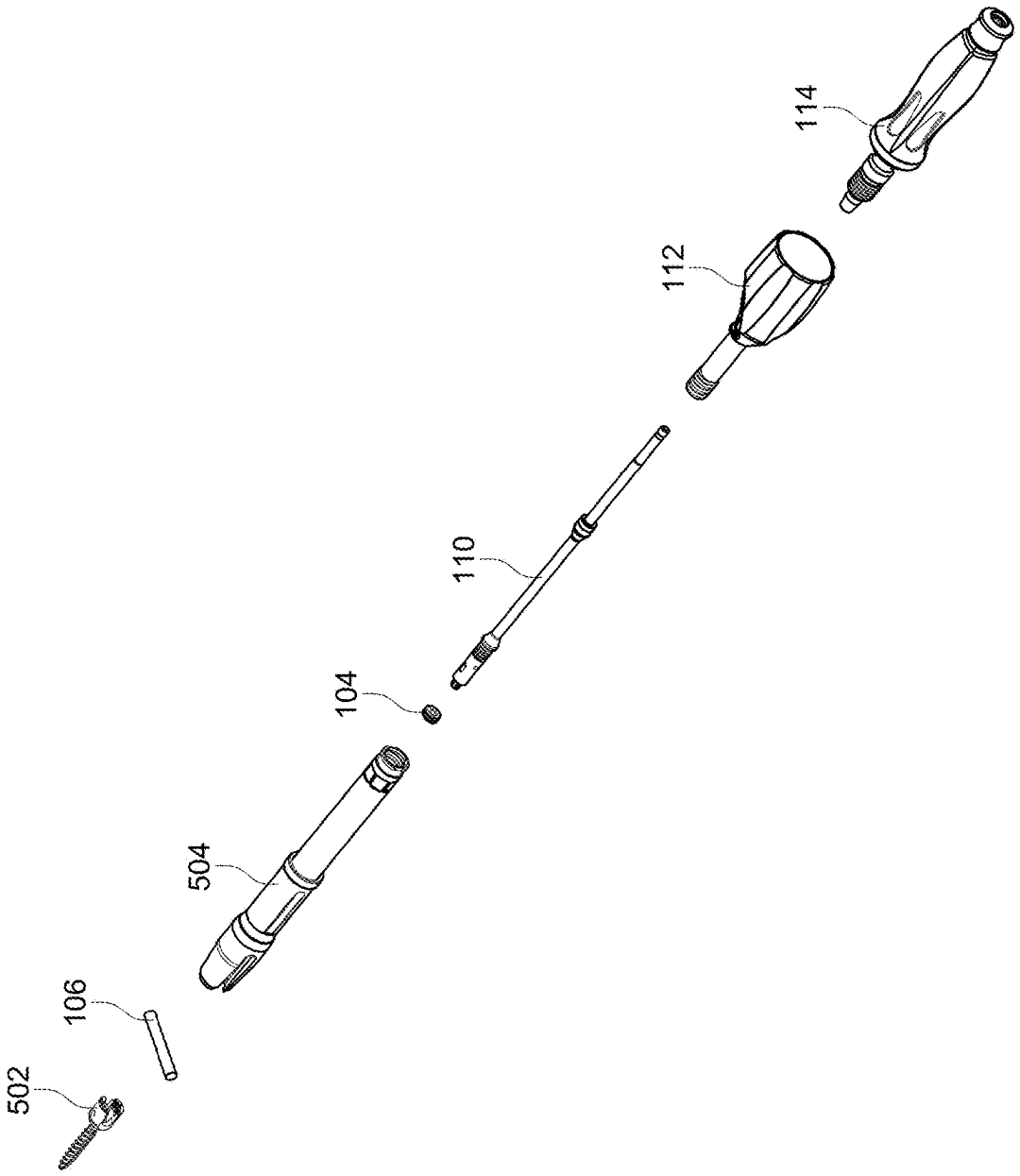


FIG. 81

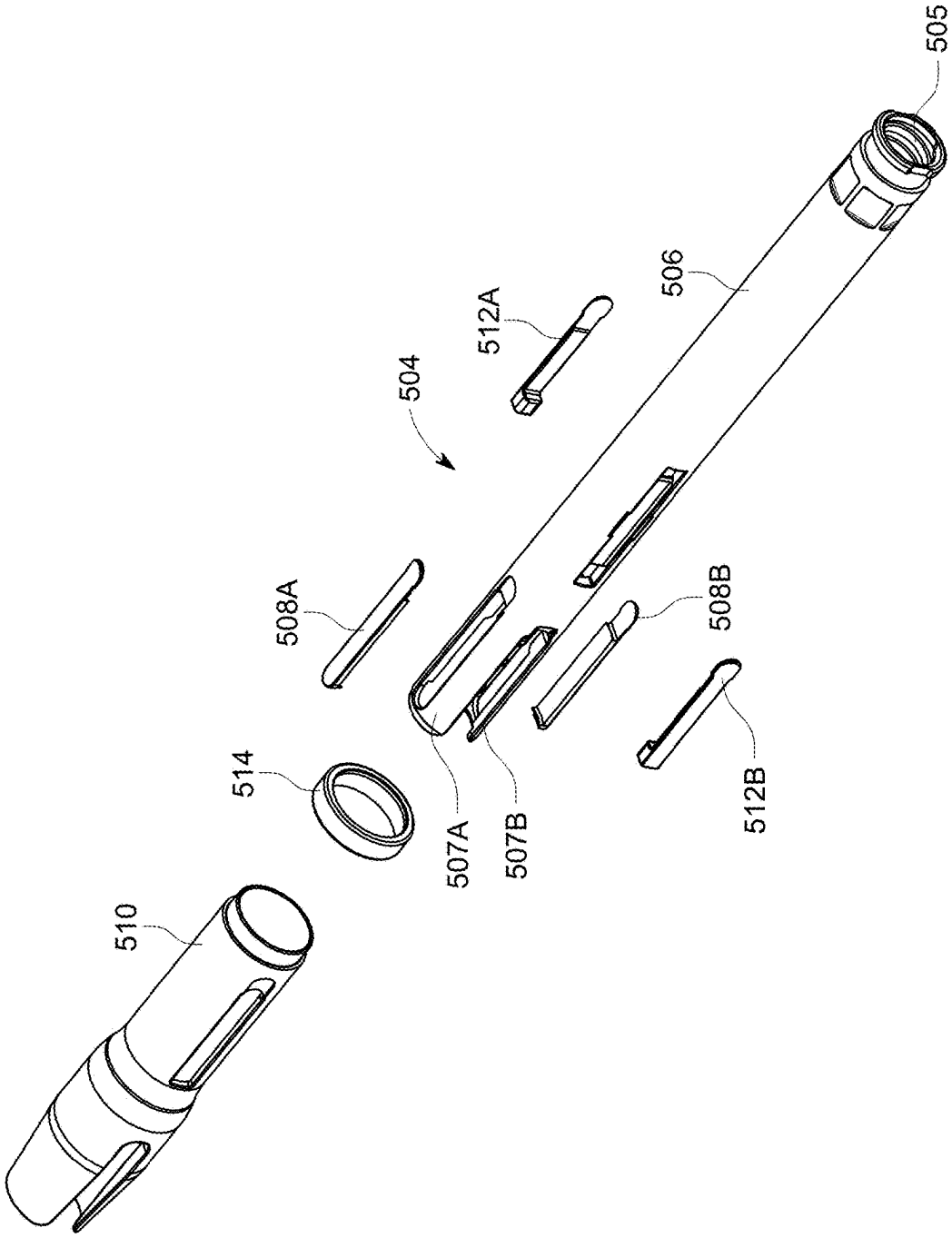


FIG. 82

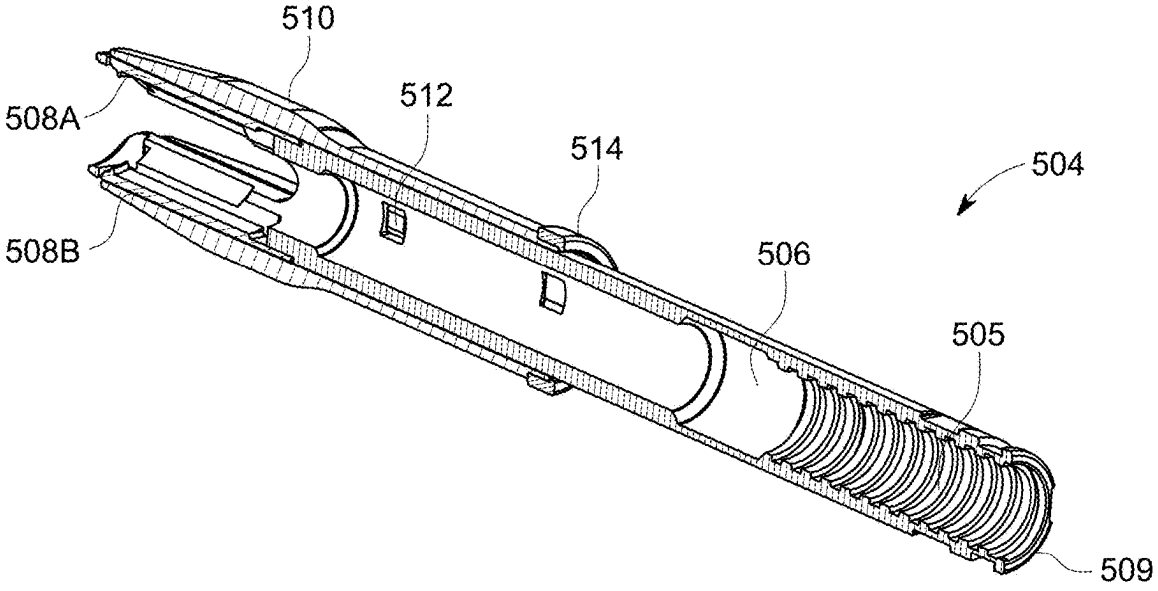

510
512
508A
514
504
508B
506
505
509

FIG. 83

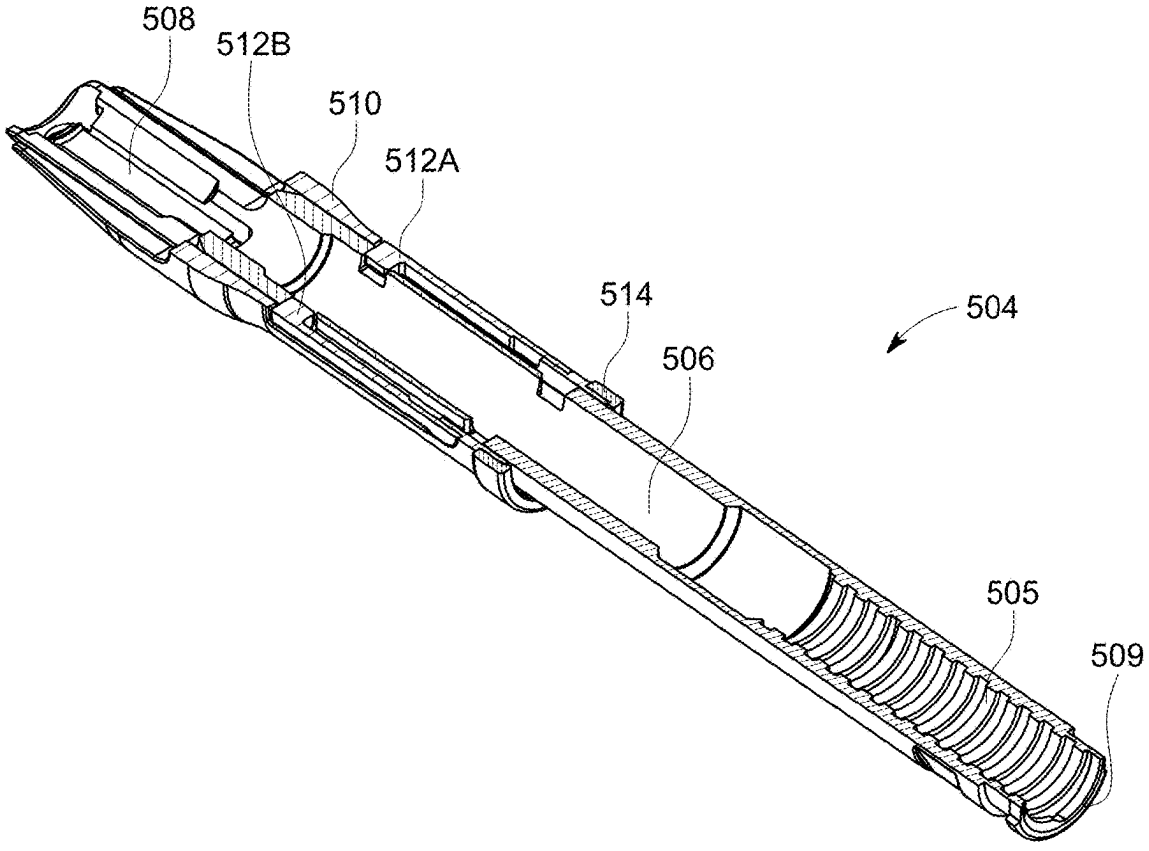

508
512B
510
512A
514
504
506
505
509

FIG. 84

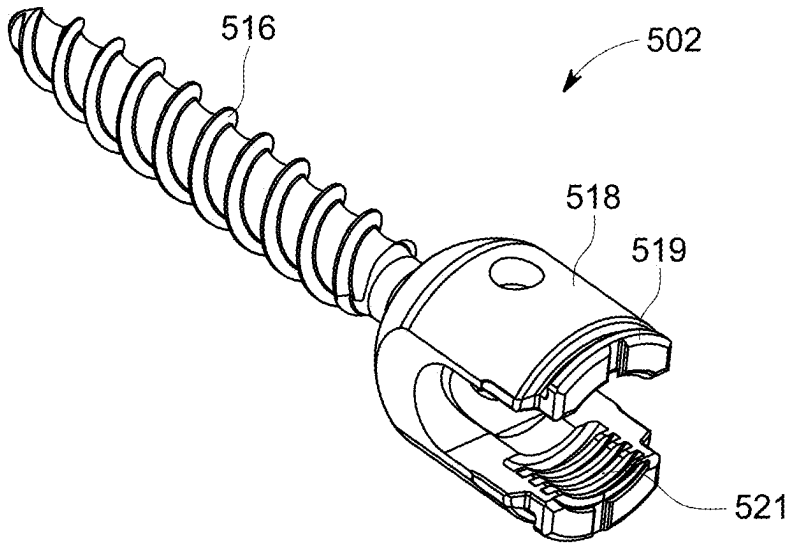


FIG. 85

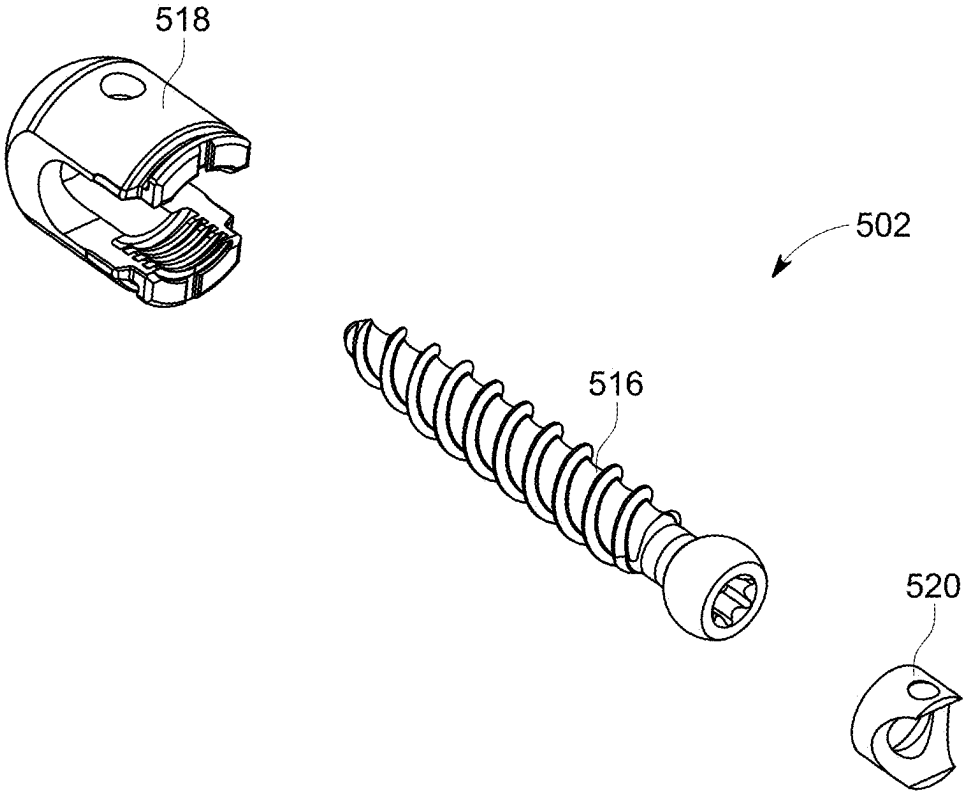


FIG. 86

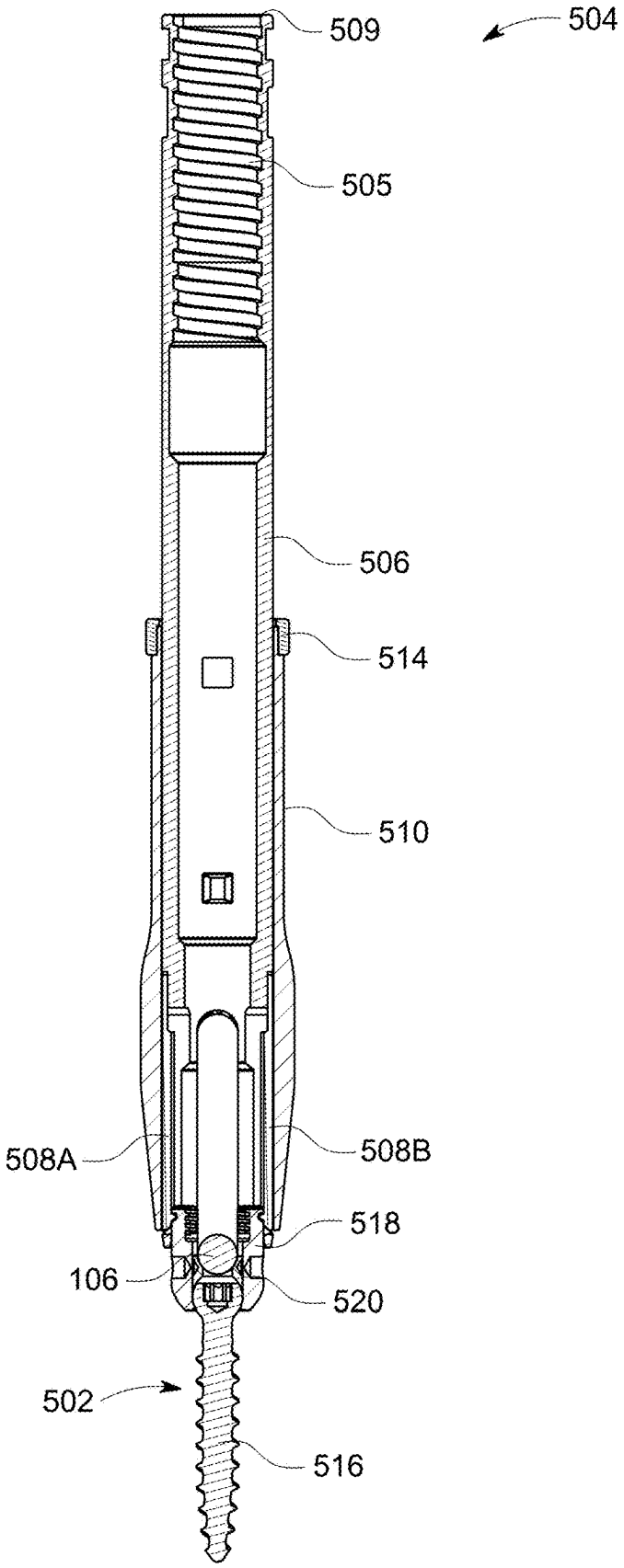


FIG. 87

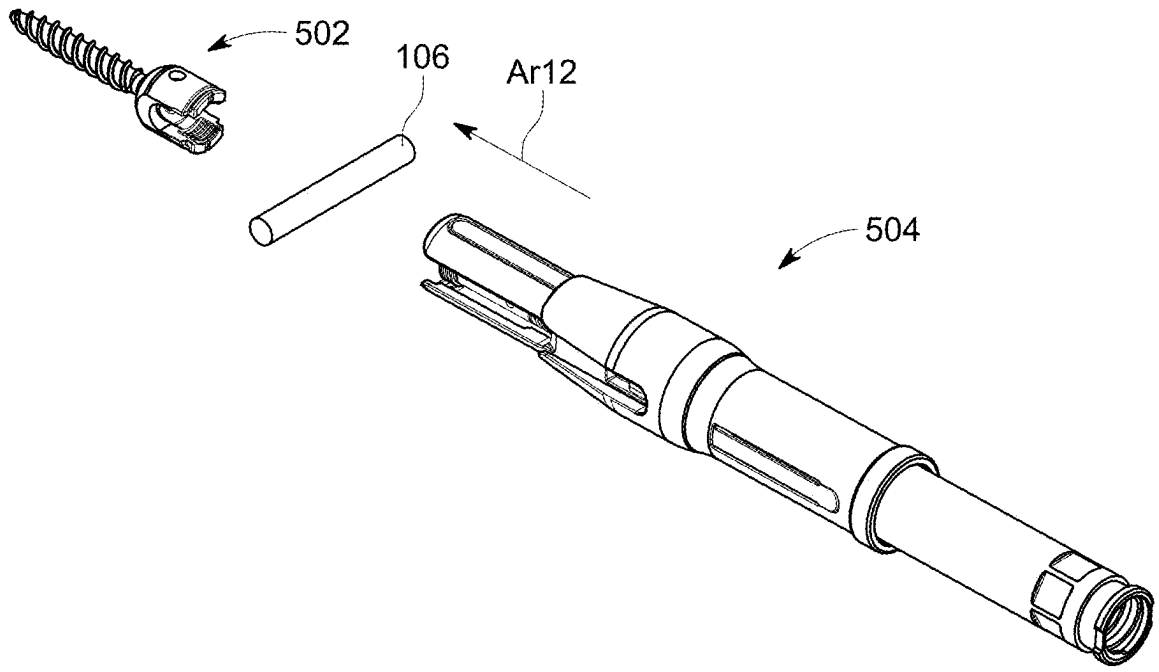


FIG. 88

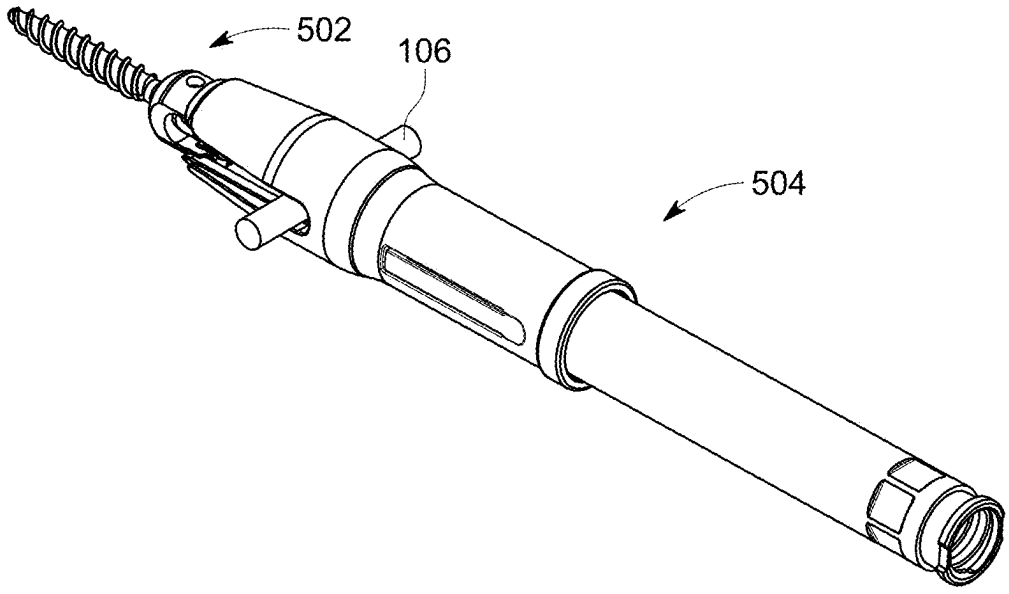


FIG. 89

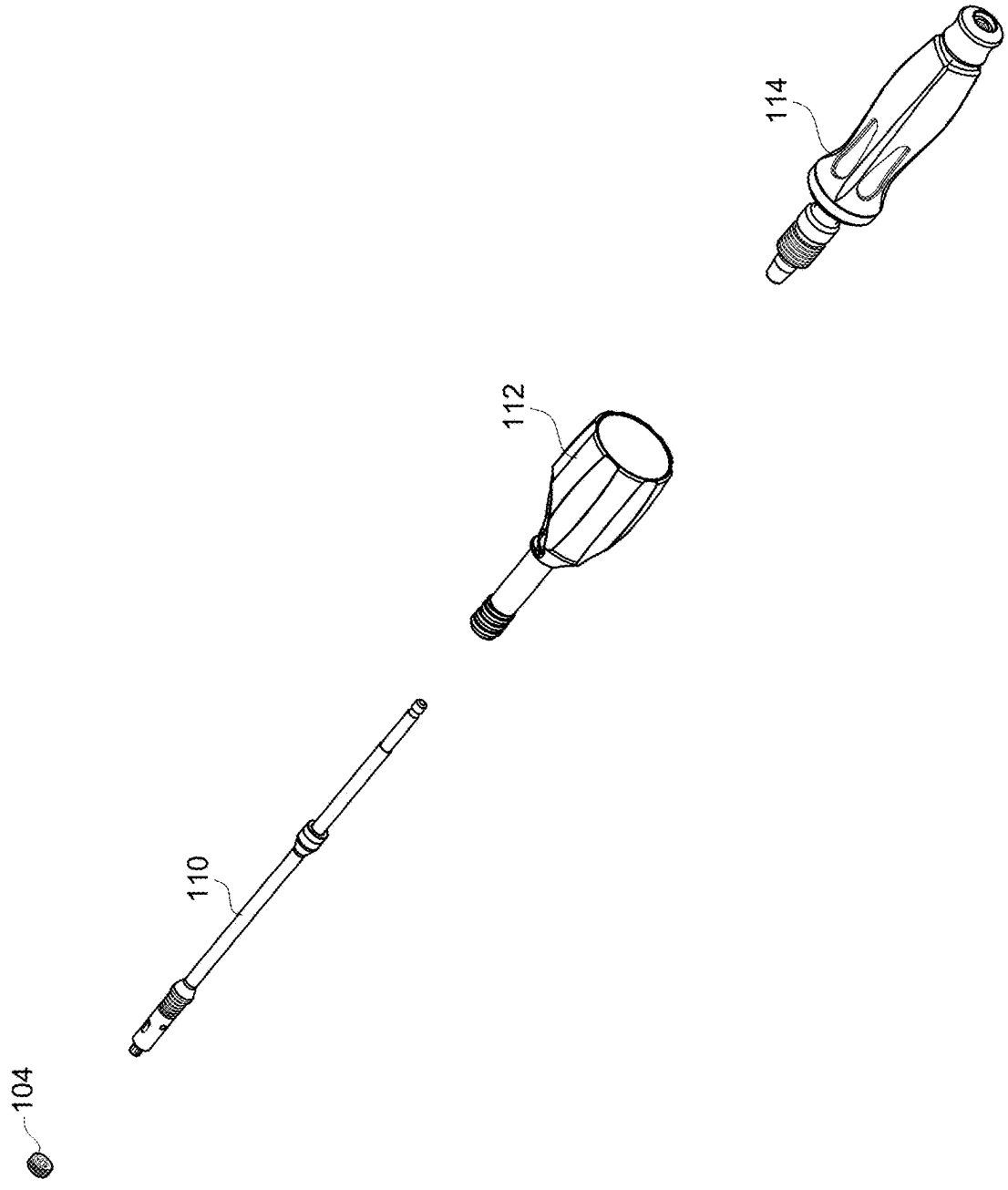


FIG. 90

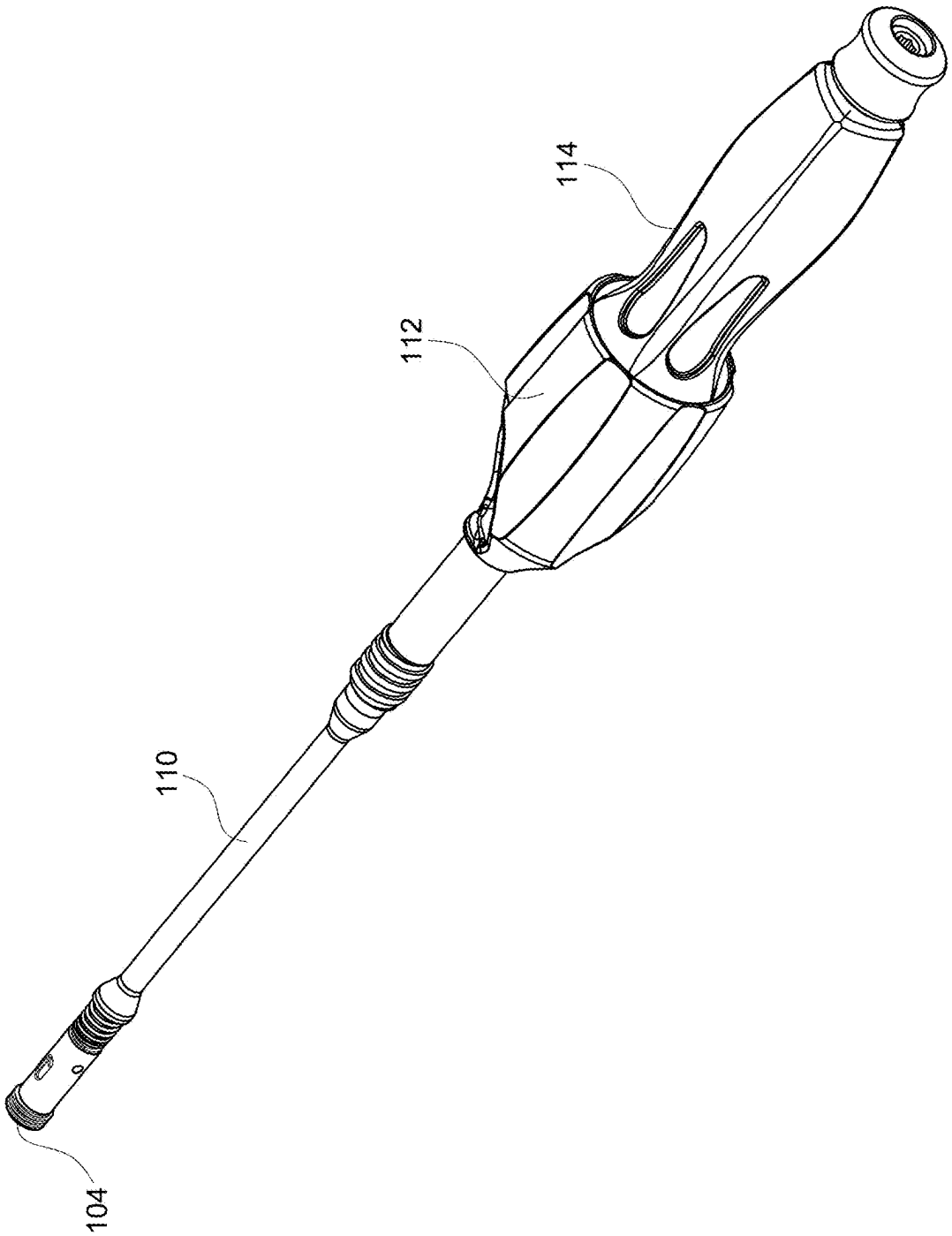


FIG. 91

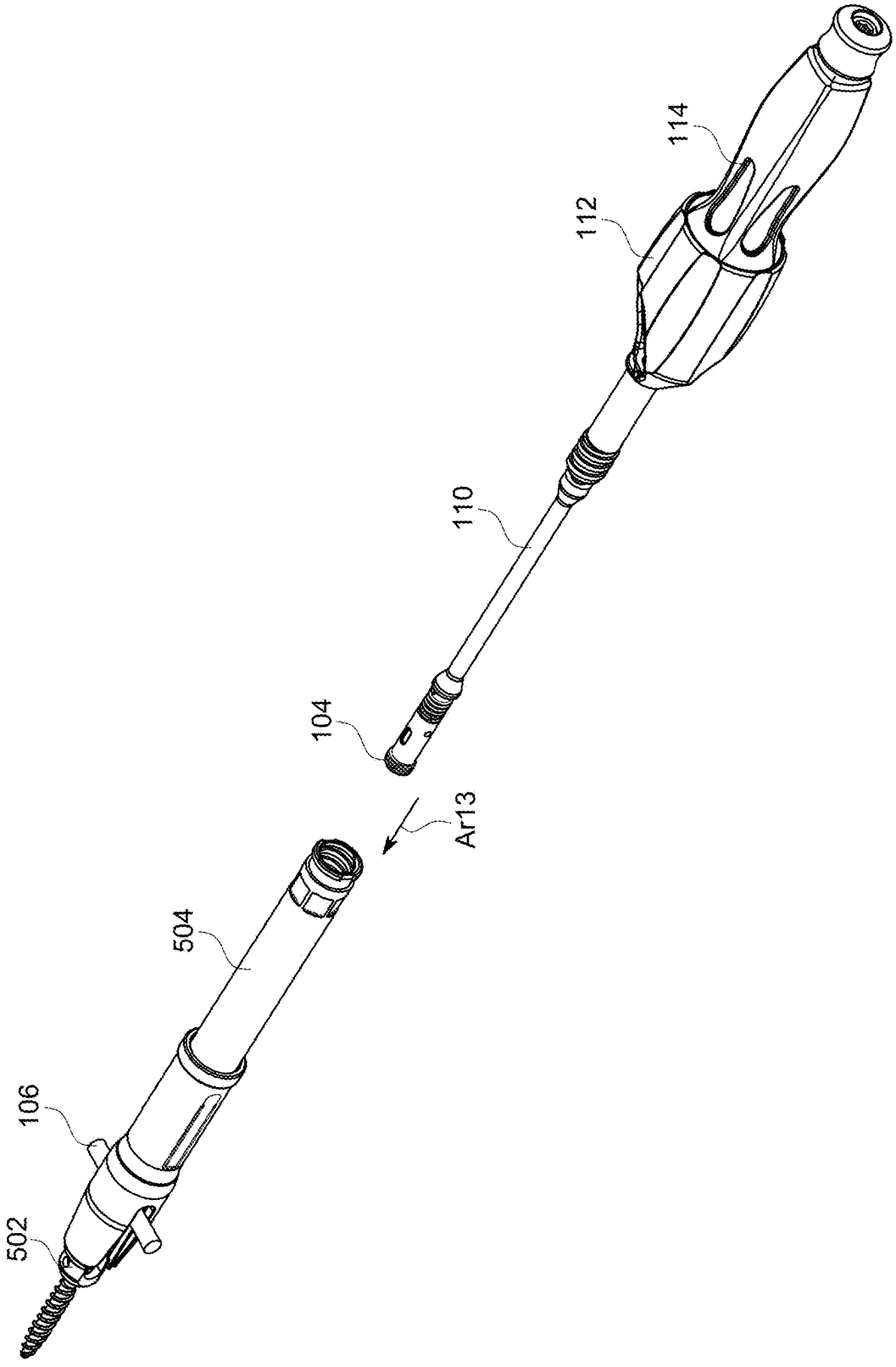


FIG. 92

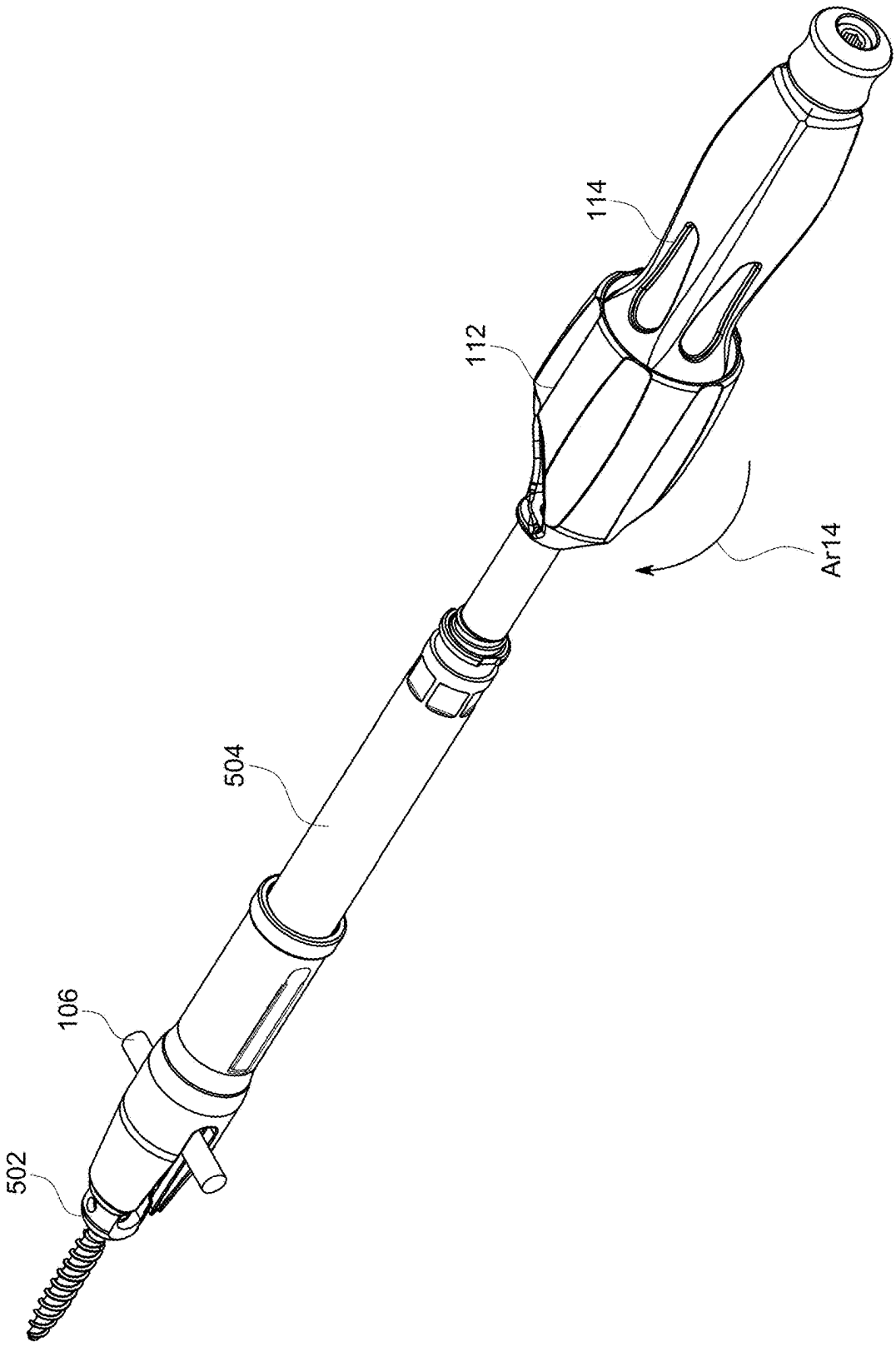


FIG. 93

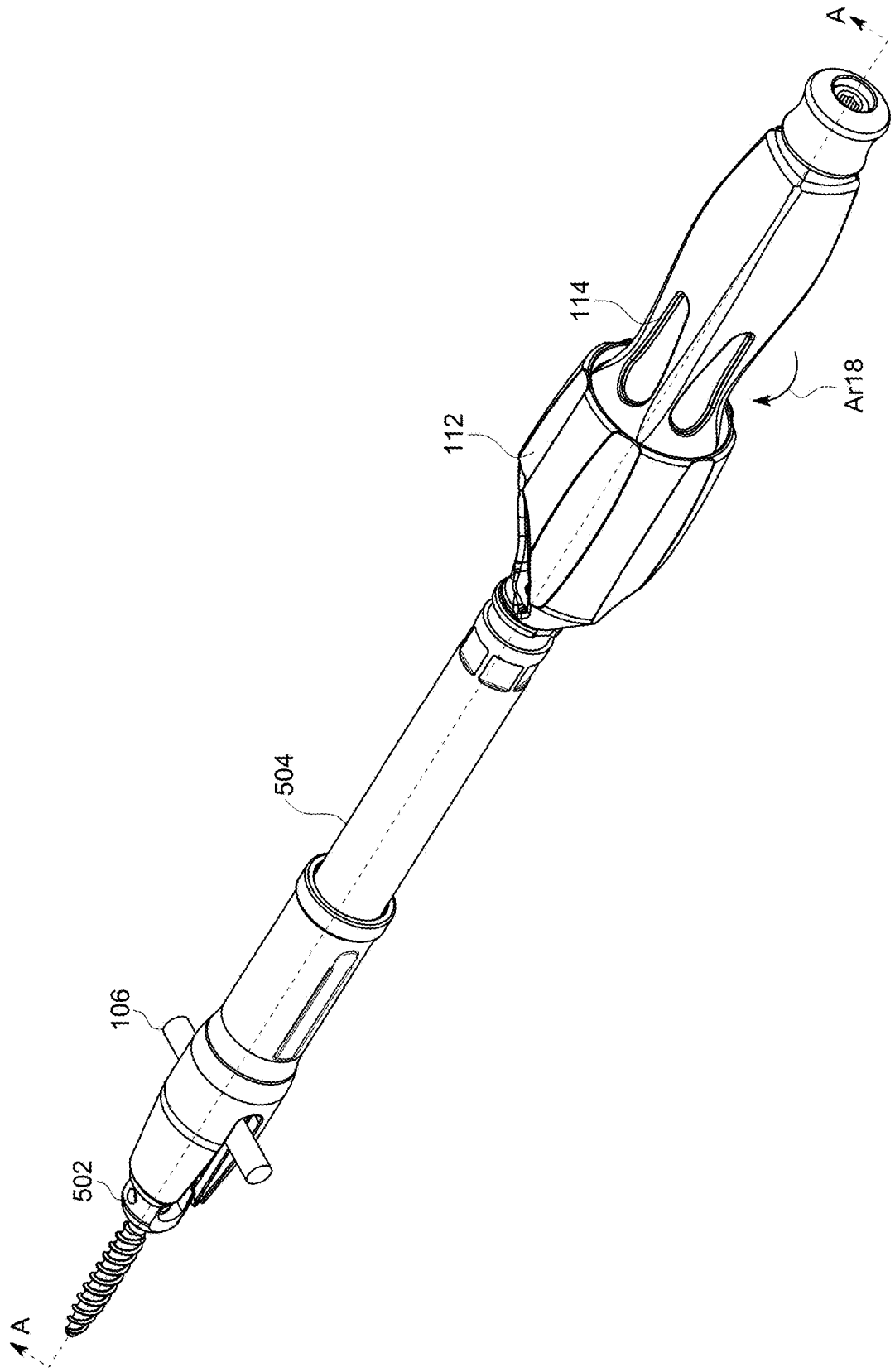


FIG. 94

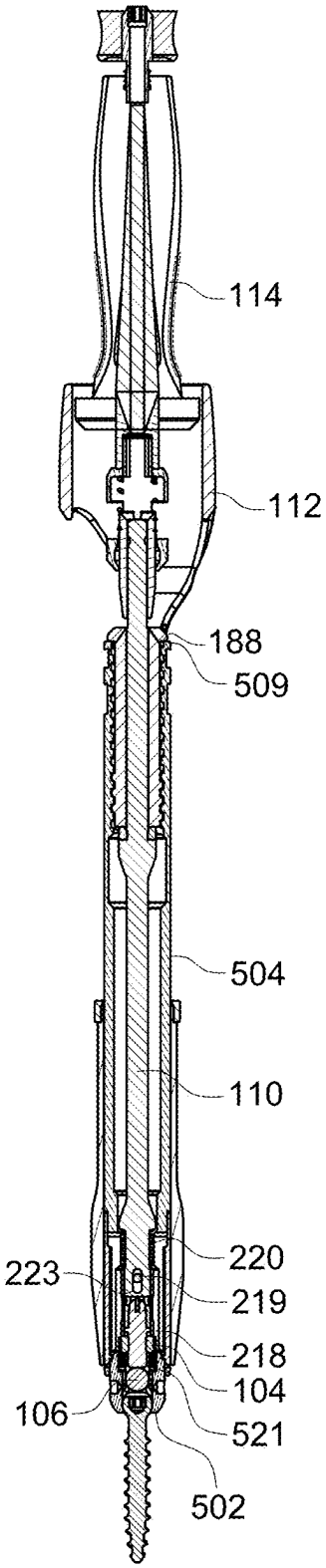

114
112
188
509
504
110
223
220
219
218
104
106
521
502

FIG. 95

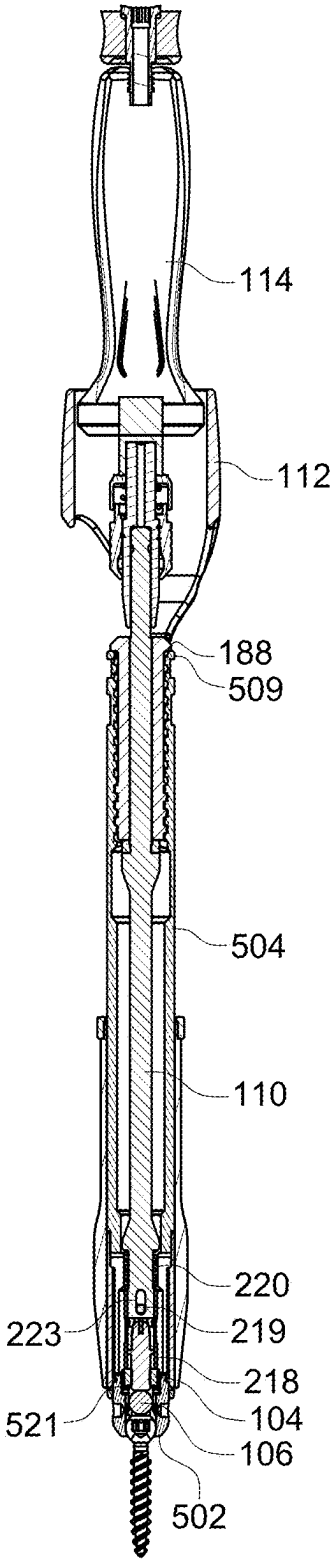

114
112
188
509
504
110
220
223
219
218
521
104
106
502

FIG. 96

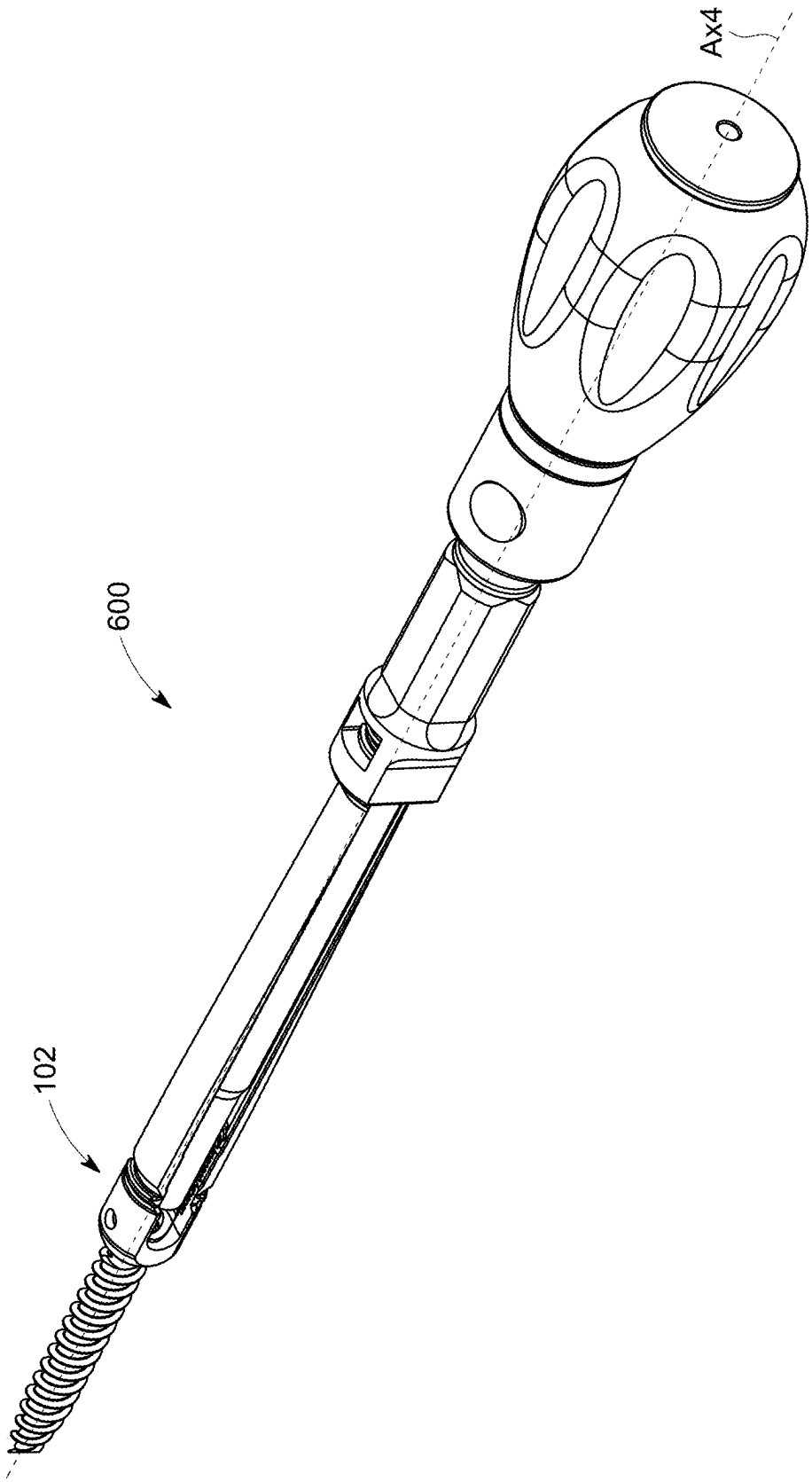


FIG. 97A

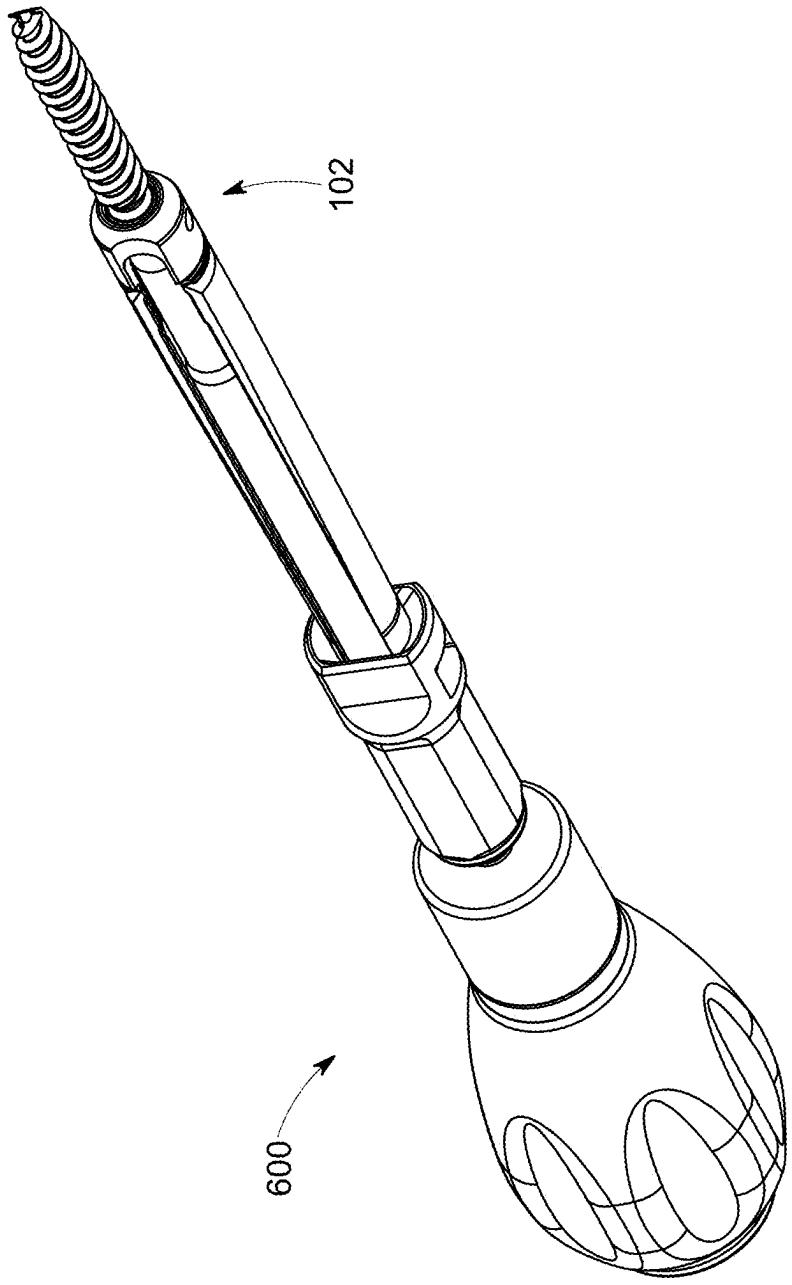


FIG. 97B

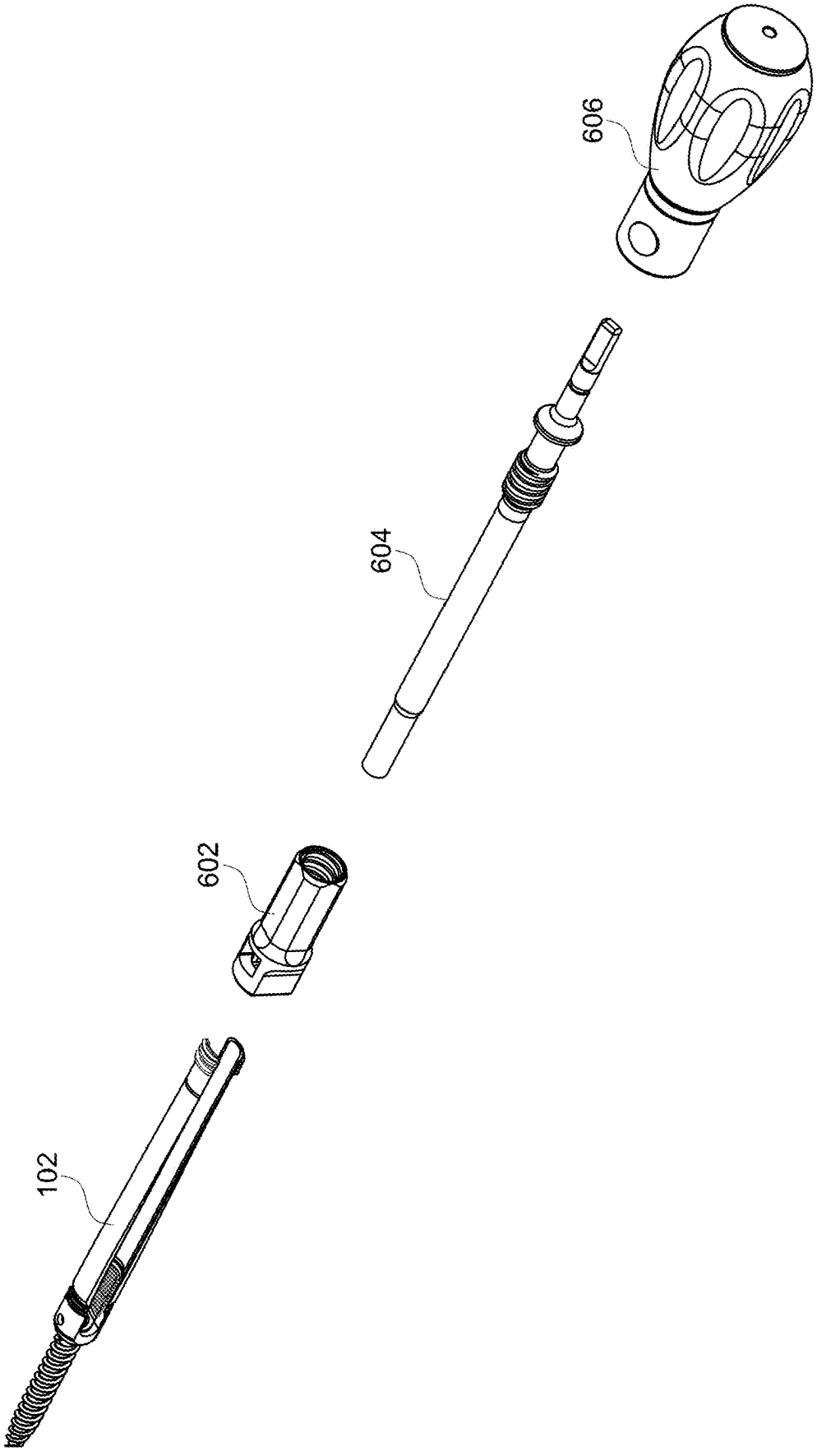


FIG. 98

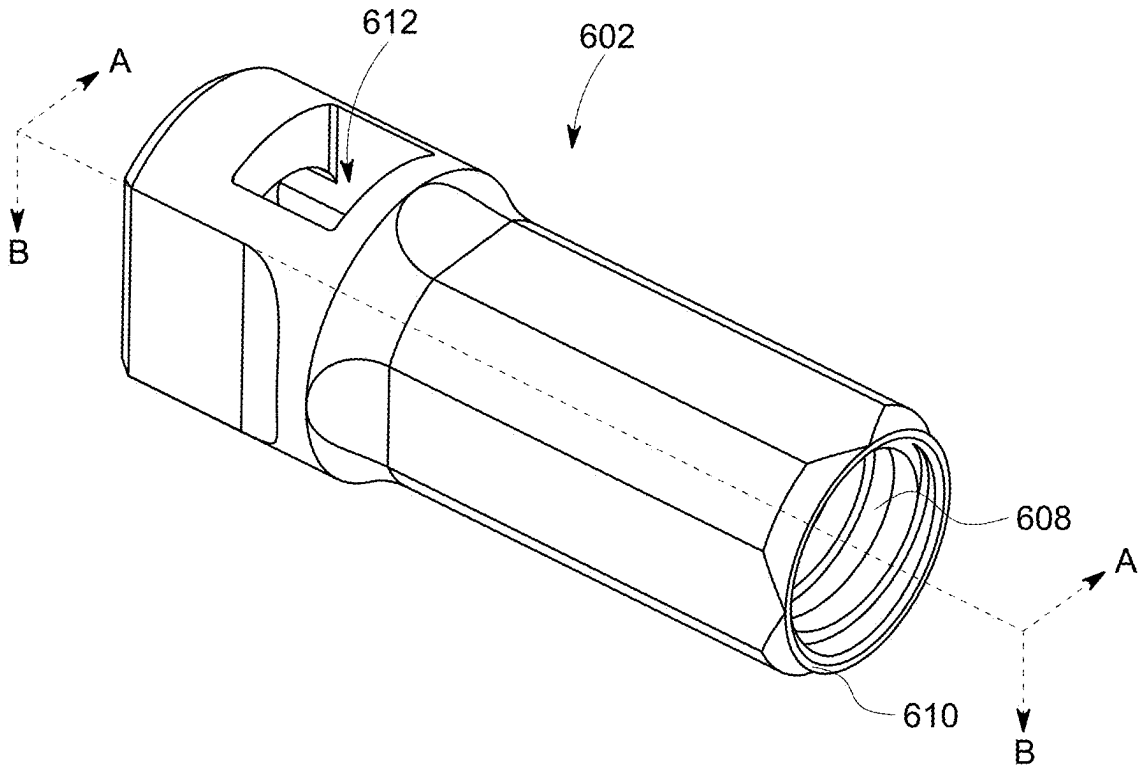


FIG. 99A

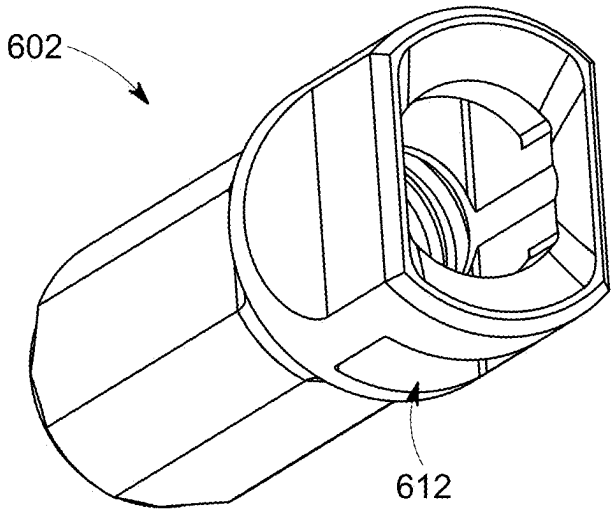


FIG. 99B

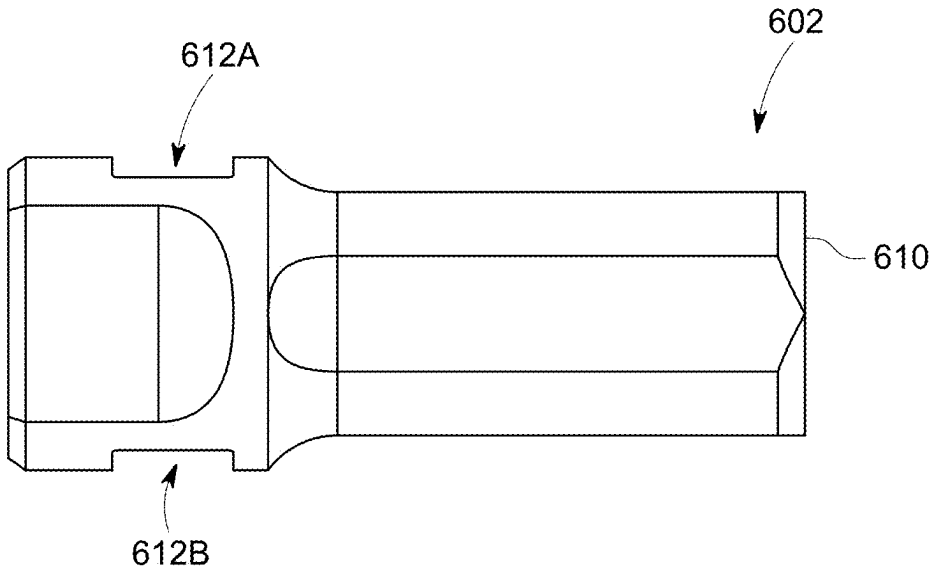


FIG. 99C

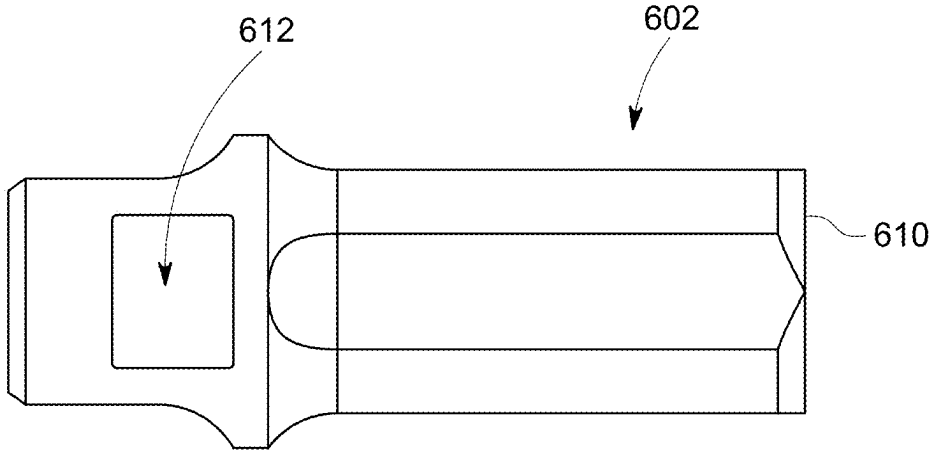


FIG. 99D

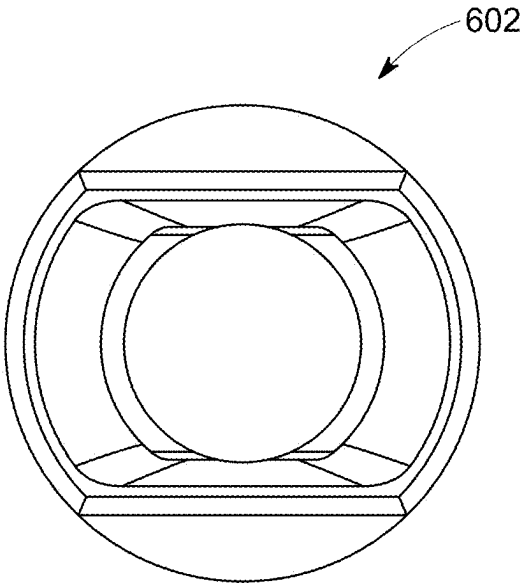


FIG. 99E

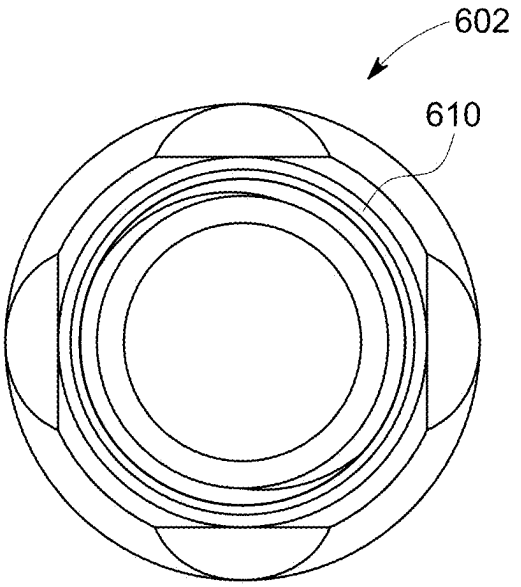


FIG. 99F

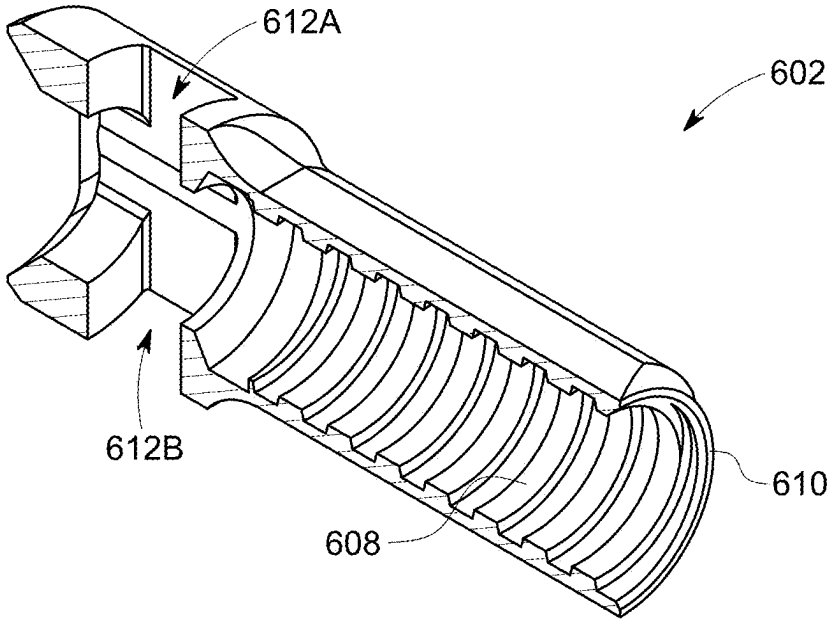


FIG. 100

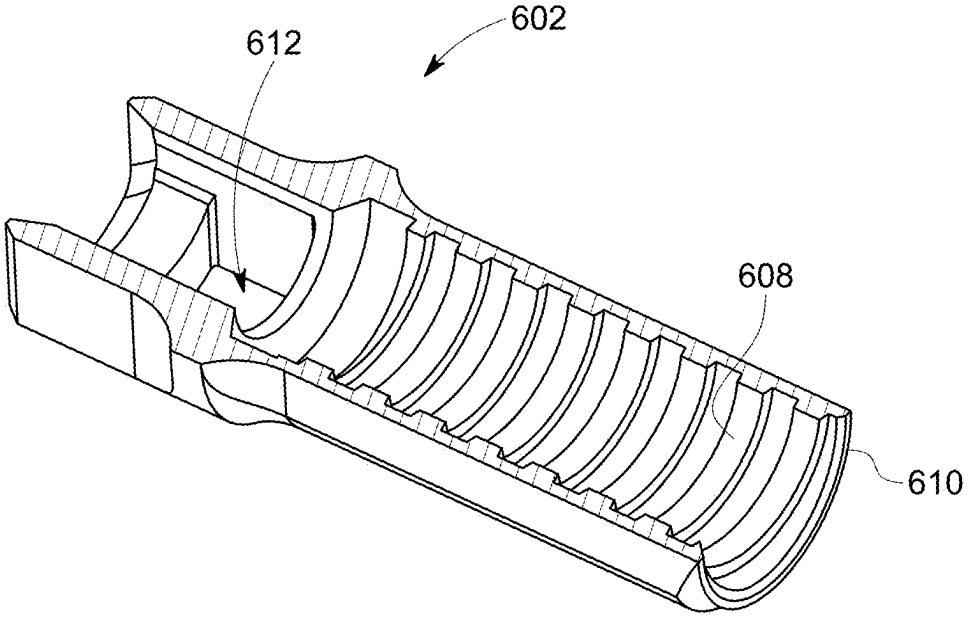


FIG. 101

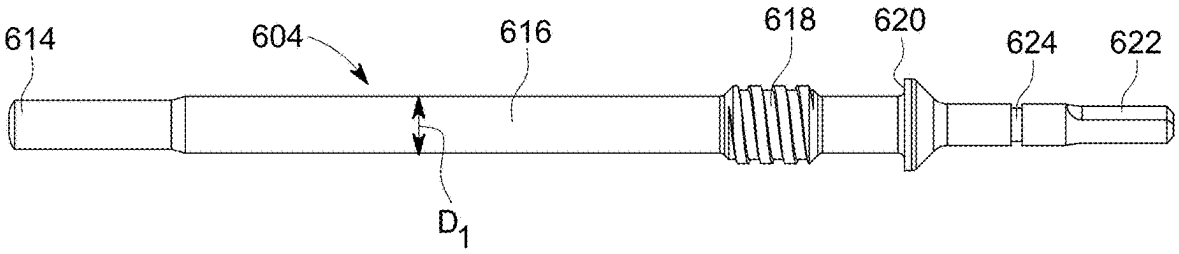


FIG. 102A

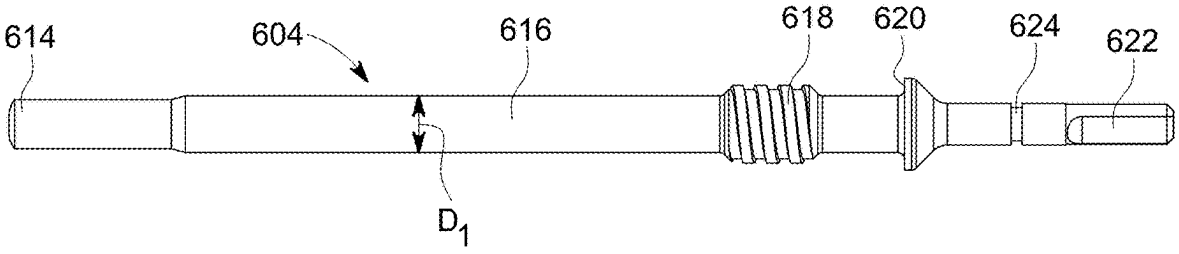


FIG. 102B

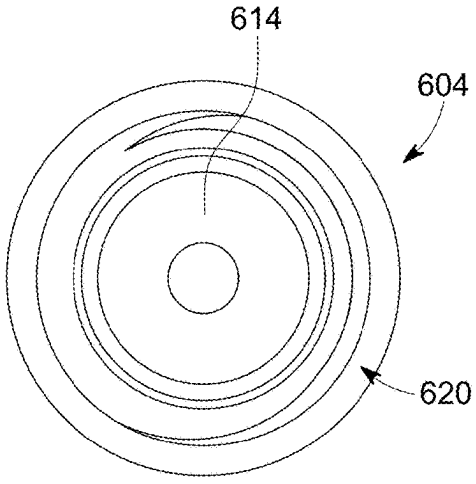


FIG. 102C

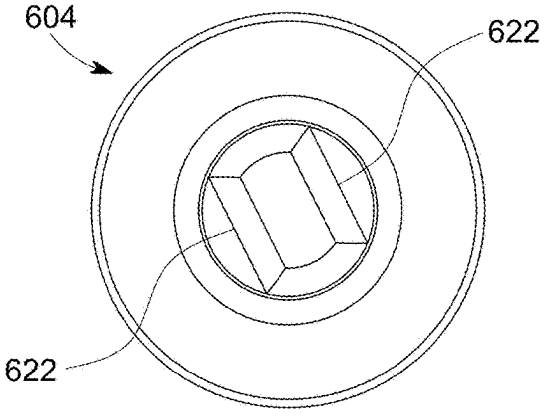


FIG. 102D

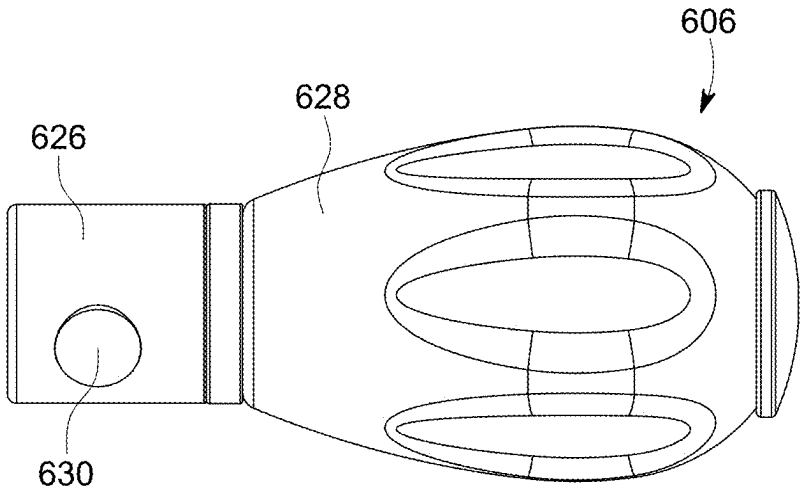


FIG. 103A

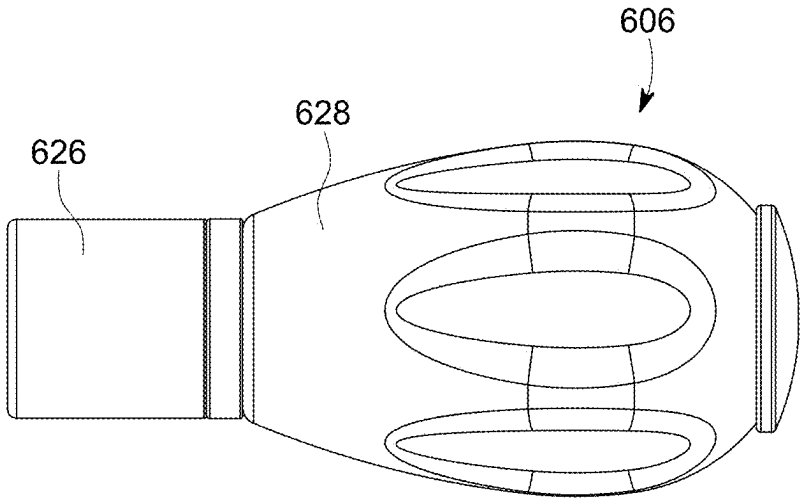


FIG. 103B

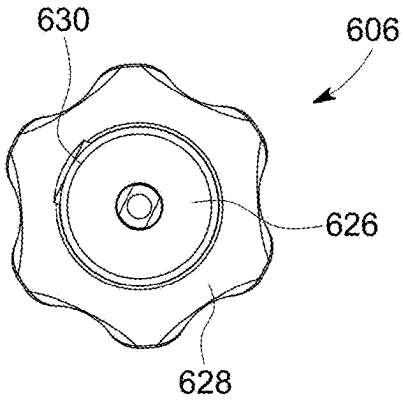


FIG. 103C

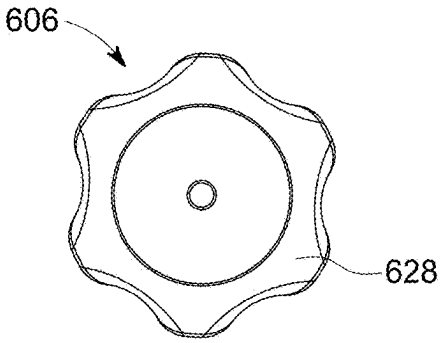


FIG. 103D

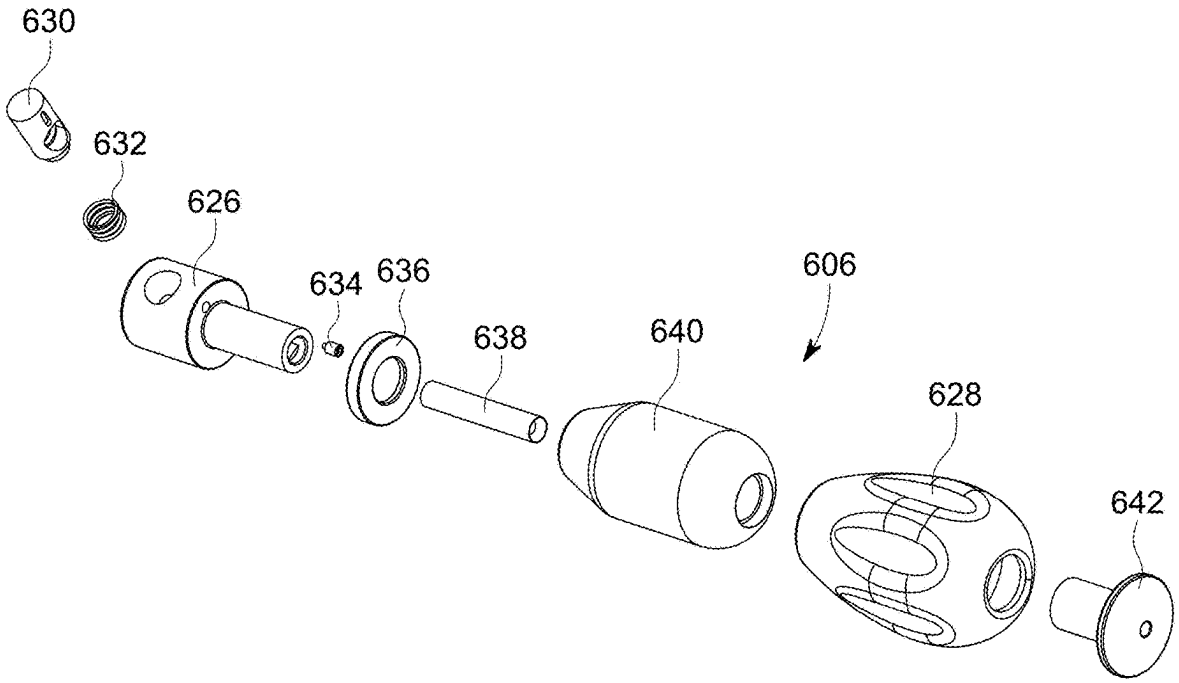


FIG. 104

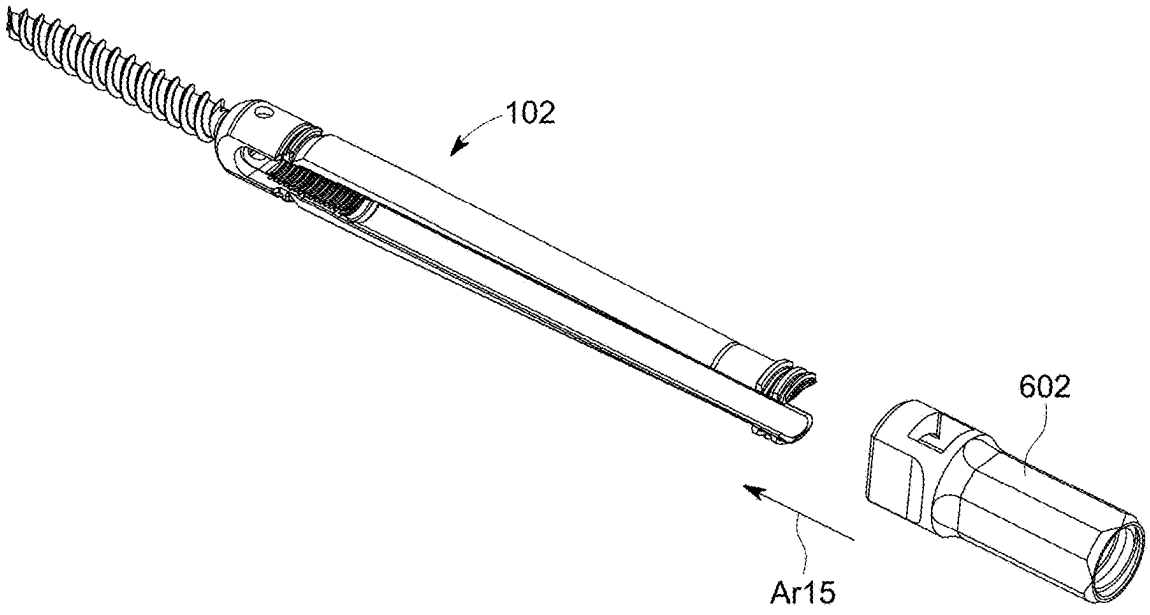


FIG. 105

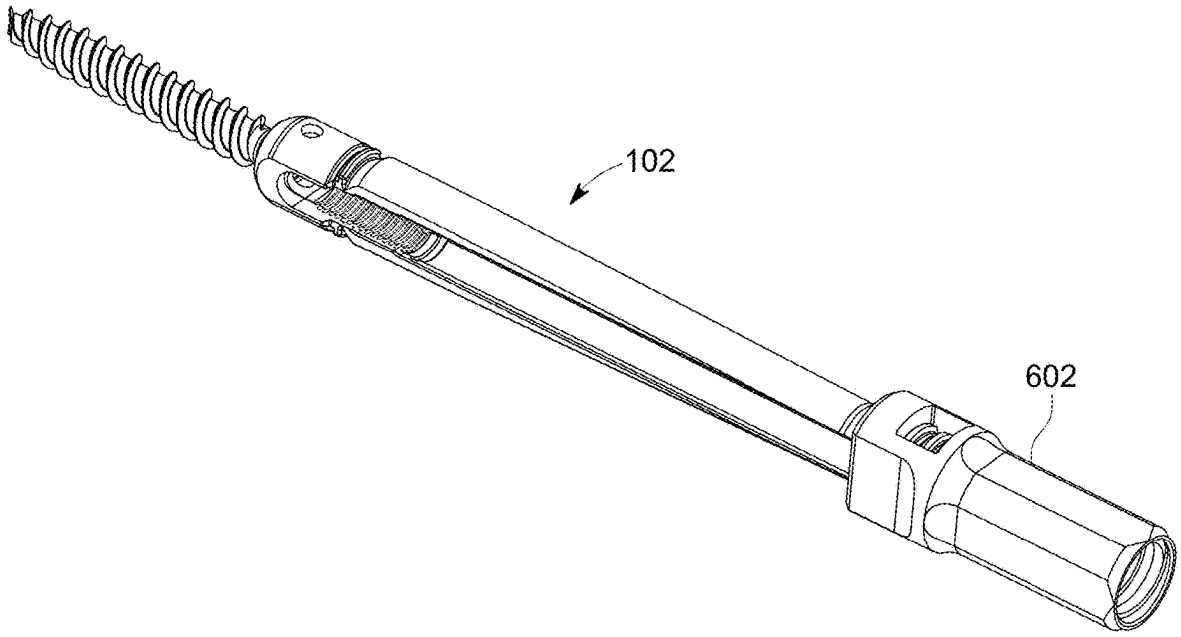


FIG. 106

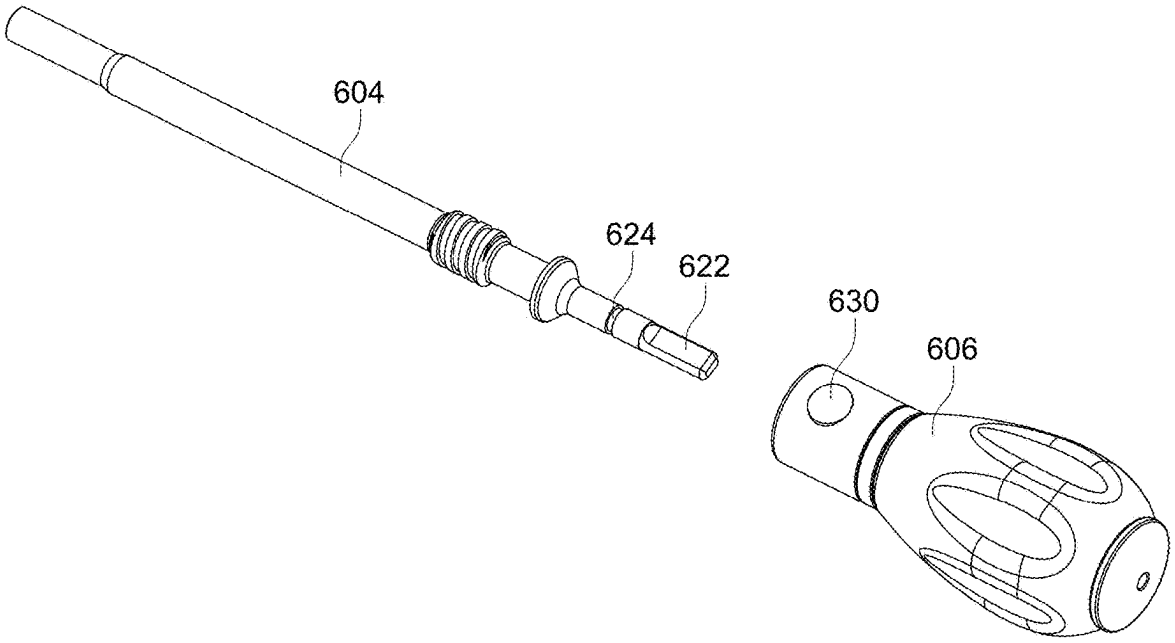


FIG. 107

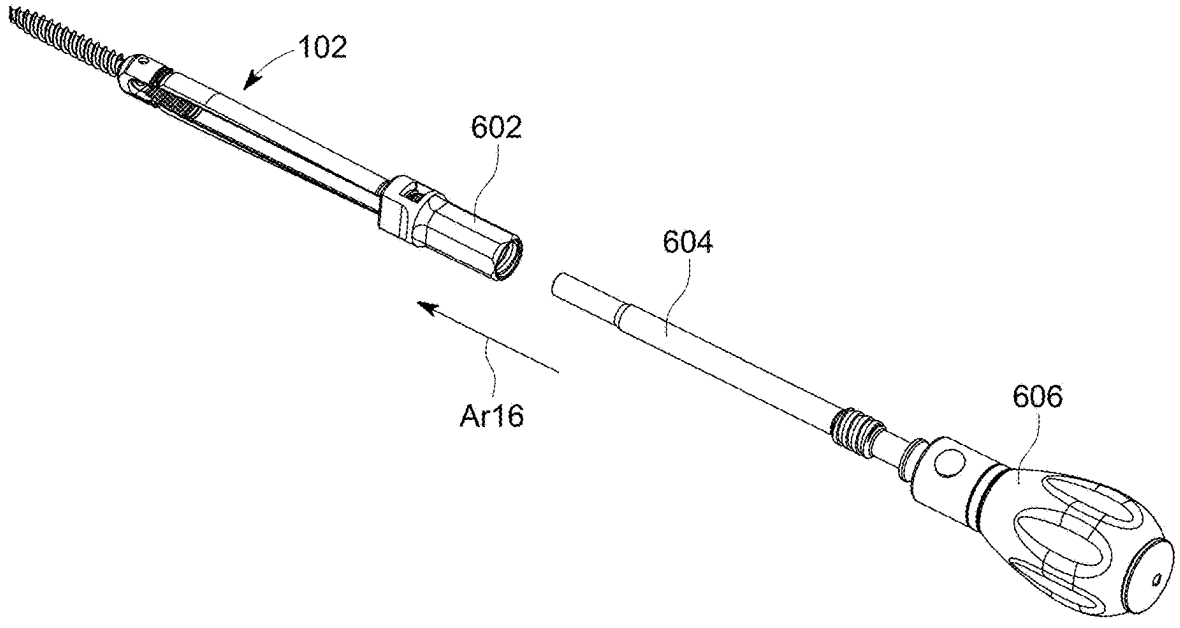


FIG. 108

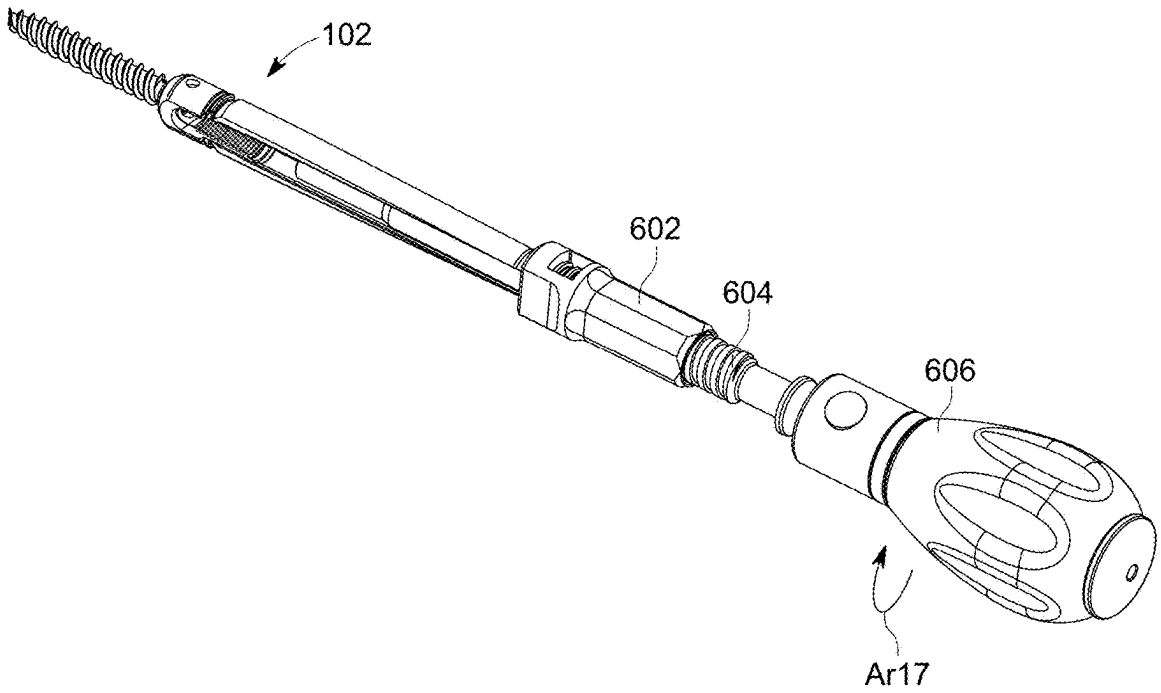


FIG. 109

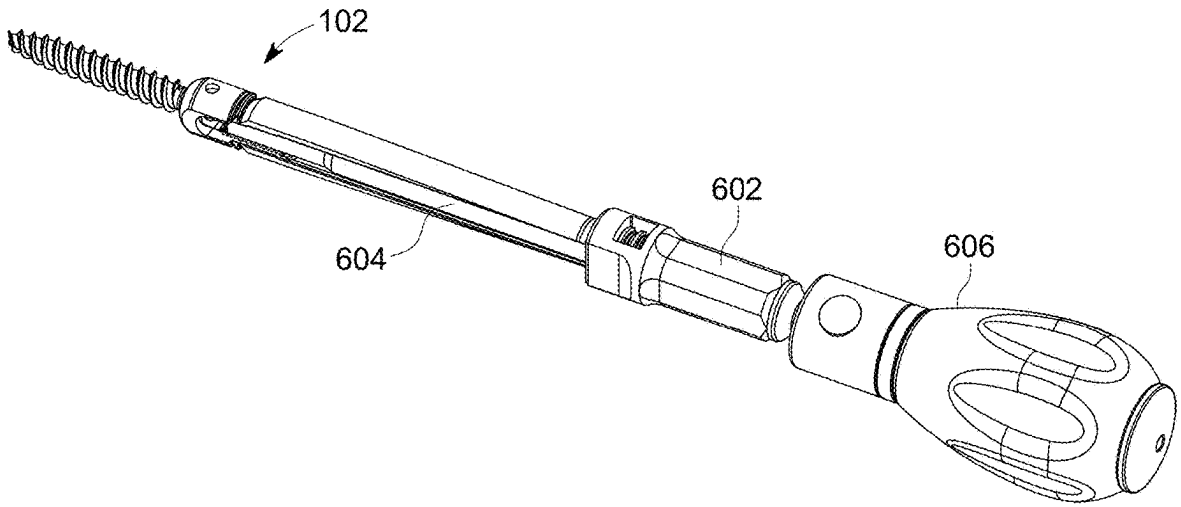


FIG. 110

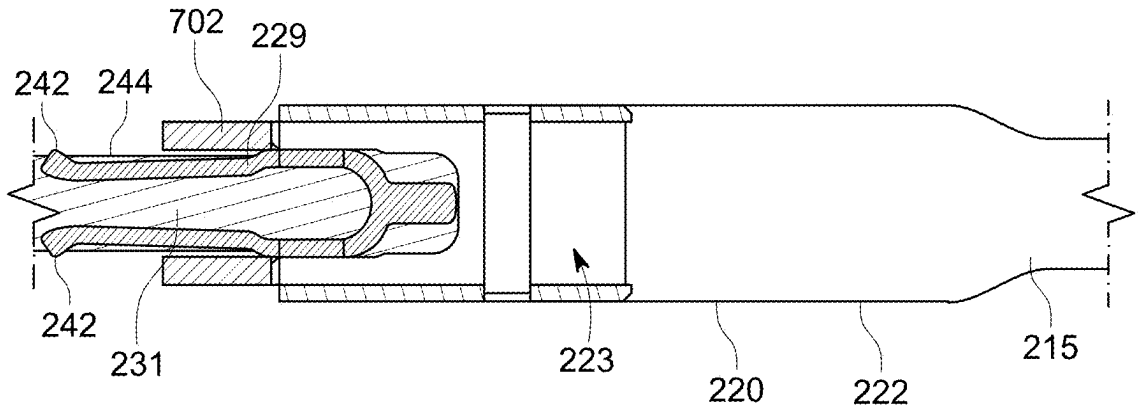


FIG. 111

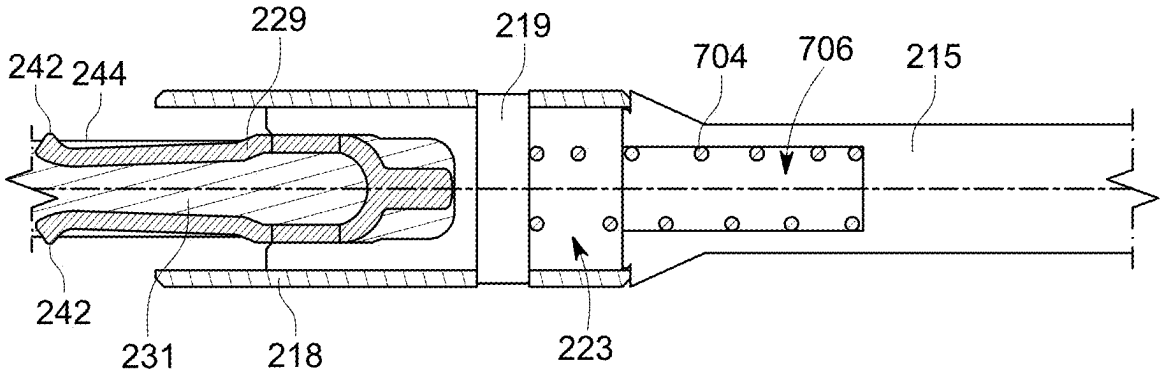


FIG. 112

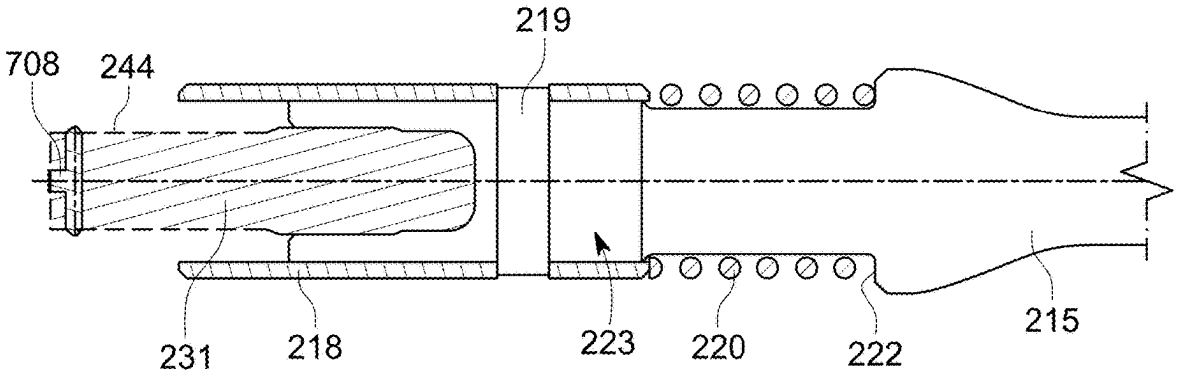


FIG. 113

PEDICLE SCREW REDUCER INSTRUMENTS AND METHODS OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 63/556,378, entitled "Pedicle Screw Reducer Instruments and Methods of Use," filed on Feb. 21, 2024. The entire contents of this application are incorporated by reference herein.

FIELD

[0002] This disclosure relates generally to surgical instruments and methods of use and, more particularly, to surgical instruments that aid in reducing or urging a spinal fixation element into a pedicle screw or other implant.

BACKGROUND

[0003] Fixation systems can be used in orthopedic surgery or neurosurgery to maintain a desired spatial relationship between multiple bones or bone fragments. For example, in spinal surgery, a spinal fixation system can be implanted into a patient to align and/or fix a desired orientation of one or more vertebrae. A typical spinal fixation system can include bone anchors, such as pedicle screws, implanted in the vertebrae and longitudinal rods or other spinal fixation elements that are secured to the bone anchors by setscrews or other closure mechanisms. Implanting the fixation system can involve multiple steps, e.g., rod reduction, derotation, and setscrew insertion, among others.

[0004] One common implantation procedure is rod reduction, whereby a rod or other spinal fixation element is aligned relative to opposed arms of a pedicle screw receiver member and reduced or urged distally toward the pedicle screw into a position where a closure mechanism like a setscrew can be utilized to secure the two components relative to one another. In some instances, a pedicle screw receiver member can have extended tabs that can facilitate alignment of the rod and reduction toward a rod seat at a base of the receiver member. The extended tabs can include threads formed along a portion thereof that can be utilized in connection with a setscrew to enable a greater amount of reduction. In some cases, the tabs can be detached or broken off after the rod is fully reduced and secured using the setscrew.

[0005] In certain cases, however, the additional amount of reduction capacity provided by the extended tabs of a pedicle screw receiver member can be insufficient for a given surgical procedure. By way of example, in some cases involving larger patients and minimally invasive surgical techniques, there can be a greater amount of tissue over a vertebra where a pedicle screw is implanted, such that the extended tabs may be insufficient to reach above the tissue and/or a skin surface of the patient. In such cases, there can be a need for additional reduction capacity to complete a procedure.

[0006] In addition, certain prior setscrew insertion instruments rigidly position a setscrew or other closure at a distal end of the instrument and, as a result, it can be difficult to properly thread the setscrew into engagement with the threads of the pedicle screw, e.g., on the extension tabs. For example, axial misalignment of the setscrew relative to the pedicle screw receiver member can make engaging the threaded interface difficult and/or damage components, such as the threads of the setscrew.

[0007] Accordingly, there is a need for improved pedicle screw reducer instruments that can provide additional reduction capability and alleviate difficulties in surgical procedures like those described herein.

SUMMARY

[0008] The present disclosure addresses the above-noted deficiencies and generally relates to surgical instruments that aid in reducing or urging a spinal fixation element into a pedicle screw or other implant (e.g., another form of bone anchor, etc.). The present disclosure provides streamlined pedicle screw reduction instruments that can facilitate delivery of a setscrew or other closure, reduction of a rod or other spinal fixation element into a pedicle screw, and securing the rod relative to the pedicle screw using the setscrew. Example instruments and methods according to the present disclosure can utilize a reducer clip that couples to a proximal end of a pedicle screw receiver head or extension tabs thereof, an inserter-reducer shaft that can couple with a setscrew at its distal end, a reducer handle that can threadably engage with the reducer clip to translate the shaft and thereby reduce a rod, and a driver handle that can rotate the inserter-reducer shaft to engage the setscrew with threads formed on the pedicle screw or extension tabs thereof.

[0009] An example system can include a reducer clip having a lumen extending from a proximal end to a distal end thereof, a recess formed in a sidewall of the reducer clip along a distal portion thereof, and threads formed in the sidewall of the reducer clip along a proximal portion thereof. The system can further include a shaft disposed through the lumen of the reducer clip. The system can further include a reducer handle having a lumen extending from a proximal end to a distal end thereof and threads formed along an outer distal portion thereof, the reducer handle threads interfacing with the threads formed along the proximal portion of the reducer clip. The system can further include a driver handle coupled to a proximal portion of the shaft extending through the reducer handle.

[0010] Any of a variety of alternative or additional features can be included and are considered within the scope of the present disclosure. For example, in some embodiments, the driver handle can extend proximal to the reducer handle.

[0011] In certain embodiments, the reducer clip can be a monolithic component. In other embodiments, the reducer clip can be a multi-part component.

[0012] In some embodiments, the reducer clip can further include a locking sleeve with a locking tab at a distal end thereof that is configured to translate relative to another portion of the reducer clip. In certain embodiments, the reducer clip can further include a biasing element that urges the locking sleeve distally relative to another portion of the reducer clip.

[0013] In certain embodiments, the reducer clip can further include opposed tabs extending radially away from a longitudinal axis of the reducer clip.

[0014] In some embodiments, the reducer clip can further include a flat formed on an outer proximal portion thereof.

[0015] In certain embodiments, the shaft can further include a distal portion configured to rotationally drive a setscrew, a sleeve disposed around the shaft over at least part

of the distal portion thereof, and a biasing element disposed proximal to the sleeve and configured to urge the sleeve distally relative to the shaft.

[0016] In some embodiments, the shaft can further include a proximal-facing shoulder. This proximal-facing shoulder can act as a bearing surface for the reducer handle to urge the shaft distally relative to a bone anchor and the reducer clip coupled thereto.

[0017] In certain embodiments, the shaft can further include a flat formed along a proximal portion thereof. The flat can be utilized to facilitate coupling of the driver handle to the shaft to allow the driver handle to rotate the shaft.

[0018] In some embodiments, the reducer handle can further include a distal-facing shoulder disposed proximal to the threads. The distal-facing shoulder can act as a stop configured to contact a proximal-facing portion of the reducer clip and prevent further distal advancement of the reducer handle relative to the reducer clip and bone anchor coupled thereto.

[0019] In certain embodiments, the reducer handle can further include a cylindrical proximal portion defining a proximal-facing recess.

[0020] In some embodiments, the reducer handle can further include opposed paddles extending radially away from a longitudinal axis of the reducer handle and defining a gap therebetween at a proximal end of the reducer handle.

[0021] In certain embodiments, the reducer clip can include a bone anchor extension having an inner sleeve with opposed distally-extending arms and a threaded proximal portion, as well as an outer sleeve disposed over the inner sleeve and configured to translate relative to the inner sleeve to selectively lock the bone anchor extension to a bone anchor.

[0022] In some embodiments, the system can further include a bone anchor, wherein the reducer clip is configured to couple to a proximal portion of the bone anchor.

[0023] In certain embodiments, the reducer handle can further include a distal-facing shoulder configured to contact a proximal-facing portion of the reducer clip to prevent further distal advancement of the reducer handle relative to the reducer clip.

[0024] An example instrument of the present disclosure is a reducer clip that can include a distal sleeve having a lumen extending from a proximal end to a distal end thereof and a recess formed in a sidewall of the distal sleeve along a distal portion thereof. The reducer clip can further include a proximal sleeve having a lumen extending from a proximal end to a distal end thereof and threads formed in a sidewall of the proximal sleeve along a proximal portion thereof. The reducer clip can further include a locking sleeve having a lumen extending from a proximal end to a distal end thereof and a locking tab at the distal end thereof. Further, a distal portion of the proximal sleeve can be received within a proximal portion of the distal sleeve. Further, a distal portion of the locking sleeve can be received within the proximal portion of the distal sleeve. Still further, the locking sleeve can be axially disposed between the distal sleeve and the proximal sleeve and configured to axially translate relative thereto.

[0025] As with the systems described above, the instruments disclosed herein can include any of a variety of additional or alternative features that are considered within the scope of the present disclosure. For example, in some embodiments, the reducer clip can further include a biasing element disposed between the locking sleeve and the proximal sleeve that is configured to distally bias the locking sleeve relative to the proximal sleeve.

[0026] In certain embodiments, the distal sleeve can include opposed recesses formed in the sidewall of the distal sleeve along a distal portion thereof and the locking sleeve includes opposed locking tabs at the distal end thereof.

[0027] In some embodiments, the locking sleeve can further include opposed tabs extending radially away from a longitudinal axis of the reducer clip.

[0028] In certain embodiments, a proximal portion of the locking sleeve can surround a portion of the proximal sleeve.

[0029] In some embodiments, the proximal sleeve can further include a flat formed on an outer proximal portion thereof.

[0030] In certain embodiments, the distal sleeve can be configured to receive a proximal portion of a bone anchor within the lumen thereof.

[0031] Another example instrument of the present disclosure is an inserter-reducer shaft that can include an elongate body having a proximal portion with a flat formed thereon, a distal portion configured to rotationally drive a setscrew, a first, distal-facing shoulder formed proximal to the distal portion, and a second, proximal-facing shoulder formed proximal to the first shoulder and distal to the proximal portion. The inserter-reducer shaft can further include a sleeve disposed around the elongate body distal to the first shoulder. The inserter-reducer shaft can further include a biasing element disposed between the sleeve and the first shoulder and configured to bias the sleeve distally relative to the elongate body.

[0032] As with the systems and instruments described above, the instruments disclosed herein can include any of a variety of additional or alternative steps that are considered within the scope of the present disclosure. For example, in some embodiments, the sleeve can be constrained against translating relative to the elongate body beyond a distal end of the portion configured to rotationally drive a setscrew.

[0033] In certain embodiments, the biasing element can be a coil spring disposed around the elongate body between a proximal end of the sleeve and the first shoulder.

[0034] In some embodiments, a portion of the elongate body extending between the first shoulder and the second shoulder can have an outer diameter that is less than a diameter of one or more of the first shoulder and the second shoulder.

[0035] In certain embodiments, a portion of the elongate body extending between the first shoulder and the second shoulder can have an outer diameter equal to the diameter of one or more of the first shoulder and the second shoulder.

[0036] In some embodiments, an outer diameter of the first shoulder and an outer diameter of the second shoulder can be equal.

[0037] In certain embodiments, the inserter-reducer shaft can further include a spring clip configured to aid retention of a setscrew along the distal portion of the elongate body.

[0038] In some embodiments, the inserter-reducer shaft can further include a thrust bearing disposed around the elongate body proximal to the second shoulder.

[0039] In certain embodiments, the distal portion of the elongate body can further include an insert received within a distal-facing recess of the elongate body.

[0040] An example surgical method according to the present disclosure can include coupling a reducer clip to a

proximal end of a bone anchor. The method can further include passing a distal portion of a shaft having a setscrew disposed thereon through a lumen of the reducer clip until a distal threaded portion of a reducer handle disposed around the shaft contacts a proximal threaded portion of the reducer clip. The method can further include rotating the reducer handle to engage the threads of the reducer handle with the threads of the reducer clip and advance the shaft distally. The method can further include rotating a driver handle coupled to a proximal end of the shaft extending through the reducer handle to engage threads on an outer surface of the setscrew with threads formed on an inner surface of the bone anchor.

[0041] As with the systems and instruments described above, the methods disclosed herein can include any of a variety of additional or alternative steps that are considered within the scope of the present disclosure. For example, in some embodiments, the method can further include passing a proximal end of the shaft through a lumen of the reducer handle.

[0042] In certain embodiments, the method can further include coupling the driver handle to the proximal end of the shaft extending through the reducer handle.

[0043] In some embodiments, the method can further include loading the setscrew onto a distal end of the shaft. Loading the setscrew onto the distal end of the shaft can include contacting the setscrew against a distally biased sleeve disposed around the shaft.

[0044] In certain embodiments, coupling the reducer clip to the bone anchor can include squeezing opposed arms of the bone anchor radially inward toward one another while passing a distal end of the reducer clip over the proximal end of the bone anchor. Further, coupling the reducer clip to the bone anchor can include releasing the opposed arms of the bone anchor after passing the distal end of the reducer clip over the proximal end of the bone anchor such that opposed portions of the opposed arms of the bone anchor extend into opposed recesses formed in a sidewall of the reducer clip.

[0045] In some embodiments, coupling the reducer clip to the bone anchor can include proximally withdrawing a locking sleeve of the reducer clip while passing a distal portion of the reducer clip over the proximal end of the bone anchor and distally advancing the locking sleeve after the distal portion of the reducer clip is positioned over the proximal end of the bone anchor.

[0046] In certain embodiments, rotating the reducer handle can include contacting a shoulder formed on the reducer handle against a proximal end of the reducer clip to prevent further distal advancement of the reducer handle relative to the reducer clip.

[0047] In some embodiments, the method can further include separating the reducer clip, the shaft, the reducer handle, and the driver handle as a single unit from the bone anchor after rotating the driver handle to engage the threads on the setscrew with the threads on the bone anchor.

[0048] Any of the features or variations described herein can be applied to any particular aspect or embodiment of the present disclosure in a number of different combinations. The absence of explicit recitation of any particular combination is due solely to avoiding unnecessary length or repetition.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] The aspects and embodiments of the present disclosure can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0050] FIG. **1**A is a proximal perspective view of one embodiment of an assembly, including a pedicle screw reducer instrument coupled to a pedicle screw, setscrew, and rod, according to one embodiment of the present disclosure;

[0051] FIG. **1**B is a distal perspective view of the assembly of FIG. **1**A;

[0052] FIG. **2**A is a proximal perspective view of the pedicle screw reducer instrument of FIG. **1**A;

[0053] FIG. **2**B is a distal perspective view of the pedicle screw reducer instrument of FIG. **1**A;

[0054] FIG. **3** is an exploded view of the pedicle screw reducer instrument of FIG. **1**A;

[0055] FIG. **4** is an exploded view of the pedicle screw and rod of FIG. **1**A;

[0056] FIG. **5** is a detail view of a rod receiving head of the pedicle screw of FIG. **1**A;

[0057] FIG. **6** is a detail view of the setscrew of FIG. **1**A;

[0058] FIG. **7**A is a proximal perspective view of a reducer clip of the pedicle screw reducer instrument of FIG. **1**A;

[0059] FIG. **7**B is a distal perspective view of the reducer clip of FIG. **7**A;

[0060] FIG. **7**C is a side view of the reducer clip of FIG. **7**A (an opposing side view can be substantially identical);

[0061] FIG. **7**D is a top view of the reducer clip of FIG. **7**A (an opposing bottom view can be substantially identical);

[0062] FIG. **7**E is a distal view of the reducer clip of FIG. **7**A;

[0063] FIG. **7**F is a proximal view of the reducer clip of FIG. **7**A;

[0064] FIG. **8** is an exploded view of the reducer clip of FIG. **7**A;

[0065] FIG. **9** is a cross-sectional view of the reducer clip of FIG. **7**A taken along the lines A-A in FIG. **7**A;

[0066] FIG. **10** is a cross-sectional view of the reducer clip of FIG. **7**A taken along the lines B-B in FIG. **7**A;

[0067] FIG. **11**A is a proximal perspective view of a distal sleeve of the reducer clip of FIG. **7**A;

[0068] FIG. **11**B is a distal perspective view of the distal sleeve of FIG. **11**A;

[0069] FIG. **11**C is a side view of the distal sleeve of FIG. **11**A (an opposing side view can be substantially identical);

[0070] FIG. **11**D is a top view of the distal sleeve of FIG. **11**A (an opposing bottom view can be substantially identical);

[0071] FIG. **11**E is a distal view of the distal sleeve of FIG. **11**A;

[0072] FIG. **11**F is a proximal view of the distal sleeve of FIG. **11**A;

[0073] FIG. **12**A is a proximal perspective view of a locking sleeve of the reducer clip of FIG. **7**A;

[0074] FIG. **12**B is a distal perspective view of the locking sleeve of FIG. **12**A;

[0075] FIG. **12**C is a side view of the locking sleeve of FIG. **12**A (an opposing side view can be substantially identical);

[0076] FIG. **12**D is a top view of the locking sleeve of FIG. **12**A (an opposing bottom view can be substantially identical);

[0077] FIG. **12**E is a distal view of the locking sleeve of FIG. **12**A;
[0078] FIG. **12**F is a proximal view of the locking sleeve of FIG. **12**A;
[0079] FIG. **13**A is a proximal perspective view of a proximal sleeve of the reducer clip of FIG. **7**A;
[0080] FIG. **13**B is a distal perspective view of the proximal sleeve of FIG. **13**A;
[0081] FIG. **13**C is a side view of the proximal sleeve of FIG. **13**A (an opposing side view can be substantially identical);
[0082] FIG. **13**D is a top view of the proximal sleeve of FIG. **13**A (an opposing bottom view can be substantially identical);
[0083] FIG. **13**E is a distal view of the proximal sleeve of FIG. **13**A;
[0084] FIG. **13**F is a proximal view of the proximal sleeve of FIG. **13**A;
[0085] FIG. **14**A is a proximal perspective view of a reducer handle of the pedicle screw reducer instrument of FIG. **1**A;
[0086] FIG. **14**B is a distal perspective view of the reducer handle of FIG. **14**A;
[0087] FIG. **14**C is a side view of the reducer handle of FIG. **14**A (an opposing side view can be substantially identical);
[0088] FIG. **14**D is a distal view of the reducer handle of FIG. **14**A;
[0089] FIG. **14**E is a proximal view of the reducer handle of FIG. **14**A;
[0090] FIG. **15**A is a proximal perspective view of a setscrew driver handle of the pedicle screw reducer instrument of FIG. **1**A;
[0091] FIG. **15**B is a distal perspective view of the setscrew driver handle of FIG. **15**A;
[0092] FIG. **15**C is a side view of the setscrew driver handle of FIG. **15**A (an opposing side view can be substantially identical);
[0093] FIG. **15**D is a distal view of the setscrew driver handle of FIG. **15**A;
[0094] FIG. **15**E is a proximal view of the setscrew driver handle of FIG. **15**A;
[0095] FIG. **16** is an exploded view of the setscrew driver handle of FIG. **15**A;
[0096] FIG. **17** is a cross-sectional view of the exploded setscrew driver handle of FIG. **16** taken along the lines A-A in FIG. **16**;
[0097] FIG. **18** is a cross-sectional view of the setscrew driver handle of FIG. **15**A taken along the lines A-A in FIG. **15**A;
[0098] FIG. **19** is a cross-sectional view of the setscrew driver handle of FIG. **15**A taken along the lines B-B in FIG. **15**A;
[0099] FIG. **20** is a cross-sectional view of the setscrew driver handle of FIG. **15**A taken along the lines C-C in FIG. **15**A;
[0100] FIG. **21**A is a proximal perspective view of an inserter-reducer shaft of the pedicle screw reducer instrument of FIG. **1**A;
[0101] FIG. **21**B is a distal perspective view of the inserter-reducer shaft of FIG. **21**A;
[0102] FIG. **21**C is a side view of the inserter-reducer shaft of FIG. **21**A (an opposing side view can be substantially identical);
[0103] FIG. **21**D is a top view of the inserter-reducer shaft of FIG. **21**A (an opposing bottom view can be substantially identical);
[0104] FIG. **21**E is a distal view of the inserter-reducer shaft of FIG. **21**A;
[0105] FIG. **21**F is a proximal view of the inserter-reducer shaft of FIG. **21**A;
[0106] FIG. **22** is an exploded view of the inserter-reducer shaft of FIG. **21**A;
[0107] FIG. **23** is a detail exploded view of a distal portion of the inserter-reducer shaft of FIG. **21**A;
[0108] FIG. **24** is a cross-sectional view of the inserter-reducer shaft of FIG. **21**A taken along the lines A-A in FIG. **21**A;
[0109] FIG. **25** is a detail cross-sectional view of a distal portion of the inserter-reducer shaft of FIG. **21**A taken along the lines A-A in FIG. **21**A;
[0110] FIG. **26** is a perspective cross-sectional view of a distal portion of the inserter-reducer shaft of FIG. **21**A taken along the lines A-A of FIG. **21**A;
[0111] FIG. **27** is a cross-sectional view of the inserter-reducer shaft of FIG. **21**A taken along the lines B-B in FIG. **21**A;
[0112] FIG. **28** is a detail cross-sectional view of a distal portion of the inserter-reducer shaft of FIG. **21**A taken along the lines H-H in FIG. **21**A;
[0113] FIG. **29** is a perspective cross-sectional view of a distal portion of the inserter-reducer shaft of FIG. **21**A taken along the lines B-B of FIG. **21**A;
[0114] FIG. **30** is a perspective view of a thrust washer of the inserter-reducer shaft of FIG. **21**A;
[0115] FIG. **31**A is a first perspective view of a distal portion of an elongate body of the inserter-reducer shaft of FIG. **21**A;
[0116] FIG. **31**B is a second perspective view of the distal portion of FIG. **31**A;
[0117] FIG. **31**C is a side view of the distal portion of FIG. **31**A (an opposing side view can be substantially identical);
[0118] FIG. **31**D is a top view of the distal portion of FIG. **31**A (an opposing bottom view can be substantially identical);
[0119] FIG. **32**A is a proximal perspective view of a retention clip of the inserter-reducer shaft of FIG. **21**A;
[0120] FIG. **32**B is a distal perspective view of the retention clip of FIG. **32**A;
[0121] FIG. **33**A is a proximal perspective view of a distal tip of the inserter-reducer shaft of FIG. **21**A;
[0122] FIG. **33**B is a distal perspective view of the distal tip of FIG. **33**A;
[0123] FIG. **33**C is a side view of the distal tip of FIG. **33**A (an opposing side view can be substantially identical);
[0124] FIG. **33**D is a top view of the distal tip of FIG. **33**A (an opposing bottom view can be substantially identical);
[0125] FIG. **33**E is a distal view of the distal tip of FIG. **33**A;
[0126] FIG. **33**F is a proximal view of the distal tip of FIG. **33**A;
[0127] FIG. **34**A is a proximal perspective view of a biasing sleeve of the inserter-reducer shaft of FIG. **21**A;
[0128] FIG. **34**B is a distal perspective view of the biasing sleeve of FIG. **34**A;
[0129] FIG. **34**C is a side view of the biasing sleeve of FIG. **34**A (an opposing side view can be substantially identical);

[0130] FIG. **34**D is a top view of the biasing sleeve of FIG. **34**A (an opposing bottom view can be substantially identical);

[0131] FIG. **34**E is a distal view of the biasing sleeve of FIG. **34**A (an opposing proximal view can be substantially identical);

[0132] FIG. **35** is a cross-sectional view of a proximal portion of the assembly of FIG. **1**A taken along the lines A-A in FIG. **1**A;

[0133] FIG. **36** is a perspective cross-sectional view of a proximal portion of the assembly of FIG. **1**A taken along the lines A-A in FIG. **1**A;

[0134] FIG. **37** is a cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines A-A in FIG. **1**A;

[0135] FIG. **38** is a perspective cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines A-A in FIG. **1**A;

[0136] FIG. **39** is a cross-sectional view of a proximal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A;

[0137] FIG. **40** is a perspective cross-sectional view of a proximal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A;

[0138] FIG. **41** is a cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A;

[0139] FIG. **42** is a perspective cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A;

[0140] FIG. **43** illustrates one step in coupling a reducer clip to a pedicle screw;

[0141] FIG. **44** illustrates the reducer clip coupled to the pedicle screw of FIG. **43**;

[0142] FIG. **45** is a perspective cross-sectional view of the reducer clip and pedicle screw of FIG. **43** taken along the lines A-A in FIG. **43** with a lock sleeve of the reducer clip withdrawn proximally;

[0143] FIG. **46** is a perspective cross-sectional view of the reducer clip and pedicle screw of FIG. **44** taken along the lines A-A in FIG. **44**;

[0144] FIG. **47** illustrates one step in assembling components of a pedicle screw reducer instrument according to the present disclosure;

[0145] FIG. **48** illustrates various components of a pedicle screw reducer instrument assembled for use;

[0146] FIG. **49** illustrates the insertion of the components of FIG. **48** through the reducer clip and pedicle screw of FIG. **44**;

[0147] FIG. **50** illustrates a position wherein threads of a reducer handle engage a reducer clip;

[0148] FIG. **51** illustrates a position wherein the reducer handle is threaded into the reducer clip to a maximum extent to reduce a rod into a pedicle screw;

[0149] FIG. **52** illustrates a position wherein a setscrew driver handle is utilized to drive a setscrew into position and secure a rod relative to a pedicle screw;

[0150] FIG. **53** is a cross-sectional view of the position of FIG. **51** taken along the lines A-A in FIG. **51**;

[0151] FIG. **54** is a cross-sectional view of the position of FIG. **52** taken along the lines A-A in FIG. **52**;

[0152] FIG. **55** is a cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A in a first position;

[0153] FIG. **56** is a cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A in a second position;

[0154] FIG. **57** is a cross-sectional view of a distal portion of the assembly of FIG. **1**A taken along the lines B-B in FIG. **1**A in a third position;

[0155] FIG. **58**A is a proximal perspective view of an assembly, including a pedicle screw reducer instrument coupled to a pedicle screw, setscrew, and rod, according to one embodiment of the present disclosure;

[0156] FIG. **58**B is a distal perspective view of the assembly of FIG. **58**A;

[0157] FIG. **59** is an exploded view of the assembly of FIG. **58**A;

[0158] FIG. **60**A is a proximal perspective view of a reducer handle of the pedicle screw reducer instrument of FIG. **58**A;

[0159] FIG. **60**B is a distal perspective view of the reducer handle of FIG. **60**A;

[0160] FIG. **60**C is a distal view of the reducer handle of FIG. **60**A;

[0161] FIG. **60**D is a proximal view of the reducer handle of FIG. **60**A;

[0162] FIG. **60**E is a side view of the reducer handle of FIG. **60**A (an opposing side view can be substantially identical);

[0163] FIG. **61** is an exploded view of the reducer handle of FIG. **60**A;

[0164] FIG. **62**A is a proximal perspective view of an assembly, including a pedicle screw reducer instrument coupled to a pedicle screw, setscrew, and rod, according to one embodiment of the present disclosure;

[0165] FIG. **62**B is a distal perspective view of the assembly of FIG. **62**A;

[0166] FIG. **63** is an exploded view of the assembly of FIG. **62**A;

[0167] FIG. **64**A is a proximal perspective view of a reducer clip of the pedicle screw reducer instrument of FIG. **62**A;

[0168] FIG. **64**B is a distal perspective view of the reducer clip of FIG. **64**A;

[0169] FIG. **64**C is a side view of the reducer clip of FIG. **64**A (an opposing side view can be substantially identical);

[0170] FIG. **64**D is a top view of the reducer clip of FIG. **64**A (an opposing bottom view can be substantially identical);

[0171] FIG. **64**E is a distal view of the reducer clip of FIG. **64**A;

[0172] FIG. **64**F is a proximal view of the reducer clip of FIG. **64**A;

[0173] FIG. **65** is a cross-sectional view of the reducer clip of FIG. **64**A taken along the lines A-A in FIG. **64**A;

[0174] FIG. **66** is a cross-sectional view of the reducer clip of FIG. **64**A taken along the lines B-B in FIG. **64**A;

[0175] FIG. **67**A is a proximal perspective view of an inserter-reducer shaft of the pedicle screw reducer instrument of FIG. **62**A;

[0176] FIG. **67**B is a distal perspective view of the inserter-reducer shaft of FIG. **67**A;

[0177] FIG. **67**C is a side view of the inserter-reducer shaft of FIG. **67**A (an opposing side view can be substantially identical);

[0178] FIG. **67**D is a top view of the inserter-reducer shaft of FIG. **67**A (an opposing bottom view can be substantially identical);

[0179] FIG. **67**E is a distal view of the inserter-reducer shaft of FIG. **67**A;

[0180] FIG. **67**F is a proximal view of the inserter-reducer shaft of FIG. **67**A;

[0181] FIG. **68** is an exploded view of the inserter-reducer shaft of FIG. **67**A;

[0182] FIG. **69**A is a proximal perspective view of an elongate body of the inserter-reducer shaft of FIG. **67**A;

[0183] FIG. **69**B is a distal perspective view of the elongate body of FIG. **69**A;

[0184] FIG. **69**C is a side view of the elongate body of FIG. **69**A (an opposing side view can be substantially identical);

[0185] FIG. **69**D is a top view of the elongate body of FIG. **69**A (an opposing bottom view can be substantially identical);

[0186] FIG. **69**E is a distal view of the elongate body of FIG. **69**A;

[0187] FIG. **69**F is a proximal view of the elongate body of FIG. **69**A;

[0188] FIG. **70** illustrates one step in coupling a reducer clip to a pedicle screw;

[0189] FIG. **71** illustrates the reducer clip coupled to the pedicle screw of FIG. **70**;

[0190] FIG. **72** illustrates one step in assembling components of a pedicle screw reducer instrument according to the present disclosure;

[0191] FIG. **73** illustrates various components of a pedicle screw reducer instrument assembled for use;

[0192] FIG. **74** illustrates the insertion of the components of FIG. **73** through the reducer clip and pedicle screw of FIG. **71**;

[0193] FIG. **75** illustrates a position wherein threads of a reducer handle engage a reducer clip;

[0194] FIG. **76** illustrates a position wherein the reducer handle is threaded into the reducer clip to a maximum extent to reduce a rod into a pedicle screw;

[0195] FIG. **77** illustrates a position wherein a setscrew driver handle is utilized to drive a setscrew into position and secure a rod relative to a pedicle screw;

[0196] FIG. **78** is a cross-sectional view of the position of FIG. **76** taken along the lines A-A in FIG. **76**;

[0197] FIG. **79** is a cross-sectional view of the position of FIG. **77** taken along the lines A-A in FIG. **77**;

[0198] FIG. **80**A is a proximal perspective view of an assembly, including a pedicle screw reducer instrument coupled to a pedicle screw, setscrew, and rod, according to one embodiment of the present disclosure;

[0199] FIG. **80**B is a distal perspective view of the assembly of FIG. **80**A;

[0200] FIG. **81** is an exploded view of the assembly of FIG. **80**A;

[0201] FIG. **82** is an exploded view of a pedicle screw extension reducer clip of the assembly of FIG. **80**A;

[0202] FIG. **83** is a cross-sectional view of the pedicle screw extension of FIG. **80**A taken along the lines A-A in FIG. **80**A;

[0203] FIG. **84** is a cross-sectional view of the pedicle screw extension of FIG. **80**A taken along the lines B-B in FIG. **80**A;

[0204] FIG. **85** is a perspective view of the pedicle screw of FIG. **80**A;

[0205] FIG. **86** is an exploded view of the pedicle screw of FIG. **85**;

[0206] FIG. **87** is a cross-sectional view of the pedicle screw, rod, and pedicle screw extension of FIG. **80**A taken along the lines A-A in FIG. **80**A;

[0207] FIG. **88** illustrates one step in coupling a pedicle screw to a pedicle screw extension;

[0208] FIG. **89** illustrates a pedicle screw coupled to a pedicle screw extension;

[0209] FIG. **90** illustrates one step in assembling components of a pedicle screw reducer instrument according to the present disclosure;

[0210] FIG. **91** illustrates various components of a pedicle screw reducer instrument assembled for use;

[0211] FIG. **92** illustrates the insertion of the components of FIG. **91** through the pedicle screw extension of FIG. **89**;

[0212] FIG. **93** illustrates a position wherein threads of a reducer handle engage a pedicle screw extension;

[0213] FIG. **94** illustrates a position wherein the reducer handle is threaded into the pedicle screw extension to a maximum extent to reduce a rod into a pedicle screw;

[0214] FIG. **95** is a cross-sectional view of the assembly of FIG. **94** taken along the lines A-A in FIG. **94** with a setscrew in a first position;

[0215] FIG. **96** is a cross-sectional view of the assembly of FIG. **94** taken along the lines A-A in FIG. **94** with a setscrew in a second position;

[0216] FIG. **97**A is a proximal perspective view of an assembly, including an adjacent level reducer instrument coupled to a pedicle screw, according to one embodiment of the present disclosure;

[0217] FIG. **97**B is a distal perspective view of the assembly of FIG. **97**A;

[0218] FIG. **98** is an exploded view of the assembly of FIG. **97**A;

[0219] FIG. **99**A is a proximal perspective view of a reducer clip of the adjacent level reducer instrument of FIG. **97**A;

[0220] FIG. **99**B is a distal perspective view of the reducer clip of FIG. **99**A;

[0221] FIG. **99**C is a side view of the reducer clip of FIG. **99**A (an opposing side view can be substantially identical);

[0222] FIG. **99**D is a top view of the reducer clip of FIG. **99**A (an opposing bottom view can be substantially identical);

[0223] FIG. **99**E is a distal view of the reducer clip of FIG. **99**A;

[0224] FIG. **99**F is a proximal view of the reducer clip of FIG. **99**A;

[0225] FIG. **100** is a cross-sectional view of the reducer clip of FIG. **99**A taken along the lines A-A in FIG. **99**A;

[0226] FIG. **101** is a cross-sectional view of the reducer clip of FIG. **99**A taken along the lines B-B in FIG. **99**A;

[0227] FIG. **102**A is a side view of a reducer shaft of the adjacent level reducer instrument of FIG. **99**A (an opposing side view can be substantially identical);

[0228] FIG. **102**B is a top view of the reducer shaft of FIG. **102**A (an opposing bottom view can be substantially identical);

[0229] FIG. **102**C is a distal view of the reducer shaft of FIG. **102**A;

[0230] FIG. **102**D is a proximal view of the reducer shaft of FIG. **102**A;

[0231] FIG. **103**A is a side view of a reducer handle of the adjacent level reducer instrument of FIG. **99**A (an opposing side view can be substantially identical);

[0232] FIG. **103**B is a top view of the reducer handle of FIG. **103**A (an opposing bottom view can be substantially identical);

[0233] FIG. **103**C is a distal view of the reducer handle of FIG. **103**A;

[0234] FIG. **103**D is a proximal view of the reducer handle of FIG. **103**A;

[0235] FIG. **104** is an exploded view of the reducer handle of FIG. **103**A;

[0236] FIG. **105** illustrates one step in coupling a reducer clip to a pedicle screw;

[0237] FIG. **106** illustrates the reducer clip coupled to the pedicle screw of FIG. **105**;

[0238] FIG. **107** illustrates one step in assembling components of an adjacent level reducer instrument according to the present disclosure;

[0239] FIG. **108** illustrates the insertion of the components of FIG. **107** through the reducer clip and pedicle screw of FIG. **106**;

[0240] FIG. **109** illustrates a position wherein threads of a reducer shaft engage a reducer clip;

[0241] FIG. **110** illustrates a position wherein the reducer shaft is threaded into the reducer clip to a maximum extent to reduce a rod into a pedicle screw;

[0242] FIG. **111** is a longitudinal cross-sectional view of a distal portion of one embodiment of an inserter-reducer shaft including an elastomeric setscrew biasing element;

[0243] FIG. **112** is a longitudinal cross-sectional view of a distal portion of one embodiment of an inserter-reducer shaft including an internally-disposed biasing element; and

[0244] FIG. **113** is a longitudinal cross-sectional view of a distal portion of one embodiment of an inserter-reducer shaft including an elastomeric setscrew retaining element.

DETAILED DESCRIPTION

[0245] Certain example embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices, systems, and methods disclosed herein. One or more examples of these embodiments are illustrated in the accompanying drawings. The devices, systems, and methods specifically described herein and illustrated in the accompanying drawings are non-limiting embodiments. The features illustrated or described in connection with one embodiment may be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present disclosure.

[0246] As noted above, the present disclosure generally relates to surgical instruments that aid in reducing or urging a spinal fixation element toward a pedicle screw or other implant (e.g., another bone anchor, etc.). The present disclosure provides streamlined reduction instruments that can facilitate delivery of a setscrew or other closure or locking element, reduction of a rod or other spinal fixation element into a pedicle screw or other bone anchor or implant, and securing the rod relative to the pedicle screw or other bone anchor or implant using the setscrew or other closure or locking element. Example instruments and methods according to the present disclosure can utilize a reducer clip that couples to a proximal end of a pedicle screw receiver head or extension tabs thereof, an inserter-reducer shaft that can couple with a setscrew at its distal end, a reducer handle that can threadably engage with the reducer clip to translate the shaft and thereby reduce a rod, and a driver handle that can rotate the inserter-reducer shaft to engage the setscrew with threads formed on the pedicle screw or extension tabs thereof.

[0247] FIGS. **1**-**57** illustrate a first embodiment of a pedicle screw reducer instrument **100** according to the present disclosure. FIGS. **1**A and **1**B illustrate an assembly of the instrument **100** coupled to a pedicle screw **102**, setscrew **104**, and rod **106**, according to one embodiment of the present disclosure. The pedicle screw reducer instrument **100** is shown in isolation in FIGS. **2**A and **2**B, and FIG. **3** shows an exploded view of the components of the assembly of FIG. **1**A. The instrument **100** can include a reducer clip **108**, an inserter-reducer shaft **110**, a reducer handle **112**, and a driver handle **114**.

[0248] FIGS. **4**-**6** illustrate an example pedicle screw **102**, setscrew **104**, and spinal fixation rod **106** in greater detail. The illustrated embodiments are examples only and the scope of the present disclosure contemplates use of the instruments and methods disclosed herein with a variety of implants, including any of a variety of pedicle screws and other bone anchors, as well as any of a variety of spinal fixation elements and locking or closure elements, such as setscrews. As shown in FIG. **4**, the pedicle screw **102** can include a shank **116** configured to be driven into bone and a rod receiving head or receiver member **118** configured to receive the spinal fixation rod **106**. The receiver member **118** can include a polyaxial seat at a distal end thereof that can be configured to receive a proximal head **120** of the shank **116** such that the receiver member **118** can move polyaxially relative to the shank when coupled thereto. The pedicle screw **102** can also include a compression cap **122** that can be received within the receiver member **118** proximal to the proximal head **120** of the shank **116**. The compression cap **122** can include a distal surface configured to contact the proximal head **120** of the shank **116**, e.g., a hemispherical recess with a diameter matched to a diameter of proximal head **120** of the shank **116**. The compression cap **122** can also include a proximal-facing rod seat configured to receive the rod **106**, e.g., opposed arms defining a U-shaped surface configured to seat the rod.

[0249] FIG. **5** illustrates the receiver member **118** in greater detail. The receiver member **118** can include opposed arms **124**A, **124**B that can form a U-shaped recess or rod seat **126** therebetween configured to receive the rod **106**. In some embodiments, each of the opposed arms **124**A, **124**B an include a proximally extending tab **128**A, **128**B that can aid in capturing and reducing the rod **106** toward the U-shaped rod seat **126**. The tabs **128**A, **128**B can be coupled to the arms **124**A, **124**B by a reduced-thickness portion of material **130**A, **130**B. That is, in some embodiments the arms **124**A, **124**B and tabs **128**A, **128**B are formed of a single piece of material with a reduced-thickness connecting portion **130**A, **130**B. The reduced-thickness material **130**A, **130**B can provide some flexibility to accommodate radial inward/outward deflection or movement of the tabs in response to force applied thereto (as discussed in more detail below), and can serve as a break point facilitating separation of the extended tabs **128**A, **128**B from the receiver member

118 after the rod 106 is captured and secured to the receiver member using the setscrew 104. An example pedicle screw with similar features is the VIPER® Extended Tab Screw made by DePuy Synthes of Raynham, Massachusetts.

[0250] An inner surface of each arm 124A, 124B can include threads 132 formed thereon. The threads 132 can extend onto the inner surfaces of the proximally extending tabs 128A, 128B for some distance. In some embodiments, the threads 132 can extend along about 10 mm of the tabs 128A, 128B, thereby providing an additional about 10 mm of possible reduction beyond that provided by the arms 124A, 124B when using the setscrew 104 to reduce the rod 106 toward the seat 126 of the receiver member 118. A proximal portion of each extended tab 128A, 128B can include one or more surface features formed on an outer surface thereof. For example, each extended tab 128A, 128B can include threads 134 and/or a flange 135 formed on an external surface thereof along a distal portion thereof. The threads 134 and/or flange 135 can be utilized, for example, to facilitate coupling the pedicle screw 102 with other components, as discussed in more detail below.

[0251] FIG. 6 illustrates the setscrew 104 in greater detail. The setscrew 104 includes a drive feature 136 formed in a center portion thereof. The drive feature 136 can be a recess or through-hole including one or more substantially flat surfaces to facilitate imparting torque to the setscrew using a driver inserted into the drive feature. In the illustrated embodiment, the drive feature 136 is a through-hole extending through a full thickness of the setscrew 104 and includes a hexagonal arrangement of substantially flat surfaces disposed around a circumference of the through-hole with curved recesses disposed between adjacent flat surfaces. The setscrew 104 also includes threads 138 formed on an outer surface thereof. The threads 138 can be configured to interface with the threads 132 formed on the inner surfaces of the receiver member 118. An example setscrew with similar features is the VIPER® 2 setscrew with X25 drive feature made by DePuy Synthes of Raynham, Massachusetts.

[0252] FIGS. 7A-10 illustrate the reducer clip 108 of the pedicle screw reducer instrument 100. The reducer clip 108 can include a lumen 140 extending from a proximal end to a distal end thereof, a recess 142 formed in a sidewall of the reducer clip along a distal portion thereof, and threads 144 formed in the sidewall of the reducer clip along a proximal portion thereof (in other embodiments, the threads 144 can be formed along a more distal portion of the reducer clip, such as a central portion or distal portion thereof). In the illustrated embodiment, and as shown particularly in the exploded and cross-sectional views of FIGS. 8-10, the reducer clip 108 can include a distal sleeve 146 having a lumen extending from a proximal end to a distal end thereof and the recess 142 formed in a sidewall of the distal sleeve along a distal portion thereof. The reducer clip 108 can also include a proximal sleeve 148 having a lumen extending from a proximal end to a distal end thereof and the threads 144 formed in a sidewall of the proximal sleeve along a proximal portion thereof. The reducer clip 108 can further include a locking sleeve 150 having a lumen extending from a proximal end to a distal end thereof and one or more locking tabs 164 at a distal end thereof.

[0253] The distal sleeve 146, proximal sleeve 148, and locking sleeve 150 can be assembled such that a distal portion of the proximal sleeve 148 is received within a proximal portion of the distal sleeve 146. Further, a distal portion of the locking sleeve 150 can be received within the proximal portion of the distal sleeve 146. Moreover, a proximal portion of the locking sleeve 150 can surround a portion of the proximal sleeve 148. Still further, the locking sleeve 150 can be axially disposed (e.g., along the longitudinal axis Ax1 of the instrument 100 shown in FIG. 1A) between the distal sleeve 146 and the proximal sleeve 148 and configured to axially translate (e.g., along the longitudinal axis Ax1) relative thereto.

[0254] The reducer clip 108 can also include a biasing element 152 disposed between the locking sleeve 150 and the proximal sleeve 148 that is configured to distally bias the locking sleeve relative to the proximal sleeve. In the illustrated embodiment, the biasing element 152 is a coil spring disposed around the proximal sleeve 148. In other embodiments, other known forms of biasing elements can be employed. Further, the reducer clip 108 can include one or more pins 154 that can extend through one or more bores 156 formed in the distal sleeve 146 and one or more bores 158 formed in the proximal sleeve 148 in order to couple the two sleeves such that they do not move relative to one another and to trap the locking sleeve 150 and biasing element 152 axially therebetween. In alternative embodiments, a number of other mechanisms can be utilized to couple the distal sleeve 146 and the proximal sleeve 148. For example, the two sleeves can be welded together without the use of pins 154. In other examples, the two sleeves could threadably couple together and could, in some embodiments, utilize a thread-locking adhesive to prevent separation thereof. In still other examples, any of a variety of fastening techniques can be utilized, including any of a variety of adhesives, mechanical fasteners, interference fits, etc.

[0255] FIGS. 11A-11F illustrate the distal sleeve 146 in isolation. The distal sleeve 146 can have a tapered, generally cylindrical or conical form with a lumen extending therethrough along a longitudinal axis thereof. The distal sleeve can include one or more features, such as recesses 159, formed on an external surface thereof to facilitate a user grasping and/or gripping the component. The lumen extending through the distal sleeve 146 can include a step or shoulder 161 formed along a sidewall thereof to accommodate a distal portion of the proximal sleeve 148 being received therein.

[0256] As noted above, the reducer clip 108 can include a recess 142 formed in a sidewall thereof. In the illustrated embodiment, the distal sleeve 146 of the reducer clip 108 includes opposed recesses 142A, 142B (as shown in FIGS. 7C and 9) formed along a distal portion thereof that communicate with the lumen 140 extending through the reducer clip. As shown in FIGS. 7C and 7D, the recesses 142A, 142B can be aligned such that they form a through-bore extending in a direction that is perpendicular to the longitudinal axis Ax1. The recesses 142A, 142B can have a shape configured to receive a portion of the pedicle screw 102, e.g., the external threads 134 and flange 135 formed on a proximal portion of the extended tabs 128A, 128B of the receiver member 118. For example, the recesses 142A, 142B can each have a generally rectangular shape and define distal surfaces 160A, 160B (see FIGS. 11A-11D) configured to contact the flange 135 formed distal to the external threads 134 to prevent proximal movement of the reducer clip 108 relative to the pedicle screw 102 when the threads 134 and/or flange 135 on each of the extended tabs 128A, 128B

are disposed within the recesses **142**A, **142**B. The recesses **142**A, **142**B can also include counterpart proximal surfaces **162**A, **162**B configured to serve a similar purpose in contacting a proximal end of the threads **134** and/or the extended tabs **128** to prevent distal movement of the reducer clip **108** relative to the pedicle screw **102** when the threads **134** and/or extended tabs **128** are disposed within the recesses **142**.

[0257] While the distal sleeve **146** of the reducer clip **108** described above is configured to couple to a pedicle screw or other bone anchor as detailed, other embodiments are within the scope of the present disclosure. For example, in one embodiment the reducer clip **108**, and distal sleeve **146** in particular, can be configured to threadably couple with a proximal portion of a bone anchor. For example, a distal portion of the inner lumen of the distal sleeve **146** can include threads configured to interface with the threads **134** formed on the extended tabs **128**A, **128**B, thereby facilitating threaded coupling between the reducer clip and bone anchor.

[0258] FIGS. **12**A-**12**F illustrate the locking sleeve **150** in isolation. The locking sleeve **150** can include a distal cylindrical body or portion **163** having a diameter configured to be received within the lumen of the distal sleeve **146** and the proximal sleeve **148**. The locking sleeve **150** can also include a proximal, generally cylindrical body or portion **165** having a larger diameter than the distal cylindrical body **163**. The proximal body **165** can be configured such that a lumen thereof is large enough to surround a proximal portion of the distal cylindrical body **163**, as well as the distal sleeve **146** and the proximal sleeve **148**. The distal body **163** and the proximal body **165** can be coupled by one or more spans **167** extending therebetween. In the illustrated embodiment, two opposed spans **167**A, **167**B are shown. Further, the locking sleeve can include one or more openings formed therein to facilitate visualization of other components of the reducer clip **108** and/or cleaning of the component. For example, the locking sleeve can include one or more elongate openings **169** that can facilitate visualization of the biasing spring **152** and/or cleaning of same. In the illustrated embodiment, the locking sleeve **150** includes two opposed openings **169**A, **169**B. The elongate openings **169** can also provide guidance to a user to prevent them from grasping the area while installing the clip (e.g., grasping the reducer clip **108** by the locking sleeve **150** alone would make coupling with a pedicle screw **102** difficult, as the locking sleeve **150** needs to translate relative to the remainder of the reducer clip and pedicle screw during coupling and separation).

[0259] The locking sleeve **150** can include one or more locking tabs **164** at a distal end thereof, e.g., extending from the distal cylindrical body **163**. As shown in FIGS. **12**A-**12**F, the locking sleeve **150** can include two opposed locking tabs **164**A, **164**B. The locking tabs **164** can be protrusions along a distal portion of the locking sleeve **150** configured to advance into a space between the opposed extended tabs **128**A, **128**B of the pedicle screw **102** and prevent radially inward movement of the tabs toward one another, which would result in movement of the tabs out of the recesses **142**A, **142**B and would allow axial movement of the reducer clip **108** relative to the pedicle screw. Accordingly, axial movement of the locking sleeve **150** relative to the remainder of the reducer clip **108** can selectively lock the reducer clip to a pedicle screw, as explained in more detail below with regard to FIGS. **43**-**46**.

[0260] The locking sleeve **150** can include one or more features to facilitate a user grasping and/or gripping and/or interacting therewith. For example, the locking sleeve **150** can include tabs **166** extending radially away from the longitudinal axis Ax1 of the instrument **100** (shown in FIG. **1**A). In the illustrated embodiment, for example, the locking sleeve **150** includes two opposed tabs **166**A, **166**B extending from a proximal portion of the proximal body **165**. The opposed tabs **166**A, **166**B can provide a syringe-like grip to a user when coupling the reducer clip **108** to a pedicle screw **102**. For example, a user can place a finger distal to each opposed tab **166**A, **166**B with a thumb or palm braced against a proximal end surface **177** of the reducer clip **108**. The user can then use their fingers to draw the locking sleeve **150** proximally relative to the remainder of the reducer clip **108** against the biasing force of the spring **152**. As explained in more detail below, proximally withdrawing the locking sleeve **150** can allow coupling of the reducer clip **108** to a pedicle screw **102**, and distal advancement of the locking sleeve **150** can selectively lock the reducer clip **108** and pedicle screw **102** against separation therebetween by positioning the locking tabs **164**A, **164**B in a position where they interfere with radially-inward movement of proximal ends of the extended tabs **128**A, **128**B of the pedicle screw **102**.

[0261] FIGS. **13**A-**13**F illustrate the proximal sleeve **148** in isolation. The proximal sleeve **148** can have a generally cylindrical shape with a lumen passing therethrough. The proximal sleeve **148** can have a distal portion **168** and a proximal portion **170** separated by a distally facing step or shoulder **172**. The shoulder **172** can serve as a surface to contact the biasing element **152** to allow that component to urge the locking sleeve **150** distally relative to the distal sleeve **146** and the proximal sleeve **148**, which are coupled to one another via the pins **154**. The distal portion **168** can have a diameter configured to pass through an annular space between the distal portion **163** and the proximal portion **165** of the locking sleeve **150**, and to extend into the lumen of the distal sleeve **146**. The distal portion **168** of the proximal sleeve **148** can extend into the distal sleeve **146** until it contacts the proximal-facing shoulder **161** formed along an inner surface of the distal sleeve and/or until the bores **156** of the distal sleeve **146** and the bores **158** formed in the distal portion **168** are aligned to receive the pins **154**.

[0262] To facilitate passage of the distal portion **168** of the proximal sleeve **148** through the space between the distal portion **163** and the proximal portion **165** of the locking sleeve **150**, the distal portion **168** can include one or more slots **174** extending proximally from a distal end of the proximal sleeve **148**. In the illustrated embodiment, the proximal sleeve **148** includes two opposed slots **174**A, **174**B. The slots **174**A, **174**B can receive the spans **167**A, **167**B of the locking sleeve **150** as the proximal sleeve **148** is passed through the locking sleeve **150**.

[0263] As noted above, a proximal portion of the lumen formed in the proximal sleeve **148** can include threads **144** formed thereon. As explained in more detail below, the threads **144** can engage with threads formed on a reduction handle to provide controlled reduction of a rod and/or setscrew relative to the pedicle screw **102** coupled to the reducer clip **108**. A proximal portion of the proximal sleeve **148** can also include one or more features to facilitate gripping and/or grasping and/or applying torque to the reducer clip **108**. For example, the proximal sleeve **148** can include one or more flat surfaces **176** on an outer proximal

portion thereof to facilitate grasping the reducer clip **108** and/or applying force thereto, either directly or doing so using an intermediate tool (e.g., flat surfaces for applying a wrench or other tool, etc.). In the illustrated embodiment, the proximal sleeve **148** includes two sets of opposed flat surfaces **176**A, **176**B, **176**C, **176**D offset from one another about the longitudinal axis Ax1 of the instrument **100**.

[0264] FIGS. **14**A-**14**E illustrate the reducer handle **112** in isolation. The reducer handle **112** can include a distal portion **178** having a generally cylindrical profile with a lumen extending therethrough, e.g., to accommodate passage of the inserter-reducer shaft **110** through the reducer handle **112**. The distal portion **178** can have a size configured to be received within the lumen of the reducer clip **108**. In addition, the distal portion **178** can include threads **180** formed on an external surface thereof that are configured to interface with the threads **144** formed on an inner surface of the proximal sleeve **148** of the reducer clip **108** to provide for controlled movement of the reducer handle **112** relative to the reducer clip, which can thereby provide for control of reduction of a spinal rod **106** and/or setscrew **104** relative to a pedicle screw **102** coupled to the reducer clip **108**.

[0265] The distal portion **178** of the reducer handle **112** can also include a blunt distal end surface **182** configured to contact the inserter-reducer shaft **110** in order to impart a distally-directed force thereto during reduction. The blunt distal end surface **182** can be substantially smooth and flat such that it is configured to bear against another flat surface on the shaft or a thrust washer or bearing disposed therebetween, to facilitate imparting an axial translation force to the shaft while allowing for relative rotation between the shaft and the reducer handle.

[0266] Still further, the distal portion **178** of the reducer handle **112** can include one or more markings **184** formed on an external surface thereof to provide feedback to a user regarding a reduction distance or amount indicated by the relative positioning of the reducer handle and the reducer clip **108**. While different amounts of reduction are possible by varying the lengths of the reducer clip **108** and reducer handle **112**, in the illustrated embodiment the reducer clip and reducer handle are configured to provide up to about 30 mm of rod reduction. Different marking or other feedback schemes are possible but, in the illustrated embodiment, an outer surface of the distal portion **178** of the reducer handle **112** includes markings **184** to show a distance of reduction that remains at a point where a proximal end of the reducer clip **108** aligns with a particular distance marking.

[0267] The reducer handle **112** can also include a proximal portion **186** configured for a user to grasp and apply torque thereto when performing rod reduction. The proximal portion **186** can have a generally cylindrical shape and can define a proximal-facing recess that can receive, e.g., a proximal portion of the inserter-reducer shaft **110** and a distal portion of the reducer handle **114**. That is, the proximal portion **186** can form a barrel handle recess for nesting the reducer handle **112** and driver handle **114**. An external surface of the proximal portion **186** can include one or more features formed thereon, such as longitudinally extending grooves **187** to aid a user in gripping and/or grasping and/or applying torque to the reducer handle **112**. Any of a variety (and number) of surface features can be utilized, including features that facilitate a user directly grasping the reducer handle **112** (e.g., texturing, knurling, finger-shaped recesses, etc.), as well as using an intermediate tool (e.g., flat surfaces for applying a wrench or other tool, etc.).

[0268] The distal portion **178** and the proximal portion **186** can be separated by distally-facing step or shoulder **188** that can serve as a stop or limit on rod reduction (at least, on rod reduction provided by the reducer handle **112** and inserter-reducer shaft **110** versus, for example, what might be additionally possible using the setscrew **104** when driven by the driver handle **114**). For example, the shoulder **188** can contact a proximal end of the reducer clip **108** at a point of maximum rod reduction, thereby preventing any further reduction using the reducer handle **112**. Contact between the shoulder **188** and the reducer clip **108** can serve as a hard stop to prevent overreduction that might, e.g., drive the setscrew **104** into the threads **132** of the pedicle screw receiver member **118** with too much force. As noted above, the proximal portion **186** can have a generally cylindrical shape with a diameter larger than the distal portion **178**. This can both facilitate easier user grasping of the reducer handle **112** and can provide a lumen or recess large enough to receive other components, such as the inserter-reducer shaft **110** and driver handle **114** coupled thereto. To accommodate the different diameters, a distal portion of the proximal portion **186** can include one or more connecting arms **190** transitioning therebetween. In the illustrated embodiment, the proximal portion **186** includes two opposed connecting arms **190**A, **190**B that make this transition and provide large openings therebetween. These openings can facilitate user visualization of components disposed within a recess or lumen of the proximal portion **186** and extending into the lumen of the distal portion **178** of the reducer handle **112**. The openings can also facilitate cleaning and sterilization of the reducer handle **112** and other components that may be coupled thereto in an assembly.

[0269] The above-described reducer handle **112** is one example and a variety of additional embodiments are within the scope of the present disclosure (as described in more detail below). For example, in some embodiments the reducer handle can include a longitudinal slot formed therein to allow side-loading of the reducer handle onto the inserter-reducer shaft. Such a configuration can be useful, for example, in embodiments where the inserter-reducer shaft and driver handle are integrally formed and/or more permanently coupled to one another.

[0270] FIGS. **15**A-FIG. **20** illustrate the driver handle **114** in isolation. The driver handle **114** can be configured to impart torque to the inserter-reducer shaft **110** and thereby rotate the shaft relative to the reducer clip **108** and pedicle screw **102**. As explained in more detail below, the inserter-reducer shaft **110** can carry the setscrew **104** in a manner that prevents relative rotation therebetween when the setscrew is coupled to the shaft. As a result, rotation of the shaft **110** imparted by the driver handle **114** can rotate the setscrew **104** relative to the pedicle screw **102** and thereby interface the threads **138** of the setscrew with the threads **132** formed on the inner surfaces of the arms **124**A, **124**B and extended tabs **128**A, **128**B of the pedicle screw **102**.

[0271] The driver handle **114** can have a generally elongate shape with an outer diameter of a size configured to be received within the lumen of the proximal portion **186** of the reducer handle **112**. A distal portion of the driver handle **114** can include a quick-connect coupling **192** configured to receive a proximal end of the inserter-reducer shaft **110** and couple the driver handle thereto in a manner that selectively

prevents relative movement therebetween, e.g., translation and/or rotation. While a driver handle with a modular coupling to an inserter-reducer shaft is shown, this is only an example and a variety of alternative embodiments are also within the scope of the present disclosure. These can include, for example, embodiments wherein the driver handle and inserter-reducer shaft are integrally formed as a unitary or monolithic structure, as well as embodiments wherein these components are discrete structures more permanently coupled to one another (e.g., via any of a variety of fastening techniques, including welding, adhesives, etc.) to form a single component. A proximal portion of the driver handle **114** can include one or more surfaces **194** configured to facilitate a user grasping and rotating the handle, as well as a proximal end cap **196** that can rotate relative to the remainder of the driver handle and can be utilized to steady the handle and/or apply axial force while rotating the handle.

[0272] The exploded and cross-sectional views of FIGS. **16-20** illustrate the construction of the driver handle **114** in greater detail. The driver handle **114** can include a central shaft **198** having a recess **200** formed in a distal end thereof that includes at least one flat surface. The recess **200** can receive a proximal portion of the quick-connect coupling **192** that can include a complementary flat surface, such that the shaft and coupling cannot rotate relative to one another. A proximal end of the shaft **198** can include a threaded recess **202** that can receive an end screw **204**. The end screw **204** can pass through a lumen of the end cap **196** and thereby retain it relative to the shaft **198** while allowing for relative rotation therebetween. The one or more surfaces **194** configured to facilitate user interaction with the driver handle **114** can be disposed over a central portion of the shaft **198**. For example, a polymer handle with a lumen and said surfaces **194** formed on an exterior thereof can be disposed over the shaft **198** (or formed thereon via an over molding process, etc.).

[0273] The quick-connect coupling **192** can include a body **206** having a proximal end configured to extend into the shaft **198** and a recess formed at a distal end thereof that can be configured to receive a proximal end of the inserter-reducer shaft **110**. The coupling can further include a rotation lock **208** disposed within a bore formed in a sidewall of the body **206** such that a radially-inward flat surface of the rotation lock **208** extends into the recess at the distal end of the body. The flat surface of the rotation lock **208** can be configured to contact a flat surface formed on a proximal portion of the inserter-reducer shaft **110** when it is received within the recess of the body **206**, thereby preventing rotation between the shaft and the body. A radially outward surface of the rotation lock **208** can align with an outer surface of the body **206**. The rotation lock **208** can be securely coupled to the body in a variety of manners, e.g., welding, adhesive, interference fit, etc. The coupling can also include a ball **210** disposed within a bore formed in the sidewall of the body **206**, e.g., opposite the rotation lock **208**, such that the ball can move radially inward or outward to selectively extend into the recess at the distal end of the body. The ball can serve as a translation lock when advanced radially inward into the recess and disposed within an at least partial circumferential groove formed in the outer surface of a proximal portion of the inserter-reducer shaft **110**.

[0274] A distal housing **212** can surround the body **206** and ball **210**. The distal housing **212** can prevent the ball **210** from falling out of the body **206** and can selectively control a radial position of the ball via a lumen formed in the distal housing with a proximally tapering diameter. The diameter of the lumen can be configured such that, when a distal portion of the lumen with a larger diameter is disposed over the ball **206**, the ball can move radially outward to minimize extension into the recess of the body **206**. Conversely, when a proximal portion of the lumen with a smaller diameter is disposed over the ball **206**, the ball can move radially inward to extend into the recess of the body. If this is done when the inserter-reducer shaft **110** is disposed within the recess, such that a circumferential groove formed therein is aligned with the ball, the ball can selectively lock the shaft against axial movement relative to the driver handle **114**.

[0275] The quick coupling **192** can further include a proximal housing **214** disposed around the body **206** and a portion of the distal housing **212**. The proximal housing **214** can define an annular recess around the body **206** that can house a biasing element **213**, such as a coil spring. The biasing element **213** disposed between the distal housing **212** and the proximal housing **214** can distally bias the distal housing **212**. Given the configuration of the distal housing **212** described above, the biasing element **213** can bias the quick-connect coupling **192** into a locked configuration in which the ball **210** is forced radially-inward such that it can lock the driver handle **114** to the inserter-reducer shaft **110**. To separate the two components, a user can proximally withdraw the distal housing **212** relative to the proximal housing **214** (and remainder of the driver handle **114**) to allow the ball **210** to move radially outward such that the driver handle **114** and inserter-reducer shaft **110** can be axially translated relative to one another.

[0276] FIGS. **21A-29** illustrate the inserter-reducer shaft **110** in isolation. The shaft **110** can include an elongate body **215** and a distal portion **216** configured to extend through a lumen formed in the setscrew **104** and rotationally drive the setscrew. The shaft **110** can further include a sleeve **218** disposed around the shaft over at least a distal portion thereof, as well as a biasing element **220** disposed proximal to the sleeve and configured to urge the sleeve distally relative to the remainder of the shaft. The biasing element **220** can be, for example, a coil spring disposed around the elongate body **215**. The shaft can further include a distal-facing shoulder **222** formed proximal to the distal portion **216** and the sleeve **218**, such that the biasing element **220** can be disposed between the sleeve **218** and the distal-facing shoulder **222**, which can allow the biasing element **220** to bias the sleeve **218** distally relative to the elongate body **215**.

[0277] While the sleeve **218** can be biased distally relative to the elongate body **215**, its range of motion can also be constrained such that it cannot translate relative to the elongate body beyond a distal end of the distal portion **216** that is configured to rotationally drive the setscrew **104**. This can be accomplished in a variety of manners. In the illustrated embodiment, for example, a pin **219** can extend through a bore **221** formed in the sleeve **218** and an elongate slot **223** formed in the elongate body **215**, such that the pin traveling in the elongate slot defines the range of motion of the sleeve relative to the elongate body. Therefore, the desired range of motion can be controlled using the axial lengths of the elongate slot **223** and the sleeve **218**, as well as their placement along the shaft **110**.

[0278] The use of a translating sleeve **218** and biasing element **220** is one example and a variety of alternative

configurations are also within the scope of the present disclosure. For example, FIG. **111** illustrates one alternative embodiment that replaces the translating sleeve **218** and biasing element **220** with a biasing element **702** in the form of a ring of elastomeric material. FIG. **111** is otherwise labeled with components similar to FIG. **28** to show context, but includes the elastomeric ring **702** disposed around a distal portion of the shaft. The ring **702** can be positioned proximal to a setscrew **104** and can be compressible, such that the elastomeric ring **702** can perform a similar function as the biased sleeve **218** described above.

[0279] FIG. **112** illustrates another alternative embodiment in which the biasing element **220** is a spring disposed within the elongate body **215** rather than around the shaft, as shown in FIG. **28**. As with FIG. **111**, FIG. **112** is otherwise labeled with components similar to FIG. **28** to show context, but includes biasing element **704** in the form of a coil spring disposed within a recess **706** formed in the elongate body **215**. The spring **704** can act on the pin **219** that moves with the sleeve **218** in order to achieve the same distal biasing of the sleeve.

[0280] Returning to the embodiment of FIGS. **21**A-**29**, the elongate body **215** can further include a proximal-facing shoulder **224** formed proximal to the distal-facing shoulder **222**. The proximal-facing shoulder **224** can provide a surface configured to engage with the distal end of the reducer handle **112** during a reduction operation. Accordingly, the distal end surface **182** of the reducer handle **112** can apply axial and distally directed reduction forces against, and rotate over, the proximal-facing shoulder **224** as the reducer handle is threaded into the reducer clip **108**. To facilitate this engagement, the inserter-reducer shaft **110** can include a thrust bearing **226** disposed around the elongate body **215** proximal to the proximal-facing shoulder **224**, though this feature can be omitted in some embodiments. FIG. **30** illustrates the thrust bearing **226** in greater detail, including its generally cylindrical shape with lumen **225** and opposed bearing surfaces **227** (only one visible in the figure). The thrust bearing **226** can have a variety of forms. For example, it can be a unitary or monolithic component, such as a polymer or metal (e.g., certain grades of stainless steel, such as nitronic **60**, etc.) washer with good wear characteristics for use in such a configuration, or a mechanical assembly, such as a cylindrical ball bearing with opposed bearing washers trapping a plurality of ball bearings therebetween.

[0281] The shoulders **222**, **224** and other components of the shaft **110** can have a variety of diameters. In some embodiments, an outer diameter of the distal-facing shoulder **22** and an outer diameter of the proximal-facing shoulder **224** can be equal. Further, in some embodiments, a portion of the elongate body **215** extending between the distal-facing shoulder **222** and the proximal-facing shoulder **224** can have an outer diameter that is less than a diameter of one or more of the shoulders **222**, **224**. In other embodiments, e.g., as shown in FIGS. **67**A-**69**F described below, a portion of the elongate body extending between a distal-facing shoulder and a proximal-facing shoulder can have an outer diameter equal to the diameter of one or more of the shoulders.

[0282] A proximal portion of the inserter-reducer shaft **110** can include one or more flat surfaces **228** formed therealong. The surface **228** can be configured to contact, for example, the rotation lock **208** of the driver handle **114** to couple the two components in a manner that prevents relative rotation therebetween. The proximal portion of the inserter-reducer shaft **110** can also include one or more at least partial circumferential grooves **230** formed therein. The proximal portion of the inserter-reducer shaft **110** containing these features can be positioned proximal to the proximal-facing shoulder **224** and/or the thrust bearing **226**.

[0283] The distal portion **216** that is configured to rotationally drive the setscrew **104** can have a cross-sectional shape that is complementary to a shape of the drive feature **136** of the setscrew. In addition, one or more features can be added to help retain a setscrew **104** when disposed over the distal portion **216**. In the illustrated embodiment, a spring clip **229** can be utilized to selectively retain a setscrew **104** on the shaft **110** until sufficient force is applied to overcome the spring clip and pass the setscrew over a distal end thereof.

[0284] The use of a spring clip **229** to retain a setscrew **104** on the inserter-reducer shaft is one example and a variety of alternative configurations are also within the scope of the present disclosure. For example, FIG. **113** illustrates one alternative embodiment that replaces the spring clip **229** with a retainer **708** formed of an elastomeric material. FIG. **113** is otherwise labeled with components similar to FIG. **28** to show context, but includes the retainer **708** disposed along a distal portion of the shaft. The retainer **708** can include one or more flexible protrusions that can interfere with the setscrew **104** drive feature (two such protrusions are shown in the figure). The protrusions (and the elastomeric retainer generally) can be compressible such that it can provide similar functionality to the spring clip **229** described above. Moreover, the figure shows the retainer **708** flush with a distal tip of the inserter-reducer shaft. Such a configuration can be achieved using an insert molding process (e.g., where the inserter-reducer shaft is placed into a mold and the elastomeric retainer **708** is molded in place on the end of the shaft). The distal tip of the shaft can be modified to provide a molding gate location in such an embodiment. For example, the shaft can have one or more cross holes drilled therein, as well as a central hole. The empty volume can be filled with liquid silicone rubber or a similar elastomer to form the retainer **708**. In some embodiments, the elastomeric setscrew retention of FIG. **113** can be combined with the elastomeric setscrew biasing shown in FIG. **111**.

[0285] Generally speaking, it can be possible to form the various components disclosed herein in a variety of manners and using either unitary, monolithic structures or assemblies of various modular components. In the illustrated embodiments, for example, the distal portion **216** configured to rotationally drive the setscrew **104** can be formed on an insert **231** that is separate from the elongate body **215**. In such an embodiment, the elongate body **215** can include a distal-facing recess **232** configured to receive a proximal portion of the insert **231**. The two components can be coupled together in any of a variety of manners to prevent unintended separation thereof (e.g., interference fit, adhesive bonding, welding, mechanical fastening, etc.). Further, they can be coupled together in a manner the prevents relative rotation therebetween (e.g., utilizing one or more flat surfaces that contact one another, a through-bolt or pin arrangement, etc.). For example, the distal-facing recess **232** formed in the elongate body **215** can include one or more flat surfaces **234** configured to contact one or more flat surfaces of the insert **231** that is received in the recess. In the illustrated embodiment, the distal-facing recess **232** can

include a plurality of flat surfaces **234**, as shown particularly in FIGS. **31**A and **31**B. The surfaces **234** can be configured to contact a corresponding plurality of flat surfaces **236** formed on a proximal portion **238** of the insert **231**.

[0286] FIGS. **32**A and **32**B illustrate the spring clip **229** in isolation. The spring clip **229** can have a generally "U" or "Y" shaped profile with opposed arms **240**A, **240**B (though, in other embodiments, a single-arm spring clip can be utilized). Distal ends of the arms **240**A, **240**B can include a protrusion, hook, or other feature **242** that can be configured to contact a setscrew **104** and prevent distal translation thereof along the distal portion **216** of the shaft **110** until sufficient force is applied to cause the opposed arms **240**A, **240**B of the spring clip **229** to deform radially-inward toward one another and allow the protrusions **242** to pass through the drive feature lumen **126** of the setscrew **104**. As shown in FIGS. **27-29**, showing cross-sectional views of the distal portion of the inserter-reducer shaft **110**, the protrusions **242** of the spring clip **229** can be positioned near a distal end of the distal portion **216** and the setscrew **104** can translate freely along the distal portion **216** when positioned proximal to the protrusions **242**.

[0287] FIGS. **33**A-**33**F illustrate the insert **231** in isolation. As noted above, the insert **231** can include the distal portion **216** configured to seat and rotationally drive the setscrew **104**. To this end, the cross-sectional profile of the distal portion **216** can have a shape that is complementary to the drive feature **136** of the setscrew **104**, e.g., including a hexagonal arrangement of surfaces **244** disposed around a circumference thereof with curved protrusions **246** disposed between adjacent flat surfaces. In other embodiments, any of a variety of different shapes can be utilized, including, e.g., torx, etc.

[0288] A flange **248** can separate the distal portion **216** from the proximal portion **238** configured to be inserted into the recess **232** of the elongate body **215**. In some embodiments, the flange **248** can serve as a proximal stop to prevent a setscrew **104** disposed over the distal portion **216** from translating proximally beyond the flange. Though, in certain embodiments, the setscrew **104** would not be able to reach the flange **248** before its proximal movement would be stopped by another component, such as the full insertion of the reducer handle **112** against the reducer clip **108** and/or the full reduction of the rod **106** into the receiver member **118**. Regardless, the flange **248** can serve as an insertion stop for the insert **231** relative to the elongate body **215**, as it prevents over-insertion and provides feedback to a user during assembly when the flange contacts a distal end surface of the elongate body.

[0289] The proximal portion **238** of the insert **231** can include a cross-sectional profile that is complementary to the cross-sectional profile of the recess **232** in the elongate body **215**. For example and as noted above, the proximal portion **238** can include one or more flat surfaces **236** configured to contact one or more corresponding flat surfaces that form the sidewalls of the recess **232**. Any of a variety of different numbers, shapes, and configurations of such surfaces can be utilized in different embodiments.

[0290] The insert **231** can also include a longitudinally extending slot **250** formed therein that can be configured to receive the spring clip **229** therein. For example, the slot **250** can extend longitudinally along opposed sides of the insert **231** and around a proximal end thereof, such that the "U" or "Y" shaped spring clip **229** can be loaded into the insert **231** by distally translating the spring clip **229** from a proximal position relative to the insert. When the insert **231** is disposed within the distal-facing recess **232** of the elongate body **215**, the two components can trap the spring clip in a desired position. The cross-sectional views of FIGS. **24-29** show the spring clip **229** assembled to the insert **231**, and the insert **231** disposed in the distal-facing recess **232** of the elongate body **215**. FIGS. **27-29**, in particular, show how the protrusions **242** at the ends of each arm **240**A, **240**B of the spring clip **229** extend above the plane of the surface **244** such that they would interfere with distal translation of a setscrew **104** off the distal portion **216** of the insert **231**. This interference can be overcome, however, with sufficient force to urge the arms **240**A, **240**B radially inward toward one another (i.e., further into the slot **250** of the insert toward a longitudinal axis thereof). Once sufficiently moved in this manner, the protrusions **242** can pass through the central drive feature lumen **136** of the setscrew **104** and the setscrew can translate distally off the distal portion **216** of the insert **231**.

[0291] In order to facilitate access and/or cleaning of these components, the elongate body **215** can include a bore **252** that intersects a proximal portion of the recess **232**. Further, the sleeve **218** can include an elongate slot **254** configured to align with the bore **252** at any point along the range of motion of the sleeve relative to the elongate body **215**. These features can be seen in the cross-sectional views of FIGS. **24-26**, as well as the isolated views of the elongate body in FIGS. **31**A and **31**B, and the isolated view of the sleeve **218** in FIGS. **34**A-**34**E.

[0292] FIGS. **35-42** illustrate cross-sectional views of various portions of the assembly of FIG. **1**A and instrument **100**. In particular, FIGS. **35-38** show cross-sectional views of the proximal and distal portions of the assembly in a first plane taken along the lines A-A in FIG. **1**A, while FIGS. **39-42** show cross-sectional view of the proximal and distal portions of the assembly in a second plane taken along the lines B-B in FIG. **1**A that is offset 90 degrees from the first plane. These figures can serve to orient the various features described above in connection with the figures showing the components in isolation.

[0293] FIGS. **43-52** illustrate one example method of utilizing the instrument **100** according to the present disclosure. As shown in FIG. **43**, for example, a rod **106** (e.g., an implanted spinal fixation rod that would extend farther than is illustrated in the figure) can be captured between the extended tabs **128** of the pedicle screw receiver member **118** and the reducer clip **108** can be brought near to the proximal end of the extended tabs **128**A, **128**B of the receiver member and aligned with a longitudinal axis thereof. Note that these operations can be performed in either order, e.g., by capturing the rod first and then coupling the reducer clip to the pedicle screw, or by first coupling the reducer clip to the pedicle screw and then capturing the rod (e.g., by passing the rod into the space between the extended tabs **128**A, **128**B of the pedicle screw receiver member from the side relative to the receiver member rather than from above along a longitudinal axis of the receiver member).

[0294] The reducer clip **108** can be coupled to the pedicle screw **102** and, more particularly, to a proximal end of the extended tabs **128**A, **128**B of the receiver member **118**, as shown in FIG. **44**. This can be accomplished by squeezing a proximal portion of the extended tabs **128**A, **128**B together (i.e., radially inward toward a longitudinal axis of the

pedicle screw **102**, as shown by arrows Ar1 in FIG. **45**) and advancing a distal portion of the reducer clip **108** over a proximal portion of the extended tabs in the direction of arrow Ar2 in FIG. **45**). During assembly, the reducer clip **108** can be held like a syringe with a user placing a finger distal to each tab **166**A, **166**B extending radially away from the locking sleeve **150**. A user can also provide a distally-directed counter-force (e.g., using a thumb or palm) to the proximal end surface **177** of the reducer clip **108** to pull back the reducer clip locking sleeve **150** proximally relative to the remainder of the reducer clip, as shown in FIG. **45**. Coupling and separating the reducer clip **108** and the pedicle screw **102** makes use of the flexible nature of the extended tabs **128**A, **128**B that, in some embodiments, can deflect along their length and/or about the reduced-thickness material **130**A, **130**B that connects the tabs to the remainder of the receiver member **118**. A proximal portion of the extended tabs **128**A, **128**B can remain collapsed radially inward toward one another until a proximal flange **135** and/or external threads **134** formed thereon are aligned with the recesses **142**A, **142**B of the reducer clip **108**. At this point, the extended tabs **128**A, **128**B can move radially outward away from one another in the direction of arrows Ar3 in FIG. **46** and return to their resting positions with the threads **134** and/or flange **135** disposed within the recesses **142**A, **142**B such that the reducer clip **108** cannot be separated from the pedicle screw **102**. This can give the user confirmation that the reducer clip **108** is correctly installed. The locking sleeve **150** can then be released, allowing the biasing element **152** to urge the locking sleeve distally relative to the remainder of the reducer clip **108** and the pedicle screw **102**. The pair of locking tabs or blades **164** formed at the distal end of the locking sleeve **150** can translate distally into a space between the opposed extended tabs **128**A, **128**B. In this distal position, the locking tabs **164** reside between the two extended tabs **128**A, **128**B, thereby preventing the extended tabs from collapsing or moving radially inward toward one another. This effectively prevents the reducer clip **108** from disassembling with respect to the pedicle screw **102**. As explained in more detail below, the reduction instruments can be threaded into the female threads **144** on the reducer clip **108**.

[0295] In other embodiments, the reducer clip **108** can be coupled to the pedicle screw **102** in a similar manner but where a user does not translate the locking sleeve **150** using the tabs **166**A, **166**B. Instead, after axially aligning the reducer clip **108** and the extended tabs **128**A, **128**B, a user can squeeze the extended tabs together and push the reducer clip over the extended tabs without retracting the locking sleeve. The extended tabs **128**A, **128**B would contact a distal portion of the locking sleeve and move it proximally with respect to the remainder of the reducer clip **108** until the threads **134** and/or flange **135** align with the recesses **142**A, **142**B. When the extended tabs **128**A, **128**B are released and expand radially outward, the locking sleeve **150** would travel distally into its locked position from the force of the biasing element **152**.

[0296] Turning to the reduction instrument aside from the reducer clip **108**, FIGS. **47** and **48** illustrate the assembly thereof in anticipation of insertion through the reducer clip **108**. In particular, a setscrew **104** can be loaded onto a distal end of an inserter-reducer shaft **110** by passing a distal portion **216** of the shaft through a drive feature lumen **136** of the setscrew **104**. This can involve passing the setscrew **104** proximally over projections **242** of a spring clip **229**. Once the projections **242** are disposed distal to the setscrew **104**, they can help retain the setscrew relative to the shaft **110** until sufficient force is applied to move the setscrew **104** distally over the projections. Furthermore, the setscrew **104** can be advanced proximally over the distal portion **216** of the shaft **110** until the setscrew contacts the distally biased sleeve **218** disposed around a portion of the shaft.

[0297] A proximal end of the inserter-reducer shaft **110** can be inserted into a distal end of the reducer handle **112** and through the lumen extending therethrough. The shaft **110** can be inserted proximally through the lumen of the reducer handle **112** until a distal end surface **182** of the reducer handle contacts a thrust bearing **226** and/or proximal-facing shoulder **224** of the shaft.

[0298] Further, the driver handle **114** can be coupled to the proximal end of the inserter-reducer shaft **110** extending proximally through the lumen of the reducer handle **112**. This can be accomplished, for example, by a user proximally withdrawing the distal housing **212** of the quick-connect coupling **192** and inserting a proximal portion of the shaft **110** into the recess formed at the distal end of the body **206** of the coupling. The user can then release the distal housing **212** and allow it to move distally from the biasing force of spring **213**, which can cause the distal housing to lock the ball **210** into the groove **230** to prevent separation of the shaft **110** and driver handle **114**. As shown in the assembled view of FIG. **48**, this can mean that a proximal portion of the shaft **110** and a distal portion of the driver handle **114** can be disposed within a proximal portion of the reducer handle **112**, and a proximal portion of the driver handle can extend proximally beyond a proximal end of the reducer handle.

[0299] The method can include passing a distal portion of the inserter-reducer shaft **110** having the setscrew **104** disposed thereon through the lumen of the reducer clip **108** into the pedicle screw **102** until a distal threaded portion of the reducer handle **112** disposed around the shaft contacts the proximal threaded portion of the reducer clip **108**. That is, the assembly from FIG. **48** can be disposed proximal to the assembly from FIG. **44**, as shown in FIG. **49**. The assembly from FIG. **48** can then be advanced distally, as shown by arrow Ar4 in FIG. **49**, to the position shown in FIG. **50**. In so doing, a distal portion of the shaft **110** with setscrew **104** disposed thereon can pass through the lumen of the reducer clip **108** into the space between the opposed extended tabs **128**A, **128**B of the pedicle screw **102**. Further, a distal end of the reducer handle **112** can enter the lumen of the reducer clip **108** and the threads **180** formed on a distal portion of the reducer handle can contact the threads **144** formed on a proximal portion of the reducer clip. Depending on the position of the rod **106** along the length of the extended tabs **128**A, **128**B, a distal end of the shaft **110** extending distally beyond the setscrew **104** may or may not contact the rod **106** at this point.

[0300] The method can include rotating the reducer handle **112** to engage the threads **180** of the reducer handle with the threads **144** of the reducer clip **108** and advance the inserter-reducer shaft **110** distally relative to the reducer clip. That is, the reducer handle **112** can be rotated, e.g., in the direction of arrow Ar5 in FIG. **50**, to cause associated distal translation of the reducer handle in the direction of Ar6 in FIG. **50**. During this rotation of the reducer handle **112**, a distal end surface **182** thereof can bear against the thrust bearing **226** (or proximal-facing shoulder **224** if the bearing is not

present) to urge the shaft **110** distally. In addition, a distal end of the shaft **110** can contact the rod **106** and urge it distally relative to the pedicle screw **102**, thereby achieving reduction of the rod toward the rod seat **126**. This movement can continue until the distally facing shoulder **188** of the reducer handle **112** contacts the proximal end surface **177** of the reducer clip **108**, as shown in FIG. **51**. At such a point, the reducer handle **112** has reduced the rod **106** to a prescribed extent and the setscrew **104** can be disposed in contact with the threads **132** of the pedicle screw **102**. Further, contact between the shoulder **188** of the reducer handle **112** and the surface **177** of the reducer clip **108** can act as a hard stop to prevent overreduction of the rod **106** and setscrew **104**. This can avoid potential damage from, e.g., advancing the setscrew **104** too far such that threads formed thereon interfere with threads formed on the pedicle screw **102** without proper rotational engagement therebetween.

[0301] The method can include rotating the driver handle **114** coupled to the proximal end of the inserter-reducer shaft **110** (including embodiments where the driver handle and inserter-reducer shaft are modular/separable and embodiments where they are unitary or permanently coupled) extending through the reducer handle **112** to engage the threads **138** on the outer surface of the setscrew **104** with the threads **132** formed on the inner surface of the pedicle screw **102**. That is, the driver handle **114** can be rotated, e.g., in the direction of arrow Ar7 in FIG. **51**, to engage the threads **138** of the setscrew **104** with the threads **132** of the pedicle screw **102**. Threaded engagement of the setscrew **104** and pedicle screw **102** can cause the setscrew **104** to continue advancing distally relative to the pedicle screw and also relative to the shaft **110**, e.g., translating distally over the distal portion **216** on which the setscrew is disposed. This can include passing over the protrusions **242** of the spring clip **229** and beyond a distal end of the shaft **110**, such that the setscrew **104** contacts the rod **106** to effect final reduction and securement of the rod within the rod seat **126** of the pedicle screw **102**. Depending upon the positioning of the shaft **110** when the reducer handle **112** reaches the point of maximum reduction shown in FIG. **51**, rotation of the driver handle **114** can result in some continued distal advancement of the shaft **110** and driver handle **114**, as shown by the transition between FIGS. **51** and **52**, as well as the counterpart cross-sectional views of FIGS. **53** and **54**. This can best be visualized in these figures with reference to the relative position of the drive handle **114** relative to a proximal end of the reducer handle **112**.

[0302] Certain prior reduction instruments have included the concept of multiple reduction handles (e.g., one that can be translated distally and another than can be rotated) in an instrument configured to introduce a setscrew. These instruments, however, can require a user to be careful to avoid jamming the threads of the setscrew and pedicle screw together in a way that might damage one or both of the components. For example, users can be required to carefully feel for the engagement of threads and partially rotate a driving handle, or perhaps repeatedly reposition with translation while rotating to properly engage threads due to, e.g., the translational positioning of the setscrew and the clocking of the threads. This can result in an instrument that requires great care and delicacy to operate correctly.

[0303] The reduction instruments disclosed herein improve on such prior instruments at least by providing the distal portion with spring-loaded sleeve **218** or other component or structure (e.g., a compressible elastomer, etc.) that distally biases the setscrew **104** along a distal portion of the inserter-reducer shaft **110**. This can allow a user to bottom out the reducer handle **112** relative to the reducer clip **108** and then simply begin rotating the driver handle **114** without concern for delicately adjusting the instrument to properly engage the setscrew threads. As noted, this is made possible by the extended distal portion **216** of the shaft **110**, along which the setscrew **104** is disposed and can translate, and which extends distally from the setscrew **104** to contact the rod **106**, as well as the extended-length spring clip **229** that selectively retains the setscrew on the distal portion of the shaft and the distally-biased sleeve **218** that urges the setscrew distally while allowing proximal movement with sufficient force to overcome the spring **220**.

[0304] As a result, the reduction instruments disclosed herein can utilize a single inserter-reducer shaft **110** to push distally on the spinal rod **106**, as well as deploy the setscrew **104**. The improved inserter tip design can allow for streamlined setscrew deployment relative to prior instruments, however. For example, the inserter tip can have a lengthened X25 drive feature (i.e., distal portion **216**) with the spring-loaded sleeve **218** that biases the setscrew **104** distally while still allowing the setscrew to translate proximally. During use, the reducer handle **112** can be rotated to advance the inserter-reducer shaft **110** and reduce the spinal rod **106**. When the shoulder **188** on the reducer handle **112** bottoms out on the proximal end **177** of the reducer clip **108**, the setscrew threads **138** can be in contact with the female threads **132** on the pedicle screw extended tabs **128**A, **128**B, and the spring-loaded sleeve **218** can be pushing the setscrew distally. This hard stop for reduction using the reducer handle **112** can position the setscrew **104** in contact with the threads **132** on the pedicle screw without overdriving the two components in a manner that may damage them. The driver handle **114** can be turned to rotate the inserter-reducer shaft **110** and thread the setscrew **104** into the pedicle screw receiver head **118**. Unlike certain prior instruments, a user does not have to worry about driving the setscrew **104** too far into the pedicle screw receiver member **118** or repeatedly go back-and-forth between the reducer and driver handles **112**, **114** to get the setscrew threads **138** to start to engage with the pedicle screw threads **132**. Once the setscrew threads **138** are engaged, the driver handle **114** can continue to be rotated to thread the setscrew distally along the reduction threads **132** on the pedicle screw **102**. The proximal portion of the inserter-reducer shaft **110** can be long enough to allow the shaft to continue to travel distally with the setscrew while avoiding any interference between components, e.g., the reducer handle **112** and driver handle **114**, etc.

[0305] FIGS. **55-57** illustrate the operation of the improved distal portion of the inserter-reducer shaft **110** described above. In the view of FIG. **55**, the rod **106** can be in contact with a distal end of the shaft **110** and the shaft can be advancing distally as a result of rotation of the reducer handle **112**. In this view, the setscrew **104** and threads **138** thereof can make initial contact with the threads **132** on the pedicle screw. Also, the sleeve **218** can be in contact with the setscrew and disposed at a distally advanced position, e.g., urging the setscrew **104** against the protrusions **242** of the spring clip **229** that retain the setscrew relative to the shaft **110** (prior to such a position, the setscrew may or may not be in contact with the sleeve).

[0306] As a user continues to rotate the reducer handle **112** and bottom it out on the reducer clip **108**, the instrument can transition from the view of FIG. **55** to the view of FIG. **56**. In this configuration, the rod **106** has been reduced farther relative to the pedicle screw **102** (e.g., compare its position in FIGS. **55** and **56** relative to the threads **132**) by the shaft **110**. The setscrew **104**, however, has not moved and remains in contact with a proximal end of the threads **132** of the pedicle screw **102**. This means the setscrew **104** has translated proximally along the distal portion **216** of the shaft **110** against the biasing force of the spring **220**. The sleeve **218** that is in contact with the setscrew **104** has also moved proximally relative to the shaft **110** and the spring **220** is in a more compressed state.

[0307] A user can further reduce the rod and secure its position by rotating the driver handle **114**. The user can begin rotating the driver handle immediately after bottoming out the reducer handle **112** against the reducer clip **108** because the setscrew **104** has been maintained in an ideal position at the proximal end of the threads **132** by the spring-loaded sleeve **218**. No undesired distal force has been applied to the setscrew **104** during the reduction operation that could potentially damage the threads of the setscrew or pedicle screw **102**. Rotation of the driver handle **114** can result in a transition from the configuration of FIG. **56** to the configuration of FIG. **57**. In this view, the setscrew **104** is translating distally off the shaft **110** as it is rotated by the shaft and driver handle **114**, which can include deforming the spring clip **229** radially inward to allow passage of the setscrew over the protrusions **242** of the spring clip. The sleeve **218** has distally advanced to the limit of its range of motion with corresponding relaxing of the spring **220** and the setscrew **104** has separated from the sleeve **218** as it advances distally along the threads **132** of the pedicle screw **102**. In this configuration, a user can perform final tightening of the setscrew **104** relative to the pedicle screw **102**, thereby securely capturing the rod **106** to the pedicle screw. In some embodiments, however, final tightening can be performed at a later point in a procedure.

[0308] Regardless of final tightening, once the setscrew **104** is engaged with the threads **132** of the pedicle screw to a desired degree, the instrument **100** can be separated from the pedicle screw **102**, rod **106**, and setscrew **104**. The instrument **100** can be separated from the pedicle screw **102** as a single unit in some embodiments, or it can be disassembled in a component-by-component fashion. To separate as a single unit, a user can proximally withdraw the locking sleeve **150** of the reducer clip **108** to retract the locking tabs **164** from the space between the extended tabs **128**A, **128**B. While holding the locking sleeve **150** in the proximally withdrawn position, the extended tabs **128**A, **128**B can be squeezed or moved radially inward toward one another to pass the threads **134** and/or flange **135** thereof out of the recesses **142**A, **142**B of the reducer clip **108**, and the instrument **100** can be withdrawn proximally relative to the pedicle screw **102**. The diameter D_1 (see FIGS. **39**, **40**, and **54**) of the inserter-reducer shaft **110** in the area of the reducer clip **108** can be smaller than a distance D**2** (see FIGS. **39**, **40**, and **54**) between the extended tabs **128**A, **128**B to allow the extended tabs **128**A, **128**B to be squeezed together in order to remove all parts of the reducer instrument **100** together.

[0309] As noted above, the instrument **100** described above can provide a novel solution to extending the reduction capability of an extended tab pedicle screw. For example, in one embodiment a pedicle screw having extended tabs can provide for about 10 mm of rod reduction, e.g., using the threads **132** formed along an inner surface of the receiver member **118**. The reducer clip **108** disclosed herein can extend the available reduction capacity. In one embodiment, for example, the reducer clip can provide an additional about 30 mm of reduction along threads **144**, resulting in a total reduction capacity of about 40 mm. The reducer clip disclosed herein can also be useful by providing additional length extending proximally from the pedicle screw. For example, in one embodiment the pedicle screw extended tabs can have a length of about 100 mm. In certain larger patients, however, this can be shorter than desired, e.g., to reach from a vertebra above a skin surface, etc. In such a case, the added length of the reducer clip **108** can be helpful during a procedure to facilitate grasping and/or manipulating the pedicle screw **102** or other components, e.g., when targeting insertion of a setscrew or other component, etc.

[0310] FIGS. **58**A-**61** illustrate another embodiment of an assembly including a pedicle screw reducer instrument **300** according to the present disclosure. The instrument **300** can be similar to the instrument **100** described above and a detailed description of every component is therefore omitted for brevity. For example, the instrument **300** can include the same reducer clip **108**, inserter-reducer shaft **110**, and driver handle **114** as the instrument **100** described above. In addition, the instrument **300** can be utilized in connection with the same pedicle screw **102**, setscrew **104**, and spinal fixation rod **106** as the instrument **100** described above.

[0311] The instrument **300** can include an alternative reducer handle **302** that has a different form factor from the reducer handle **112** described above. In particular, the reducer handle **302** can have a wing-nut-like handle with opposed wings or paddles **304**A, **304**B configured to interface with a user and facilitate application of torque to the reducer handle to effect distal reduction or translation of the rod **106** relative to the pedicle screw **102**.

[0312] As shown in the detail views of FIGS. **60**A-**60**E, a distal portion of the reducer handle **302** can be similar to the reducer handle **112** described above. That is, it can include a distal portion **306** having a generally cylindrical profile with a lumen extending therethrough, e.g., to accommodate passage of the inserter-reducer shaft **110** through the reducer handle **302**. The distal portion **306** can have a size configured to be received within the lumen of the reducer clip **108**. In addition, the distal portion **306** can include threads **308** formed on an external surface thereof that are configured to interface with the threads **144** formed on an inner surface of the proximal sleeve **148** of the reducer clip **108** to provide for controlled movement of the reducer handle **302** relative to the reducer clip, which can thereby provide for control of reduction of a spinal rod **106** and/or setscrew **104** relative to a pedicle screw **102** coupled to the reducer clip **108**.

[0313] The distal portion **306** of the reducer handle **302** can also include a blunt distal end surface **310** configured to contact the inserter-reducer shaft **110** in order to impart a distally-directed force thereto during reduction. The blunt distal end surface **310** can be substantially smooth and flat such that it is configured to bear against another flat surface on the shaft or a thrust washer or bearing disposed therebetween, to facilitate imparting an axial translation force to the shaft while allowing for relative rotation between the shaft and the reducer handle.

[0314] Still further, the distal portion **306** of the reducer handle **302** can include one or more markings **312** formed on an external surface thereof to provide feedback to a user regarding a reduction distance or amount indicated by the relative positioning of the reducer handle and the reducer clip **108**. While different amounts of reduction are possible by varying the lengths of the reducer clip **108** and reducer handle **302**, in the illustrated embodiment the reducer clip and reducer handle are configured to provide up to about 30 mm of rod reduction. Different marking or other feedback schemes are possible but, in the illustrated embodiment, an outer surface of the distal portion **306** of the reducer handle **302** includes markings **312** to show a distance of reduction that remains at a point where a proximal end of the reducer clip **108** aligns with a particular distance marking.

[0315] The reducer handle **302** can also include a proximal portion **314** configured for a user to grasp and apply torque thereto when performing rod reduction. The proximal portion **314** can include the opposed wings or paddles **304**A, **304**B separated by a space **316** that can receive, e.g., a proximal portion of the inserter-reducer shaft **110** and a distal portion of the reducer handle **114**. An external surface of each wing can include one or more features formed thereon, such as grooves **318** to aid a user in gripping and/or grasping and/or applying torque to the reducer handle **302**. Any of a variety (and number) of surface features can be utilized (e.g., texturing, knurling, finger-shaped recesses, etc.).

[0316] The distal portion **306** and the proximal portion **314** can be separated by distally-facing step or shoulder **320** that can serve as a stop or limit on rod reduction (at least, on rod reduction provided by the reducer handle **302** and inserter-reducer shaft **110** versus, for example, what might be additionally possible using the setscrew **104** when driven by the driver handle **114**). For example, the shoulder **320** can contact a proximal end of the reducer clip **108** at a point of maximum rod reduction, thereby preventing any further reduction using the reducer handle **302**. Contact between the shoulder **320** and the reducer clip **108** can serve as a hard stop to prevent overreduction that might, e.g., drive the setscrew **104** into the threads **132** of the pedicle screw **102** with too much force. The wings **304**A, **304**B can extend radially outward from a central longitudinal axis of the instrument by a greater distance than a diameter of the distal portion **306**. To accommodate the different diameters, a distal portion of the proximal portion **314** can include connecting arms **322**A, **322**B transitioning therebetween.

[0317] In some embodiments, the reducer handle **302** can be formed from a unitary or monolithic piece of material, e.g., through a single injection molding or other manufacturing operation. In certain embodiments, however, the reducer handle **302** can be formed from a plurality of components coupled. For example, FIG. **61** shows an exploded view of an embodiment wherein the reducer handle distal portion **306** and proximal portion **314** are separate components. In this embodiment, the reducer handle **302** can also include a ring **324** that can be disposed therebetween. These components can be coupled in manner that allows for selective disassembly when desired, e.g., threading, interference fit, etc., or can be joined in a more permanent manner such that disassembly is not contemplated after manufacturing, e.g., using an adhesive, welding, etc.

[0318] As noted above, operation of the instrument **300**, including the reducer handle **302**, is substantially the same as with instrument **100** described above. Accordingly, a detailed description of the operation and methods of use of the instrument **300** is omitted here for brevity.

[0319] FIGS. **62**A-**79** illustrate another embodiment of an assembly including a pedicle screw reducer instrument **400** according to the present disclosure. The instrument **400** can be similar to the instrument **100** described above and a detailed description of every component is therefore omitted for brevity. For example, the instrument **400** can include the same reducer handle **112** and driver handle **114** as the instrument **100** described above. In addition, the instrument **400** can be utilized in connection with the same pedicle screw **102**, setscrew **104**, and spinal fixation rod **106** as the instrument **100** described above.

[0320] The instrument **400**, however, can include an alternative embodiment of a reducer clip **402** that does not utilize a spring-loaded locking sleeve to facilitate coupling to a pedicle screw **102**. Instead, as explained in more detail below, the instrument **400** utilizes a unitary reducer clip **402** and an inserter-reducer shaft **404** with an enlarged diameter along a central portion thereof that can prevent radially-inward movement of the extended tabs **128**A, **128**B of the pedicle screw **102** and thereby avoid unintended separation of the reducer clip from the pedicle screw.

[0321] FIGS. **64**A-**66** illustrate the reducer clip **402** in isolation. The reducer clip **402** can be envisioned as a single-piece combination of the above-described distal sleeve **146** and proximal sleeve **148** of the reducer clip **108**. For example, the reducer clip **402** includes a lumen **406** extending therethrough and a distal portion of the reducer clip includes recesses **408**A, **408**B formed in a sidewall thereof that can be configured to receive the threads **134** and/or flange **135** formed on an external surface of each extended tab **128**A, **128**B. Further, a proximal portion of the reducer clip **402** can include threads **410** configured to interface with the reducer handle **112**. An external surface of the reducer clip **402** can include one or more features to facilitate grasping or manipulating the reducer clip and/or other components coupled thereto. Any of a variety (and number) of surface features can be utilized, including features **412** that facilitate a user directly grasping the reducer clip **402** (e.g., texturing, knurling, finger-shaped recesses, etc.), as well as features **414** that facilitate doing so using an intermediate tool (e.g., flat surfaces for applying a wrench or other tool, etc.).

[0322] FIGS. **67**A-**67**F illustrate the inserter-reducer shaft **404** in isolation. The inserter-reducer shaft **404** can be largely similar to the inserter-reducer shaft **110** described above, including utilizing the same distal end components that provide a spring-loaded sleeve **218** to bias a setscrew distally during use. The primary difference relative to the inserter-reducer shaft **110** is the different shape of the elongate body **414**, shown in isolation in FIGS. **69**A-**69**F.

[0323] The elongate body **414** can have similar proximal and distal end geometries, including the use of one or more flats **228** and one or more at least partial circumferential grooves **230** along a proximal portion thereof, as well as a distal-facing recess **232** with one or more flats **234**, along with an elongate slot **223** and through-hole **252** along a distal portion thereof. The elongate body **414** can also include a

distal-facing shoulder **222** along a distal portion thereof, and a proximal-facing shoulder **224** along a proximal portion thereof.

[0324] An intermediate portion of the elongate body **414** extending between the two shoulders **222**, **224**, however, can have an enlarged diameter D_1 relative to the elongate body **215** of the inserter-reducer shaft **110** described above. The enlarged diameter D_1 can be, for example, similar to the diameter of the shoulders **222**, **224**, such that the intermediate portion of the elongate body **414** extending between the two shoulders can have a constant diameter in some embodiments. The diameter D_1 can be selected to match the nominal inner diameter between the opposed extended tabs **128**A, **128**B in a resting position, as explained in more detail below.

[0325] FIGS. **70-79** illustrate one example method of utilizing the instrument **400**. As shown in FIG. **70**, a pedicle screw **102** can be aligned with a spinal fixation rod **106** such that the rod is disposed between the opposed extended tabs **128**A, **128**B of the pedicle screw. The reducer clip **402** can be brought near a proximal end of the pedicle screw **102**. The reducer clip **402** can be moved distally, as shown by arrow Ar8 in FIG. **70**, from the position of FIG. **70** to the position of FIG. **71**. In connection with advancing the reducer clip **402** distally, the extended tabs **128**A, **128**B of the pedicle screw **102** can be squeezed together or moved radially inward toward a longitudinal axis Ax2 (see FIG. **62**A) to permit the proximal ends of the extended tabs to pass into the lumen of the reducer clip **402**.

[0326] Once the threads **134** and/or flange **135** are aligned with the recesses **408** formed in the reducer clip **402**, the extended tabs **128**A, **128**B can be allowed to return radially outward to their normal resting position. In doing so, the threads **134** and/or flange **135** can enter the recesses **408** to couple the reducer clip **402** to the pedicle screw **102**, as shown in FIG. **71**.

[0327] As shown in FIG. **72**, the various other components of the instrument **400** can be assembled and readied for use with the reducer clip **402**. For example, a setscrew **104** can be loaded onto the distal portion **216** of the inserter-reducer shaft **404**. In addition, a proximal end of the inserter-reducer shaft **404** can be passed proximally through the lumen of the reducer handle **112** and passed into the distal-facing recess of the driver handle **114**. FIG. **73** shows the components of FIG. **72** assembled together for use.

[0328] As shown in FIG. **74**, the assembled components of FIG. **73** can be disposed near a proximal end of the reducer clip **402** and advanced distally, as shown by arrow Ar9 to the position shown in FIG. **75** when the threads **180** of the reducer handle **112** contact the threads **410** of the reducer clip **402**. Note that, in this configuration, the intermediate portion of the inserter-reducer shaft **404** can be disposed through the lumen of the reducer clip **402**, especially over a distal portion thereof where the recesses **408** are disposed. As noted above, the outer diameter D_1 of the shaft **404** in this area can substantially match the inner diameter or distance between the opposed tabs **128**A, **128**B. As a result, the presence of the shaft **404** can prevent the tabs **128**A, **128**B from moving radially inward and thereby inadvertently separating the pedicle screw **102** from the reducer clip **402**.

[0329] To reduce the spinal fixation rod **106** from the configuration shown in FIG. **75**, the reducer handle **112** can be rotated, as shown by arrow Ar10. The interaction of the threads **180** on the reducer handle **112** with the threads **410** of the reducer clip **402** can cause distal advancement of the inserter-reducer shaft **404** and any rod **106** that it is contacting. The reducer handle **112** can be rotated until the threads bottom out and/or the shoulder **188** on the reducer handle contacts the proximal end surface **415** of the reducer clip **402**, as shown in FIG. **76**.

[0330] As explained above in connection with instrument **100**, at the position shown in FIG. **76**, the setscrew **104** can be positioned in contact with the threads **132** of the pedicle screw receiver member **118**. The spring-loaded sleeve **218** can allow proximal movement of the setscrew **104** along the distal portion **216** of the inserter-reducer shaft during reduction to prevent unintentional damage by, e.g., advancing the setscrew too far distally and pressing it into the threads **132**. A user can engage the setscrew **104** with the threads **132** by turning the driver handle **114**, as shown by arrow Ar11 in FIG. **76**. This rotation can be continued to the configuration shown in FIG. **77**, wherein the setscrew **104** has completed final reduction and securement of the spinal fixation rod **106** relative to the pedicle screw **102**.

[0331] FIGS. **78** and **79** illustrate the configurations of FIGS. **76** and **77** in cross-section. In these views, the operation of the sleeve **218** and spring **220** can be seen. In particular, in the view of FIG. **76**, where the reducer handle **112** has been rotated until the shoulder **188** contacts the proximal surface **415** of the reducer clip **402**, shows the setscrew **104** in contact with a proximal end of the threads **132** on the pedicle screw **102**. Instead of continuing to advance distally during reduction using the reducer handle **112**, the setscrew **104** has translated proximally along the distal portion **216** of the inserter-reducer shaft **404** after contacting the threads **132**. In doing so, it has moved the sleeve **218** proximally relative to the remainder of the shaft **404** against the bias of the spring **220**. The spring **220** and sleeve **218** maintain distal pressure (of a desired magnitude) against the setscrew **104** such that it will engage with the threads **132** of the pedicle screw **102** as soon as a user begins rotating the driver handle **114**.

[0332] Also shown in FIG. **78** is the diameter D_1 of the inserter-reducer shaft **404** along an intermediate portion thereof that is aligned with a distal portion of the reducer clip **402** containing the recesses **408**A, **408**B. As shown in the figure, the diameter D_1 substantially matches the distance or diameter D_2 between the extended tabs **128**A, **128**B at this position, such that the tabs cannot deflect radially inward to allow separation of the reducer clip **402** from the pedicle screw **102** as long as the shaft **404** is present.

[0333] FIG. **79** illustrates a configuration in which the driver handle **114** is being rotated to engage the threads of the setscrew **104** with the threads **132** of the pedicle screw **102**. As the driver handle **114** is rotated, the setscrew **104** can move distally along the distal portion **216** of the shaft **404**. As the setscrew **104** advances distally, the sleeve **218** can advance distally with it, as allowed by the pin **219** traveling within the elongate slot **223**, and the spring **220** can return to a more relaxed state. In some embodiments, the distal advancement of the setscrew **104** can include overcoming the biasing force of the spring clip **229** and separating from the shaft **404** entirely. In other embodiments, the setscrew **104** can overcome the biasing force of the spring clip **229** and separate from the shaft **404** when the instrument **100** is being removed.

[0334] The reducer clip **402** described above can be more simple to manufacture when compared to the reducer clip

108, e.g., because it can be formed as a unitary or monolithic component. It contrast, however, it can require insertion and/or removal of the instrument **400** as separate components because there is no ability to separate the reducer clip **402** from the pedicle screw **102** when the inserter-reducer shaft **404** is disposed through the lumen of the reducer clip. With the reducer clip **108** and shaft **110** described above, the reduced diameter of the shaft along an intermediate portion thereof can allow for the insertion and/or removal of the instrument **100** together as a single unit.

[0335] FIGS. **80**A-**96** illustrate another embodiment of an assembly including a pedicle screw reducer instrument **500** according to the present disclosure. The instrument **500** can be similar to the instrument **100** described above and a detailed description of every component is therefore omitted for brevity. For example, the instrument **500** can include the same inserter-reducer shaft **110**, reducer handle **112**, and driver handle **114** as the instrument **100** described above. In addition, the instrument **500** can be utilized in connection with the same setscrew **104** and spinal fixation rod **106** as the instrument **100** described above. The main differences relative to the instrument **100** can be its use in connection with a different pedicle screw **502** that lacks extended tabs **128**A, **128**B and a reducer clip in the form of a pedicle screw extension **504**.

[0336] FIG. **81** illustrates an exploded view of the components in the assembly of FIGS. **80**A, **80**B, while FIG. **82** illustrates the components of the pedicle screw extension **504** in greater detail, while FIGS. **83** and **84** illustrate cross-sectional views of the pedicle screw extension. As shown in the figures, the pedicle screw extension **504** can include an inner sleeve **506** having a lumen formed therethrough. The inner sleeve **506** can have threads **505** formed on an inner surface along a proximal portion thereof, as well as opposed arms **507**A, **507**B formed at a proximal end thereof. The extension **504** can also include resilient arms **508**A, **508**B disposed in recessed formed in each arm **507** of the inner sleeve **506**. The arms **508**A, **508**B can be configured to extend into the inner lumen of the sleeve **506** and engage with a feature formed on an external surface of the pedicle screw **502**, such as the groove or notch **519** (see FIG. **85**).

[0337] The pedicle screw extension **504** can further include an outer sleeve **510** disposed over the inner sleeve **506**. The outer sleeve **510** can be configured to translate over a portion of the inner sleeve **506** and can selectively lock the extension to a pedicle screw by preventing radially outward movement of the resilient arms **508**A, **508**B. The outer sleeve **510** can house resilient arms **512**A, **512**B in recesses formed therein. These arms can extend into recesses, slots, or tracks formed in the inner sleeve **506** to define the movement of the outer sleeve **510** relative to the inner sleeve, as well as lock the outer sleeve in a proximal and/or distal position. Further, a ring **514** can be disposed over a proximal portion of the outer sleeve **510**.

[0338] FIGS. **85** and **86** illustrate the pedicle screw **502** in isolation. The pedicle screw **502** can be similar to the pedicle screw **102** described above, but can lack the extended tabs **128**A, **128**B of the pedicle screw **102**. The pedicle screw **502** can include a distally-extending implantable shank **516**, a proximal receiver member **518** that polyaxially couples with a proximal head of the shank **516**, and a compression member **520** disposed within the receiver member proximal to the head of the shank **516**.

[0339] FIG. **87** illustrates the pedicle screw extension **504** coupled to the pedicle screw **502**. As shown in the figure, the inner sleeve extends over a proximal portion of the pedicle screw receiver member **518**. Distal portions of the resilient arms **508**A, **508**B extend through the recesses formed in the opposed arms **507**A, **507**B of the inner sleeve **506** and into the groove or notch **519** formed in an external surface of the receiver member **518**. The outer sleeve **510** is shown advanced into a distal position in which it blocks any radially-outward movement of the resilient arms **508**A, **508**B relative to a longitudinal axis Ax3 (see FIG. **80**A). In such a configuration, the arms **508**A, **508**B cannot move radially outward to clear the groove or notch **519**, effectively locking the pedicle screw extension **504** to the pedicle screw **502**.

[0340] FIGS. **88**-**96** illustrate one method of use of the instrument **500**. The method can include coupling the pedicle screw extension **504** to the pedicle screw **502** and aligning a spinal fixation rod **106** with opposed arms of the pedicle screw receiver member **518**. To do this, the outer sleeve **510** can be withdrawn proximally, as shown in FIG. **88**, to allow the resilient arms **508**A, **508**B to move radially outward as a proximal portion of the pedicle screw receiver member **518** passes between the opposed arms **507**A, **507**B of the inner sleeve **506**. When a distal portion of the resilient arms **508**A, **508**B is aligned with the groove or notch **519** formed in the receiver member **518**, the arms can move radially inward such that outer surfaces thereof can be flush with an outer surface of the inner sleeve **506**. The outer sleeve **510** can then be advanced distally, in the direction of Ar12 in FIG. **88**, to lock the pedicle screw extension **504** relative to the pedicle screw receiver member **518**, as shown in FIG. **89**.

[0341] FIG. **90** illustrates the assembly of the remaining components of the instrument **500**. In particular, a setscrew **104** can be loaded on a distal portion of the inserter-reducer shaft **110**, and a proximal end of the shaft can be passed proximally through the lumen of the reducer handle **112**. The driver handle **114** can be coupled to the proximal end of the shaft **110** that extends proximally through the reducer handle **112** to form the assembly shown in FIG. **91**.

[0342] FIG. **92** illustrates a step wherein the assembly of FIG. **91** is disposed near a proximal end of the pedicle screw extension **504**. The setscrew **104** and associated components can be advanced distally relative to the pedicle screw extension **504**, as shown by arrow Ar13 in FIG. **92**, to the configuration of FIG. **93** wherein the threads of the reducer handle **112** contact the threads **505** of the pedicle screw extension **504**.

[0343] The reducer handle **112** can be rotated, as shown by arrow Ar14 in FIG. **93**, to distally advance the reducer handle **112**, shaft **110**, and setscrew **104** relative to the pedicle screw extension **504**. This can also distally reduce the rod **106** in contact with a distal end of the shaft **110**. As noted above, the reducer handle **112** can be rotated until the distal-facing shoulder **188** contacts a proximal surface **509** of the pedicle screw extension **504** or, in some embodiments, until the rod **106** is fully reduced into the receiver member **518** (which may occur before the distal-facing shoulder **188** contacts the proximal surface **509**). At such a point, as shown in FIG. **95**, the setscrew **104** can be in contact with the threads **521** of the pedicle screw receiver member **518**. As noted above, the spring-loaded sleeve **218** of the shaft **110** can exert a distally-directed force on the setscrew **104** to

maintain it in contact with the threads **521** of the receiver member **518** while allowing the setscrew to move proximally along a distal portion of the shaft to prevent damage by over-advancing the setscrew during reduction via the reducer handle **112**.

[0344] The setscrew **104** can be engaged with the threads **521** of the pedicle screw receiver member **518** by rotating the driver handle **114**, as shown by arrow Ar18 in FIG. **94**. This can advance the setscrew **104** distally along the shaft **110**, as shown in FIG. **96**, to perform final reduction and securing of the spinal fixation rod **106** relative to the pedicle screw **502**.

[0345] Note that the above-described inserter-reducer shaft, which utilizes the spring-loaded sleeve to distally bias a setscrew disposed along a distal portion thereof while allowing proximal translation against the biasing force, can be utilized in a variety of embodiments with pedicle screws that include or lack extended tabs. Such a configuration of setscrew inserter can allow for some play when introducing the setscrew and facilitate easier starting of a threaded engagement between the setscrew and the pedicle screw. In addition, utilizing a single shaft for both reduction and setscrew deployment can minimize the amount and bulk of instrumentation, thereby improving various aspects of a procedure, such as the ability for a user to visualize a surgical site, a position of the setscrew and operation of the instrument, etc. For example, separate rod reduction instruments can contact a rod at positions outboard from the setscrew, thereby blocking the ability for a user to directly visualize the setscrew during delivery.

[0346] Further, the above-described configurations can be utilized in a variety of reducer instruments, including instruments where a reducer handle may or may not bottom out against a reducer clip to achieve maximum reduction of a spinal fixation rod. As noted above, in certain embodiments the distal portion of an inserter-reducer shaft can extend distally beyond a setscrew disposed thereon and contact a rod directly. In some embodiments, distal advancement of the shaft can achieve full or maximum reduction of the rod, pressing it fully into a rod-receiving seat of a pedicle screw. The reducer instruments can be configured such that, having achieved full reduction, the setscrew is in contact with the threads of the pedicle screw (with the spring-loaded sleeve urging it distally) and can be threaded into engagement with the pedicle screw by rotating the inserter-reducer shaft.

[0347] FIGS. **97**A-**110** illustrate another embodiment of an assembly including a pedicle screw reducer instrument **600** according to the present disclosure. The instrument **600** can be similar to the other instruments described above and a detailed description of every component is therefore omitted for brevity. For example, the instrument **600** can be utilized in connection with the same pedicle screw **102** and spinal fixation rod **106** as the instrument **100** described above. The instrument **600**, however, can be configured for use in reducing a spinal fixation rod **106** at an "adjacent level" to facilitate the introduction of a setscrew **104** using another instrument disposed nearby. For example, in a spinal fixation construct utilizing pedicle screws implanted in a plurality of vertebra or vertebral levels, the instrument **600** can be utilized to reduce or distally advance a rod into a pedicle screw at a first vertebra or level, which can facilitate the introduction of a setscrew into a pedicle screw at an adjacent, second vertebra or level to capture, reduce, and/or secure the rod. FIG. **98** illustrated the components of the instrument **600** in an exploded view. The instrument **600** can include a reducer clip **602**, a reducer shaft **604**, and a reducer handle **606**.

[0348] FIGS. **99**A-**101** illustrate the reducer clip **602** in isolation. The reducer clip **602** can be similar to the reducer clip **402** described above. For example, the reducer clip **602** can be a unitary or monolithic component with a lumen extending therethrough having threads **608** that extend from a proximal end **610** thereof and recesses **612**A, **612**B formed in a sidewall along a distal portion thereof. The recesses **612**A, **612**B can be configured to receive the threads **134** and/or flange **135** formed on an external surface of a proximal portion of the extended tabs **128**A, **128**B of the pedicle screw **102**.

[0349] FIGS. **102**A-**102**D illustrate the reducer shaft **604** in isolation. Given that the reducer shaft **604** does not introduce or deploy a set screw and instead only pushes on a rod **106** to provisionally reduce it, the shaft can have a simpler, blunt distal end **614** without the spring-loaded sleeve **218** and other components found on the inserter-reducer shafts described above. The shaft **604** can also include an intermediate portion **616** with an outer diameter D_1 that is substantially the same as an inner diameter or distance between the opposed extended tabs **128**A, **128**B of the pedicle screw **102**. In this manner, the presence of the shaft **604** disposed between the extended tabs **128**A, **128**B can prevent the radially-inward movement of the tabs that might allow separation of the reducer clip **604** from the pedicle screw **102**, similar to the inserter-reducer shaft **404** and reducer clip **402** described above.

[0350] The reducer shaft **604** can also include threads **618** formed along a portion thereof that can be configured to interface with the threads **608** of the reducer clip **602** to perform rod reduction. A distal-facing shoulder **620** can be formed proximal to the threads **618** and can be configured to contact a proximal end **610** of the reducer clip **602** to stop any further reduction. A proximal portion of the shaft **604** can include any combination of surfaces configured to facilitate coupling to the reducer handle **606**, such as one or more flats **622** and/or one or more at least partial circumferential grooves **624**.

[0351] FIGS. **103**A-**104** illustrate the reducer handle **606** in isolation. The reducer handle **606** can include a distal body **626** with a distal-facing recess configured to receive a proximal portion of the reducer shaft **604**, as well as a proximal handle **628** coupled thereto. The reducer handle **606** can also include a spring-loaded button **630** that can be utilized to selectively lock the reducer handle against separation from the reducer shaft **604**.

[0352] The exploded view of FIG. **104** illustrates additional components of the reducer handle **606**, including a spring **632** to bias the button **630**, as well as a pin **634** that can be disposed within a bore formed in the body **626** and can extend into an elongate slot formed in the button **630** to limit its travel and prevent ejection from the body **626** by the force of the spring **632**. A washer **636** can retain the pin **634** within the body **626**. Also shown is a shaft **638**, core **640**, and cap **642** that can form components of the proximal handle **628**.

[0353] FIGS. **105**-**110** illustrate a method of operation of the reducer instrument **600**. In FIG. **105**, the reducer clip **602** can be positioned near a proximal end of the pedicle screw **102**. The reducer clip **602** can be advanced distally, in the direction of arrow Ar15, to pass a distal portion of the

reducer clip **602** over a proximal portion of the pedicle screw **102**. To do this, proximal ends of the extended tabs **128**A, **128**B of the pedicle screw **102** can be squeezed together or moved radially inward relative to a longitudinal axis Ax4 (see FIG. **97**A) to allow them to pass into the lumen of the reducer clip **602**. When the threads **134** and/or flange **135** formed on the external surface of the extended tabs **128**A, **128**B are aligned with the recesses **612**A, **612**B of the reducer clip **602**, the extended tabs **128**A, **128**B can move radially outward and return to their resting position, thereby coupling the reducer clip to the pedicle screw, as shown in FIG. **106**.

[0354] As shown in FIG. **107**, the reducer shaft **604** can be coupled to the reducer handle **606** by inserting a proximal end of the shaft into the distal-facing recess of the handle. The spring-loaded button **630** can seat itself in the at least partial circumferential groove **624** to selectively lock the two components together, and a flat surface of the recess in the handle can interface with the flat surface **622** of the shaft to prevent relative rotation between the shaft and handle.

[0355] As shown in FIG. **108**, the shaft **604** can be positioned near a proximal end of the reducer clip **602** and advanced distally relative thereto, as shown by arrow Ar16. The distal end of the shaft **604** can be inserted through the lumen of the reducer clip **602** until threads **618** of the shaft contact the threads **608** of the reducer clip, as shown by FIG. **109**. From here, the reducer handle **606** can be rotated, as shown by arrow Ar17, to engage the threads **618** of the shaft **604** with the threads **608** of the reducer clip **602** and thereby distally advance the shaft, along with any rod in contact with its distal end, distally relative to the reducer clip and pedicle screw **102**. The reducer handle **606** can be rotated until the distal-facing shoulder **620** contacts the proximal end **610** of the reducer clip **602**.

[0356] As noted above, the "adjacent level" reducer instrument **600** can be utilized in connection with a pedicle screw implanted at a first vertebra or vertebral level in order to provisionally reduce a rod relative to the pedicle screw. This can have the effect of also reducing the rod relative to a pedicle screw implanted at an adjacent, second vertebra or vertebral level. Reducing the rod in this manner can facilitate a user introducing a setscrew into the pedicle screw implanted at the second vertebra or vertebral level in order to further reduce and securely capture the rod. Once the setscrew is utilized to maintain a position of the rod relative to the second pedicle screw, the instrument **600** can be removed from the first pedicle screw and a setscrew can be inserted into the first pedicle screw. Removing the instrument **600** can require the separate removal of the reducer shaft **604** and reducer clip **602**. This can be because the presence of the reducer shaft **604**, with its enlarged diameter D_1 along an intermediate portion thereof, between the extended tabs **128**A, **128**B of the pedicle screw can prevent radially-inward movement of the extended tabs that can be necessary to separate the pedicle screw from the reducer clip **602**.

[0357] Various devices and methods disclosed herein can be used in minimally invasive surgery and/or open surgery. While various devices and methods disclosed herein are generally described in the context of surgery on a human patient, the methods and devices disclosed herein can be used in any of a variety of surgical procedures with any human or animal subject, or in non-surgical procedures.

[0358] Various devices disclosed herein can be constructed from any of a variety of known materials. Example materials include those that are suitable for use in surgical applications, including metals such as stainless steel, titanium, titanium nitride, nickel, cobalt, chrome, cobalt-chromium, or alloys and combinations thereof, polymers such as PEEK, ceramics, carbon fiber, and so forth. The various components of the devices disclosed herein can be rigid or flexible. In addition, one or more of the components or devices disclosed herein can be formed as monolithic or unitary structures, e.g., formed from a single continuous material, or can be formed from separate components coupled together in a variety of manners that either facilitate or discourage subsequent separation. One or more components or portions of the device can be formed from a radiopaque material to facilitate visualization under fluoroscopy and other imaging techniques, or from a radiolucent material so as not to interfere with visualization of other structures. Example radiolucent materials include carbon fiber and high-strength polymers. Further, various methods of manufacturing can be utilized, including 3D printing or other additive manufacturing techniques, as well as more conventional manufacturing techniques, including molding, stamping, casting, machining, etc.

[0359] Various devices or components disclosed herein can be designed to be disposed of after a single use, or they can be designed to be used multiple times. In either case, however, various devices or components can be reconditioned for reuse after at least one use. Reconditioning can include any combination of the steps of disassembly, followed by cleaning or replacement of particular pieces, and subsequent reassembly. In particular, a device or component can be disassembled, and any number of the particular pieces or parts thereof can be selectively replaced or removed in any combination. Upon cleaning and/or replacement of particular parts, the device or component can be reassembled for subsequent use either at a reconditioning facility, or by a surgical team immediately prior to a surgical procedure. Reconditioning of a device or component can utilize a variety of techniques for disassembly, cleaning/replacement, and reassembly. Use of such techniques, and the resulting reconditioned device or component, are within the scope of the present disclosure.

[0360] Various devices or components described herein can be processed before use in a surgical procedure. For example, a new or used device or component can be obtained and, if necessary, cleaned. The device or component can be sterilized. In one sterilization technique, the device or component can be placed in a closed and sealed container, such as a plastic or TYVEK bag. The container and its contents can be placed in a field of radiation that can penetrate the container, such as gamma radiation, x-rays, or high-energy electrons. The radiation can kill bacteria on the device or component and in the container. The sterilized device or component can be stored in the sterile container. The sealed container can keep the device or component sterile until it is opened in the medical facility. Other forms of sterilization are also possible, including beta or other forms of radiation, ethylene oxide, steam, or a liquid bath (e.g., cold soak). Certain forms of sterilization may be better suited to use with different devices or components, or portions thereof, due to the materials utilized, the presence of electrical components, etc.

[0361] In this disclosure, articles "a" and "an" are used to refer to one or to more than one (i.e., at least one) of the grammatical object of the article. By way of example, "an element" means at least one element and can include more than one element. The term "about" is used to provide flexibility to a numerical range endpoint by providing that a given value may be "slightly above" or "slightly below" the endpoint without affecting the desired result. The use herein of the terms "including," "comprising," or "having," and variations thereof, is meant to encompass the elements listed thereafter and equivalents thereof, as well as additional elements. As used herein, "and/or" refers to and encompasses any and all possible combinations of one or more of the associated listed items, as well as the lack of combinations where interpreted in the alternative ("or"). Further, phrases such as "at least one of" or "one or more of" may occur followed by a conjunctive list of elements or features. The term "and/or" may also occur in a list of two or more elements or features. Unless otherwise implicitly or explicitly contradicted by the context in which it is used, such a phrase is intended to mean any of the listed elements or features individually or any of the recited elements or features in combination with any of the other recited elements or features. For example, the phrases "at least one of A and B," "one or more of A and B," and "A and/or B" are each intended to mean "A alone, B alone, or A and B together." A similar interpretation is also intended for lists including three or more items. For example, the phrases "at least one of A, B, and C," "one or more of A, B, and C," and "A, B, and/or C" are each intended to mean "A alone, B alone, C alone, A and B together, A and C together, B and C together, or A and B and C together." In addition, use of the term "based on," is intended to mean, "based at least in part on," such that an un-recited feature or element is also permissible.

[0362] To the extent that linear, circular, or other dimensions are used in the description of the disclosed devices and methods, such dimensions are not intended to limit the types of shapes that can be used in conjunction with such devices and methods. Equivalents to such dimensions can be determined for different geometric shapes, etc. Further, like-numbered components of the embodiments can generally have similar features. Still further, sizes and shapes of the devices, and the components thereof, can depend at least on the anatomy of the subject in which the devices will be used, the size and shape of objects with which the devices will be used, and the methods and procedures in which the devices will be used.

[0363] The figures provided herein are not necessarily to scale. Still further, to the extent arrows are used to describe a direction of movement, these arrows are illustrative and in no way limit the direction that the respective component can or should be moved. Other movements and directions may be possible to create the desired result in view of the present disclosure.

[0364] Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. For example, if a concentration range is stated as 1% to 50%, it is intended that values such as 2% to 40%, 10% to 30%, or 1% to 3%, etc., are expressly enumerated in this specification. These are only examples of what is specifically intended, and all possible combinations of numerical values between and including the lowest value and the highest value enumerated are to be considered to be expressly stated in this disclosure.

[0365] Further features and advantages based on the above-described embodiments are possible and within the scope of the present disclosure. Accordingly, the disclosure is not to be limited by what has been particularly shown and described. All publications and references cited herein are expressly incorporated herein by reference in their entirety, except for any definitions, subject matter disclaimers, or disavowals, and except to the extent that the incorporated material is inconsistent with the express disclosure herein, in which case the language in this disclosure controls.

[0366] Examples of the above-described embodiments can include the following:

[0367] 1. A surgical system, comprising:

[0368] a reducer clip having a lumen extending from a proximal end to a distal end thereof, a recess formed in a sidewall of the reducer clip along a distal portion thereof, and threads formed in the sidewall of the reducer clip along a proximal portion thereof;

[0369] a shaft disposed through the lumen of the reducer clip;

[0370] a reducer handle having a lumen extending from a proximal end to a distal end thereof and threads formed along an outer distal portion thereof, the reducer handle threads interfacing with the threads formed along the proximal portion of the reducer clip; and

[0371] a driver handle coupled to a proximal portion of the shaft extending through the reducer handle.

[0372] 2. The system of example 1, wherein the driver handle extends proximal to the reducer handle.

[0373] 3. The system of any of examples 1 to 2, wherein the reducer clip is a monolithic component.

[0374] 4. The system of any of examples 1 to 2, wherein the reducer clip further comprises a locking sleeve with a locking tab at a distal end thereof that is configured to translate relative to another portion of the reducer clip.

[0375] 5. The system of example 4, wherein the reducer clip further comprises a biasing element that urges the locking sleeve distally relative to another portion of the reducer clip.

[0376] 6. The system of any of examples 1 to 5, wherein the reducer clip further comprises opposed tabs extending radially away from a longitudinal axis of the reducer clip.

[0377] 7. The system of any of examples 1 to 6, wherein the reducer clip further comprises a flat formed on an outer proximal portion thereof.

[0378] 8. The system of any of examples 1 to 7, wherein the shaft further comprises a distal portion configured to rotationally drive a setscrew, a sleeve disposed around the shaft over at least part of the distal portion thereof, and a biasing element disposed proximal to the sleeve and configured to urge the sleeve distally relative to the shaft.

[0379] 9. The system of any of examples 1 to 8, wherein the shaft further comprises a proximal-facing shoulder.

[0380] 10. The system of any of examples 1 to 9, wherein the shaft further comprises a flat formed along a proximal portion thereof.

[0381] 11. The system of any of examples 1 to 10, wherein the reducer handle further comprises a distal-facing shoulder disposed proximal to the threads that is configured to contact a proximal-facing portion of the reducer clip and prevent further distal advancement of the reducer handle relative to the reducer clip.

[0382] 12. The system of any of examples 1 to 11, wherein the reducer handle further comprises a cylindrical proximal portion defining a proximal-facing recess.

[0383] 13. The system of any of examples 1 to 11, wherein the reducer handle further comprises opposed paddles extending radially away from a longitudinal axis of the reducer handle and defining a gap therebetween at a proximal end of the reducer handle.

[0384] 14. The system of any of examples 1 to 13, wherein the reducer clip comprises a bone anchor extension having an inner sleeve with opposed distally-extending arms and a threaded proximal portion, as well as an outer sleeve disposed over the inner sleeve and configured to translate relative to the inner sleeve to selectively lock the bone anchor extension to a bone anchor.

[0385] 15. The system of any of examples 1 to 14, further comprising a bone anchor, wherein the reducer clip is configured to couple to a proximal portion of the bone anchor.

[0386] 16. A reducer clip, comprising:

[0387] a distal sleeve having a lumen extending from a proximal end to a distal end thereof and a recess formed in a sidewall of the distal sleeve along a distal portion thereof;

[0388] a proximal sleeve having a lumen extending from a proximal end to a distal end thereof and threads formed in a sidewall of the proximal sleeve along a proximal portion thereof; and

[0389] a locking sleeve having a lumen extending from a proximal end to a distal end thereof and a locking tab at the distal end thereof;

[0390] wherein a distal portion of the proximal sleeve is received within a proximal portion of the distal sleeve;

[0391] wherein a distal portion of the locking sleeve is received within the proximal portion of the distal sleeve;

[0392] wherein the locking sleeve is axially disposed between the distal sleeve and the proximal sleeve and configured to axially translate relative thereto.

[0393] 17. The reducer clip of example 16, further comprising a biasing element disposed between the locking sleeve and the proximal sleeve that is configured to distally bias the locking sleeve relative to the proximal sleeve.

[0394] 18. The reducer clip of any of examples 16 to 17, wherein the distal sleeve includes opposed recesses formed in the sidewall of the distal sleeve along a distal portion thereof and the locking sleeve includes opposed locking tabs at the distal end thereof.

[0395] 19. The reducer clip of any of examples 16 to 18, wherein the locking sleeve further comprises opposed tabs extending radially away from a longitudinal axis of the reducer clip.

[0396] 20 The reducer clip of any of examples 16 to 19, wherein a proximal portion of the locking sleeve surrounds a portion of the proximal sleeve.

[0397] 21. The reducer clip of any of examples 16 to 20, wherein the proximal sleeve further comprises a flat formed on an outer proximal portion thereof.

[0398] 22. The reducer clip of any of examples 16 to 21, wherein the distal sleeve is configured to receive a proximal portion of a bone anchor within the lumen thereof.

[0399] 23 An inserter-reducer shaft, comprising:

[0400] an elongate body having a proximal portion with a flat formed thereon, a distal portion configured to rotationally drive a setscrew, a first, distal-facing shoulder formed proximal to the distal portion, and a second, proximal-facing shoulder formed proximal to the first shoulder and distal to the proximal portion;

[0401] a sleeve disposed around the elongate body distal to the first shoulder; and

[0402] a biasing element disposed between the sleeve and the first shoulder and configured to bias the sleeve distally relative to the elongate body.

[0403] 24. The shaft of example 23, wherein the sleeve is constrained against translating relative to the elongate body beyond a distal end of the portion configured to rotationally drive a setscrew.

[0404] 25. The shaft of any of examples 23 to 24, wherein the biasing element is a coil spring disposed around the elongate body between a proximal end of the sleeve and the first shoulder.

[0405] 26 The shaft of any of examples 23 to 25, wherein a portion of the elongate body extending between the first shoulder and the second shoulder has an outer diameter that is less than a diameter of one or more of the first shoulder and the second shoulder.

[0406] 27. The shaft of any of examples 23 to 26, wherein a portion of the elongate body extending between the first shoulder and the second shoulder has an outer diameter equal to the diameter of one or more of the first shoulder and the second shoulder.

[0407] 28 The shaft of any of examples 23 to 27, wherein an outer diameter of the first shoulder and an outer diameter of the second shoulder are equal.

[0408] 29 The shaft of any of examples 23 to 28, further comprising a spring clip configured to aid retention of a setscrew along the distal portion of the elongate body.

[0409] 30 The shaft of any of examples 23 to 29, further comprising a thrust bearing disposed around the elongate body proximal to the second shoulder.

[0410] 31. The shaft of any of examples 23 to 30, wherein the distal portion of the elongate body further comprises an insert received within a distal-facing recess of the elongate body.

[0411] 32. A surgical method, comprising:

[0412] coupling a reducer clip to a proximal end of a bone anchor;

[0413] passing a distal portion of a shaft having a setscrew disposed thereon through a lumen of the reducer clip until a distal threaded portion of a reducer handle disposed around the shaft contacts a proximal threaded portion of the reducer clip;

[0414] rotating the reducer handle to engage the threads of the reducer handle with the threads of the reducer clip and advance the shaft distally;

[0415] rotating a driver handle coupled to a proximal end of the shaft extending through the reducer handle to engage threads on an outer surface of the setscrew with threads formed on an inner surface of the bone anchor.

[0416] 33. The method of example 32, further comprising passing a proximal end of the shaft through a lumen of the reducer handle.

[0417] 34 The method of any of examples 32 to 33, further comprising coupling the driver handle to the proximal end of the shaft extending through the reducer handle.

[0418] 35. The method of any of examples 32 to 34, further comprising loading the setscrew onto a distal end of the shaft.

[0419] 36. The method of example 35, wherein loading the setscrew onto the distal end of the shaft includes contacting the setscrew against a distally biased sleeve disposed around the shaft.

[0420] 37. The method of any of examples 32 to 36, wherein coupling the reducer clip to the bone anchor further comprises squeezing opposed arms of the bone anchor radially inward toward one another while passing a distal end of the reducer clip over the proximal end of the bone anchor.

[0421] 38. The method of example 37, wherein coupling the reducer clip to the bone anchor further comprises releasing the opposed arms of the bone anchor after passing the distal end of the reducer clip over the proximal end of the bone anchor such that opposed portions of the opposed arms of the bone anchor extend into opposed recesses formed in a sidewall of the reducer clip.

[0422] 39. The method of any of examples 32 to 38, wherein coupling the reducer clip to the bone anchor further comprises proximally withdrawing a locking sleeve of the reducer clip while passing a distal portion of the reducer clip over the proximal end of the bone anchor and distally advancing the locking sleeve after the distal portion of the reducer clip is positioned over the proximal end of the bone anchor.

[0423] 40. The method of any of examples 32 to 39, wherein rotating the reducer handle further comprises contacting a shoulder formed on the reducer handle against a proximal end of the reducer clip to prevent further distal advancement of the reducer handle relative to the reducer clip.

[0424] 41. The method of any of examples 32 to 40, further comprising separating the reducer clip, the shaft, the reducer handle, and the driver handle as a single unit from the bone anchor after rotating the driver handle to engage the threads on the setscrew with the threads on the bone anchor.

What is claimed is:

1. A surgical system, comprising:

a reducer clip having a lumen extending from a proximal end to a distal end thereof, a recess formed in a sidewall of the reducer clip along a distal portion thereof, and threads formed in the sidewall of the reducer clip along a proximal portion thereof;

a shaft disposed through the lumen of the reducer clip;

a reducer handle having a lumen extending from a proximal end to a distal end thereof and threads formed along an outer distal portion thereof, the reducer handle threads interfacing with the threads formed along the proximal portion of the reducer clip; and

a driver handle coupled to a proximal portion of the shaft extending through the reducer handle.

1. The system of claim **1**, wherein the driver handle extends proximal to the reducer handle.

2. The system of claim **1**, wherein the reducer clip is a monolithic component.

3. The system of claim **1**, wherein the reducer clip further comprises a locking sleeve with a locking tab at a distal end thereof that is configured to translate relative to another portion of the reducer clip.

4. The system of claim **4**, wherein the reducer clip further comprises a biasing element that urges the locking sleeve distally relative to another portion of the reducer clip.

5. The system of claim **1**, wherein the reducer clip further comprises opposed tabs extending radially away from a longitudinal axis of the reducer clip.

6. The system of claim **1**, wherein the reducer clip further comprises a flat formed on an outer proximal portion thereof.

7. The system of claim **1**, wherein the shaft further comprises a distal portion configured to rotationally drive a setscrew, a sleeve disposed around the shaft over at least part of the distal portion thereof, and a biasing element disposed proximal to the sleeve and configured to urge the sleeve distally relative to the shaft.

8. The system of claim **1**, wherein the shaft further comprises a proximal-facing shoulder.

9. The system of claim **1**, wherein the shaft further comprises a flat formed along a proximal portion thereof.

10. The system of claim **1**, wherein the reducer handle further comprises a distal-facing shoulder disposed proximal to the threads that is configured to contact a proximal-facing portion of the reducer clip and prevent further distal advancement of the reducer handle relative to the reducer clip.

11. The system of claim **1**, wherein the reducer handle further comprises a cylindrical proximal portion defining a proximal-facing recess.

12. The system of claim **1**, wherein the reducer handle further comprises opposed paddles extending radially away from a longitudinal axis of the reducer handle and defining a gap therebetween at a proximal end of the reducer handle.

13. The system of claim **1**, wherein the reducer clip comprises a bone anchor extension having an inner sleeve with opposed distally-extending arms and a threaded proximal portion, as well as an outer sleeve disposed over the inner sleeve and configured to translate relative to the inner sleeve to selectively lock the bone anchor extension to a bone anchor.

14. The system of claim **1**, further comprising a bone anchor, wherein the reducer clip is configured to couple to a proximal portion of the bone anchor.

15. A surgical method, comprising:

coupling a reducer clip to a proximal end of a bone anchor;

passing a distal portion of a shaft having a setscrew disposed thereon through a lumen of the reducer clip until a distal threaded portion of a reducer handle

disposed around the shaft contacts a proximal threaded portion of the reducer clip;

rotating the reducer handle to engage the threads of the reducer handle with the threads of the reducer clip and advance the shaft distally;

rotating a driver handle coupled to a proximal end of the shaft extending through the reducer handle to engage threads on an outer surface of the setscrew with threads formed on an inner surface of the bone anchor.

16. The method of claim **16**, further comprising passing a proximal end of the shaft through a lumen of the reducer handle.

17. The method of claim **16**, further comprising coupling the driver handle to the proximal end of the shaft extending through the reducer handle.

18. The method of claim **16**, further comprising loading the setscrew onto a distal end of the shaft.

19. The method of claim **19**, wherein loading the setscrew onto the distal end of the shaft includes contacting the setscrew against a distally biased sleeve disposed around the shaft.

20. The method of claim **16**, wherein coupling the reducer clip to the bone anchor further comprises squeezing opposed arms of the bone anchor radially inward toward one another while passing a distal end of the reducer clip over the proximal end of the bone anchor.

21. The method of claim **21**, wherein coupling the reducer clip to the bone anchor further comprises releasing the opposed arms of the bone anchor after passing the distal end of the reducer clip over the proximal end of the bone anchor such that opposed portions of the opposed arms of the bone anchor extend into opposed recesses formed in a sidewall of the reducer clip.

22. The method of claim **16**, wherein coupling the reducer clip to the bone anchor further comprises proximally withdrawing a locking sleeve of the reducer clip while passing a distal portion of the reducer clip over the proximal end of the bone anchor and distally advancing the locking sleeve after the distal portion of the reducer clip is positioned over the proximal end of the bone anchor.

23. The method of claim **16**, wherein rotating the reducer handle further comprises contacting a shoulder formed on the reducer handle against a proximal end of the reducer clip to prevent further distal advancement of the reducer handle relative to the reducer clip.

24. The method of claim **16**, further comprising separating the reducer clip, the shaft, the reducer handle, and the driver handle as a single unit from the bone anchor after rotating the driver handle to engage the threads on the setscrew with the threads on the bone anchor.

* * * * *