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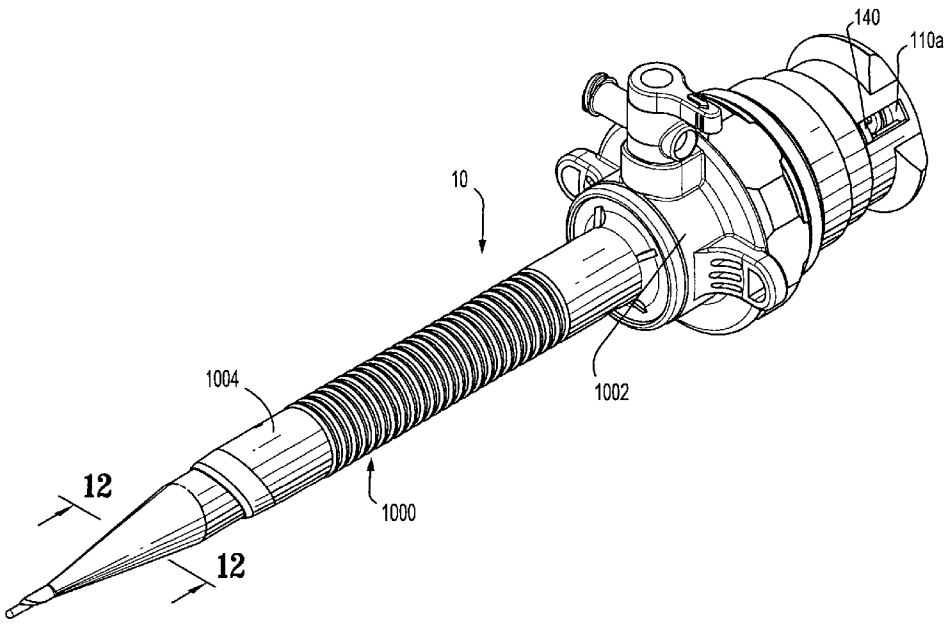
(54) **Title:** TROCAR ASSEMBLY WITH OBTURATOR AND RETRACTABLE STYLET



(57) **Abstract:** A surgical system for penetrating tissue includes a cannula having a cannula housing and a cannula sleeve extending from the cannula housing and an obturator at least partially positionable within the cannula. The obturator includes an obturator housing, an obturator member extending from the obturator housing and having a penetrating member adapted to penetrate tissue and a stylet at least partially disposed within the obturator member. The stylet and the obturator member are adapted for relative longitudinal movement between a first relative position corresponding to an unarmed condition of the penetrating member and a second relative position corresponding to an armed condition of the penetrating member.

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TROCAR ASSEMBLY WITH OBTURATOR AND RETRACTABLE STYLET

BACKGROUND

1. Technical Field

The present disclosure relates to a trocar assembly for use in minimally invasive surgical procedures, such as endoscopic or laparoscopic type procedures.

2. Background of the Related Art

Minimally invasive procedures are continually increasing in number and variation. Forming a relatively small diameter temporary pathway to the surgical site is a key feature of most minimally invasive surgical procedures. The most common method of providing such a pathway is by inserting a trocar assembly through the skin. In many procedures, the trocar assembly is inserted into an insufflated body cavity of a patient. In such procedures, the trocar assemblies with seal mechanisms are utilized to provide the necessary pathway to the surgical site while minimizing leakage of insufflation gases.

Trocar assemblies typically include an obturator which is removably inserted through a cannula. The obturator may include a safety shield which protects against unintentional puncturing by the sharpened tip of the obturator. The safety shield includes a mechanism which controls the relative movement and locking of the safety shield. One example of a safety shield mechanism is disclosed in commonly assigned U.S. Patent No. **6,319,266** to Stellon et al., the entire contents of which are hereby incorporated by reference.

SUMMARY

Accordingly, the present disclosure is directed to further improvements in trocar technology. In one preferred embodiment, a surgical system for penetrating tissue includes a cannula having a cannula housing and a cannula sleeve extending from the cannula housing, and an obturator at least partially positionable within the cannula. The obturator is adapted to pass through tissue, and is removable from the cannula subsequent to accessing an underlying tissue site. The obturator includes an obturator housing, an obturator member extending from the obturator housing and having a penetrating member adapted to penetrate tissue and a stylet at least partially disposed within the obturator member. The stylet and the obturator member are adapted for relative longitudinal movement between a first relative position corresponding to an unarmed condition of the penetrating member and a second relative position corresponding to an armed condition of the penetrating member. A latch member is associated with the obturator housing. The latch member is moveable from an initial position securing the stylet and the obturator in the first relative position to a release position permitting relative movement of the stylet and the obturator to the second relative position.

The stylet may be adapted for longitudinal movement relative to the obturator housing between an extended position corresponding to the unarmed condition of the penetrating end of the obturator member and a retracted position corresponding to the armed condition of the obturator member. The stylet is dimensioned to at least partially extend beyond the penetrating member of the obturator member when in the extended position. The stylet may be normally biased toward the extended position. The latch member may be adapted to secure the stylet in the extended position when in the initial position of the latch member and may be adapted to

permit movement of the stylet to the retracted position when in the release position of the latch member.

A release member may be mounted to the obturator housing and operatively coupled with the latch member. The release member may be adapted to move the latch member to the release position during positioning of the obturator within the longitudinal opening of the cannula. The latch member may be monolithically formed with the obturator housing and arranged in cantilever relation therewith and being normally biased toward the initial portion thereof. Alternatively, the release member is adapted for movement relative to the obturator housing during positioning of the obturator within the longitudinal opening of the cannula, to thereby move the latch member to the release position. The release member may include a release button. The release button is dimensioned to extend distally beyond the obturator housing, and positioned to engage a cannula housing of the cannula upon mating of the obturator housing and the cannula housing whereby a generally proximally directed force applied by the cannula housing on the release button causes displacement of the release member and movement of the latch member to the release position.

The penetrating end may include a tapered portion extending towards a penetrating tip. The penetrating tip may define a beveled edge. The penetrating end may include a cylindrical portion disposed between the penetrating tip and the tapered portion.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present disclosure are described hereinbelow with references to the drawings, wherein:

FIG. 1 is a perspective view of a trocar assembly in accordance with the principles of the present disclosure;

FIG. 2 is a perspective view with parts separated of the obturator assembly illustrating the cannula assembly and the obturator assembly;

FIG. 3 is a perspective view with parts separated of the obturator assembly illustrating the obturator housing, the obturator member and the stylet;

FIG. 4 is a side cross-sectional view of the obturator assembly;

FIG. 5 is an enlarged cross-sectional view of the indicated area of detail of **FIG. 4**;

FIG. 6 is a second enlarged cross-sectional view of the obturator housing of the obturator assembly;

FIG. 7 is a perspective view of the indicator collar of the obturator housing;

FIG. 8 is a perspective view of the housing cover of the obturator housing;

FIG. 9 is a perspective view of the housing base of the obturator housing;

FIGS. 10-11 are perspective views illustrating the components of the latch mechanism;

FIG. 12 is a perspective view in partial cross-section taken along the lines **12-12** of **FIG. 1** illustrating the obturator member and the stylet;

FIGS. 13-14 are perspective views illustrating the stylet in respective advanced and retracted positions relative to the obturator member;

FIG. 15 is a side cross-sectional view of the trocar assembly illustrating the obturator assembly mounted relative to the cannula assembly and the latch member in an actuated position;

FIG. 16 is a view of the indicated area of detail of **FIG. 15** illustrating the relationship of the components of the latch member in the actuated position;

FIG. 17 is a view similar to the view of **FIG. 15** illustrating the stylet of the obturator assembly in a retracted position;

FIG. 18 is a view of the indicated area of detail of **FIG. 17** illustrating the relationship of the components of the latch member when the stylet is in the retracted position;

FIG. 19 is a perspective view illustrating insertion of the trocar assembly within tissue; and

FIG. 20 is a view similar to the view of **FIG. 19** illustrating rotation of the obturator housing of the obturator assembly.

DETAIL DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now in detail to the drawing figures, in which, like references numerals identify similar or identical elements, there is illustrated, in **FIGS. 1** and **2**, a trocar assembly constructed in accordance with a preferred embodiment of the present disclosure and designated generally by reference numeral **10**. Trocar assembly **10** is particularly adapted for use in minimally invasive surgical procedures such as endoscopic or laparoscopic procedures. Generally, trocar assembly **10** includes two principal subassemblies, namely, obturator assembly **100** and cannula assembly **1000**.

Cannula assembly **1000** may be any cannula assembly suitable for use in a laparoscopic surgical procedure. In one preferred embodiment, cannula assembly **1000** includes cannula housing **1002** and cannula sleeve **1004** extending from the cannula housing **1002**. Either or both cannula housing **1002** and cannula sleeve **1004** may be transparent in part or in whole and may be fabricated from biocompatible metal or polymeric material. Cannula assembly **1000** may include an internal seal such as a duck-bill valve or other zero closure valve adapted to close in the absence of a surgical instrument to prevent passage of insufflation gases through the cannula assembly **1000**.

Trocar assembly **10** may also include a seal assembly **2000** which is preferably releasably mounted to cannula housing **1002**. Means for releasably connected seal assembly **2000** to cannula housing **1002** may include a bayonet coupling, threaded connection, latch, friction fit, tongue and groove arrangements, snap-fit, etc. Seal assembly **2000** includes seal housing **2002** and at least one internal seal which is adapted to form a fluid tight seal about an instrument inserted through the seal assembly **2000**. One suitable seal may be the fabric seal disclosed in commonly assigned U.S. Patent No. **6,702,787**, which issued March **9, 2004**, the entire contents of which are incorporated herein by reference. The seal disclosed in the '**630** patent may be a flat septum seal having a first layer of resilient material and a second fabric layer juxtaposed relative to the first layer. Further details of the seal may be ascertained by reference to the ''**787** patent. Seal assembly **2000** may or may not be a component of cannula assembly **1000**. For example, the seal assembly may be a separate, removable assembly. In the alternative, the seal assembly may comprise an integral part of the cannula assembly **1000** and not be removable.

With reference now to **FIGS. 3-5**, in conjunction with **FIG. 2**, obturator assembly **100** includes obturator housing **102**, elongated obturator member **104** extending distally from the housing **102** and stylet **106** at least partially disposed within the obturator member **104**. Obturator member **104** defines obturator axis "**x**" and will be discussed in greater detail hereinbelow. Obturator housing **102** includes housing base **108** and housing cover **110**. Once the appropriate components are positioned therewithin (as described below), housing base **108** may be attached to housing cover **110** by engaging mating surfaces, for example, by resilient latches **112** of cover **110** interlocking with correspondingly dimensioned latch openings **114** of housing base **108**. Preferably, to uniformly connect base **108** and cover **110** at least three corresponding latches **112** and openings **114** are spaced evenly around the circumference of the cover **110** and the base **108**, respectively. Housing base **108** further defines base extension **116**. Base extension **116** includes a stepped configuration defining an internal shelf **118** as best depicted in **FIG. 5**. Base extension **116** receives obturator member **104** to mount the obturator member **104** to the obturator housing **102**.

With reference to **FIGS. 3-5**, obturator member **104** includes mounting extension **120** at its proximal end and penetrating end **122** at its distal end. Penetrating end **122** will be discussed in greater detail hereinbelow. Mounting extension **120** includes a plurality, e.g., four, of axially depending tabs **124**. Tabs **124** define circumferential ledges **126**. Tabs **124** are adapted to move radially inwardly upon initial insertion of mounting extension **120** within base extension **116** of obturator base **108**, and thereafter return to their initial outward positions after circumferential ledges **126** clear internal shelf **118**. In such position, circumferential ledges **126** of mounting extension **120** securely engage internal shelf **118** of housing base **108**. Mounting

extension **120** also defines outer annular shelf **128** which contacts the distal end **130** of base extension **116** thereby preventing movement of obturator member **104** in a proximal direction. Thus, the aforedescribed mounting arrangement of obturator member **104** and housing base **108** secures the obturator member **104** from moving in an axial direction relative to obturator housing **102**. However, obturator housing **102** may rotate relative to obturator member **104**. In particular, circumferential ledges **126** of obturator member **104** are dimensioned to slide along internal shelf **118** of base extension **106** during manipulation and use of the obturator assembly **100**. Thus, during insertion, the operator may rotate obturator housing **102** without concern of underlying rotation of penetrating end **122** of obturator member **104**.

Referring now to **FIGS. 5-7**, in conjunction with **FIG. 3**, obturator assembly **100** further includes indicator collar **132** positioned within obturator housing **102** and secured to proximal end **134** of stylet **106**. In one preferred arrangement, indicator collar **132** incorporates cylindrical section **136** defining internal bore **138** which receives proximal end **134** of stylet **106**. Stylet **106** may be fixed within internal bore **138** through conventional means including cements, adhesives, interference fit, etc. With this arrangement, indicator collar **132** and stylet **106** move concurrently along the longitudinal axis "x" and relative to obturator housing **102** during use of the instrument.

Indicator collar **132** further includes a shield position indicator, such as indicator flag **140**, extending transversely relative to the indicator collar **132**. Indicator flag **140** is visible from the exterior of obturator housing **102** as it extends through groove **110a** of housing cover **110** (see also **FIGS. 2** and **6**). Preferably, indicator flag **140** is colored to contrast sharply with

the surrounding housing components. For example, indicator flag **140** may be red if the surrounding housing components are white or light colored. Indicator collar **132** further includes collar ledge **144** and a pair of posts **146** formed below the ledge **144** and extending radially outwardly from the ledge **144**. Collar ledge **144** serves to releasably lock stylet **106** in a distal position corresponding to an unarmed condition of obturator assembly **100**. **FIG. 4** illustrates the unarmed condition of obturator assembly **100**.

Indicator flag **140** and stylet **106** are spring biased in the distal direction by coil spring **148**. In particular, coil spring **148** is received within internal bore **150** of indicator collar **132** and engages internal shelf **152** (see **FIG. 6**) of the indicator collar **132**. The proximal end of coil spring **138** is coaxially mounted about spring mount **154** (see also **FIG. 8**) depending from the interior surface of housing cover **110**.

Referring now to **FIGS. 9-11**, in conjunction with **FIGS. 3-5**, obturator assembly **100** includes a latching mechanism disposed within obturator housing **102** to prevent proximal movement of stylet **106** until such time as the obturator assembly **100** is mounted to cannula assembly **1000** and the surgeon is prepared to begin trocar entry. Latching mechanism includes latch member **156**, and release member such as slider **158**, as best seen n **FIG. 3**. Latch member **156** has two vertical legs **160** connected by web **162**. A pair of biasing posts **164** extends outwardly, one for each side of latch member **156**. Collar ledge **144** of indicator collar **132** is engaged and secured by web **162** of latch member **156** when in an initial position of the latch member **156** as depicted in **FIGS. 10-11**. In the initial position of latch member **156**, stylet **106** is retained in a first extended position shown in **FIG. 4** corresponding to the unarmed condition

of obturator assembly **100**. Latch member **156** is preferably molded as part of housing base **106** in cantilever fashion. However, latch member **156** may be formed as a separate element and secured to base **106** by suitable known techniques.

Slider **158** includes post **166** disposed at its lower end, arming button **168** extending distally from the distal face of slider **158** and a pair of slider legs **170** which terminate in crooks **172**. Crooks **172** defined in slider legs **170** are configured and dimensioned to engage posts **164** of latch member **156**, as shown in **FIGS. 10** and **11**. Slider **158** is distally biased by slider spring **174** which is maintained in axial alignment by slider post **166** of slider **158**. The proximal end of slider spring **174** bears against the inner surface of housing cover **110** and is maintained in position between proximal post **178** and cylindrical post **180** formed in the housing cover **110** (see **FIG. 5**). The distal biasing of slider **158** causes arming button **168** to project through opening **182** formed in housing base **106**. The lower end or transverse leg **184** of slider **158** resides with mounting posts **172 a-c** of housing base **106** with post base **184** of slider **158** residing within mounting posts **172b**, **172c**. (See **FIG. 10**). Mounting of obturator assembly **100** relative to cannula assembly **112** causes slider **158** to translate or rotate generally vertically in a generally proximal direction as will be described further hereinbelow.

With reference to **FIGS. 12-14**, penetrating end **122** of obturator member **104** will be discussed. Penetrating end **122** of obturator member **104** generally tapers inwardly relative to longitudinal axis "**x**" towards penetrating tip **190**. Penetrating tip **190** defines a general beveled arrangement, and may have a sharpened edge or may be generally blunt if desired. Extending contiguously from penetrating tip **190** is an annular, e.g., cylindrical, end portion **192** of

relatively small diameter. Cylindrical end portion **192** provides a reduced profile when viewed axially to facilitate initial passage of penetrating end **122** through tissue. Tapered section **194** extends contiguously from cylindrical end portion **192**.

Stylet **106** may be any suitable relatively rigid or slightly flexible member. Stylet **106** preferably defines a rounded or blunted end **106**a to minimize trauma to tissue.

With reference now to **FIGS. 15-16**, a method of use and operation of trocar assembly **10** will be discussed. Obturator assembly **100** is inserted within cannula assembly **1000** and advanced to where obturator housing **102** is approximated with seal housing **2002** of the seal assembly **2000**. Seal assembly **2000** may comprise a separate part or may be a component of cannula assembly **1000**. Seal housing **2002** and housing base **108** of obturator housing **102** may be appropriately dimensioned to form a friction fit or may be coupled to each other by conventional means including bayonet coupling, tongue-groove, etc. Approximating the obturator housing **102** and the seal housing **202** releases the stylet **106** from a locked condition, actuating the trocar assembly. With the obturator housing **102** and seal housing **2002** approximated, arming button **168** of slider **158** engages surface **2004** of seal housing **2002** and is forced upwardly (depicted by directional arrow "**u**") from the position depicted in **FIG. 5** to the position depicted in **FIGS. 15-16**. During this movement, slider **158** pivots or angulates whereby legs **170** of slider **158** push latch member **156** in a radial outward direction (depicted by directional arrow "**z**") such that web portion **162** of latch member **156** is out of axial alignment with ledge **144** of indicator collar **132**. In this position, indicator collar **132** and stylet **106** are free to axially move.

Referring now to **FIGS. 17-18**, the surgeon begins to insert trocar assembly **10** through the body wall of the patient. Stylet **106** contacts the tissue and is driven upwardly to cause the stylet **106** and indicator collar **132** to move proximally (depicted by directional arrow "**v**") against the bias of coil spring **148**. Such movement exposes the penetrating tip **190** of penetrating end **122** of obturator member **104** to incise the tissue as shown in **FIG. 17**. This armed condition of obturator assembly **100** is visually verified by the proximal location of indicator flag **140** of indicator collar **132**. In addition, proximal movement of indicator collar **132** causes posts **146** of the indicator collar **132** to ride along outer surfaces **170a** of legs **170** of slider **158** to thereby move the slider **158** at least radially inwardly and upwardly (as shown by the directional arrows "**r**") in a general aligned position relative to the obturator axis "**x**". **FIG. 18** illustrates this actuated position of latch member **156**. With penetrating tip **190** exposed, the surgeon may apply a distally-directed force to obturator assembly **100** to cause penetration through the tissue. The surgeon may rotate obturator housing **102** during manipulation and advancement of obturator assembly **100** into the tissue without concern of corresponding rotation of penetrating end **122**. **FIGS. 19-20** illustrate rotation of obturator housing **102** while penetrating end **122** remains stationary during advancement of trocar assembly **10** within tissue "**t**". It is noted that indicator flag **140** in its proximal position provides visual confirmation of the armed condition of knife blade **190**.

Once penetrating tip **190** and stylet **106** pass through the body wall of the patient, the stylet **106** moves distally to extend beyond penetrating tip **190** to assume the unarmed condition depicted in **FIG. 4**. In particular, indicator collar **132** and stylet **106** are driven distally under the influence of coil spring **148**. Concurrently with this movement, slider **158**, which is

aligned relative to axis "**x**", is driven distally under the influence of coil spring **174**. In the respective positions of indicator collar **132** and slider **158** depicted in **FIGS. 4** and **5**, collar ledge **144** of indicator collar **132** securely engages web **162** of latch member **156** to secure stylet **106** in the extended position. The obturator assembly **100** is removed from cannula assembly **1000** and surgery is performed with instruments inserted through cannula assembly **1000**.

The materials utilized in the components of the presently disclosed trocar assembly generally include materials such as, for example, ABS, polycarbonate, stainless steel, titanium and any other suitable biocompatible metals and/or polymeric materials. A preferred ABS material is CYCOLAC which is available from General Electric. A preferred polycarbonate material is also available from General Electric under the trademark LEXAN. An alternative polycarbonate material which may be utilized is CALIBRE polycarbonate available from Dow Chemical Company. The polycarbonate materials may be partially glass filled for added strength.

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

WHAT IS CLAIMED IS:

1. A surgical system for penetrating tissue, which comprises:

a cannula including a cannula housing and a cannula sleeve extending from the cannula housing;

an obturator at least partially positionable within the cannula and being adapted to pass through tissue, the obturator being removable from the cannula subsequent to accessing an underlying tissue site, the obturator including:

an obturator housing;

an obturator member extending from the obturator housing and having a penetrating member adapted to penetrate tissue;

a stylet at least partially disposed within the obturator member, the stylet and the obturator member being adapted for relative longitudinal movement between a first relative position corresponding to an unarmed condition of the penetrating member and a second relative position corresponding to an armed condition of the penetrating member; and

a latch member associated with the obturator housing, the latch member being moveable from an initial position securing the stylet and the obturator in the first relative position to a release position permitting relative movement of the stylet and the obturator to the second relative position.

2. The surgical system according to claim **1** wherein the stylet is adapted for longitudinal movement relative to the obturator housing between an extended position corresponding to the unarmed condition of the penetrating end of the obturator member and a retracted position corresponding to the armed condition of the obturator member.

3. The surgical system according to claim 2 wherein the stylet is dimensioned to at least partially extend beyond the penetrating member of the obturator member when in the extended position.

4. The surgical system according to claim 3 wherein the stylet is normally biased toward the extended position.

5. The surgical system according to claim 4 including wherein the latch member is adapted to secure the stylet in the extended position when in the initial position of the latch member and is adapted to permit movement of the stylet to the retracted position when in the release position of the latch member.

6. The surgical system according to claim 5 including a release member mounted to the obturator housing and operatively coupled with the latch member, the release member adapted to move the latch member to the release position during positioning of the obturator within the longitudinal opening of the cannula.

7. The surgical system according to claim 6 wherein the latch member is monolithically formed with the obturator housing and arranged in cantilever relation therewith and being normally biased toward the initial portion thereof.

8. The surgical system according to claim 6 wherein the release member is adapted for movement relative to the obturator housing during positioning of the obturator within

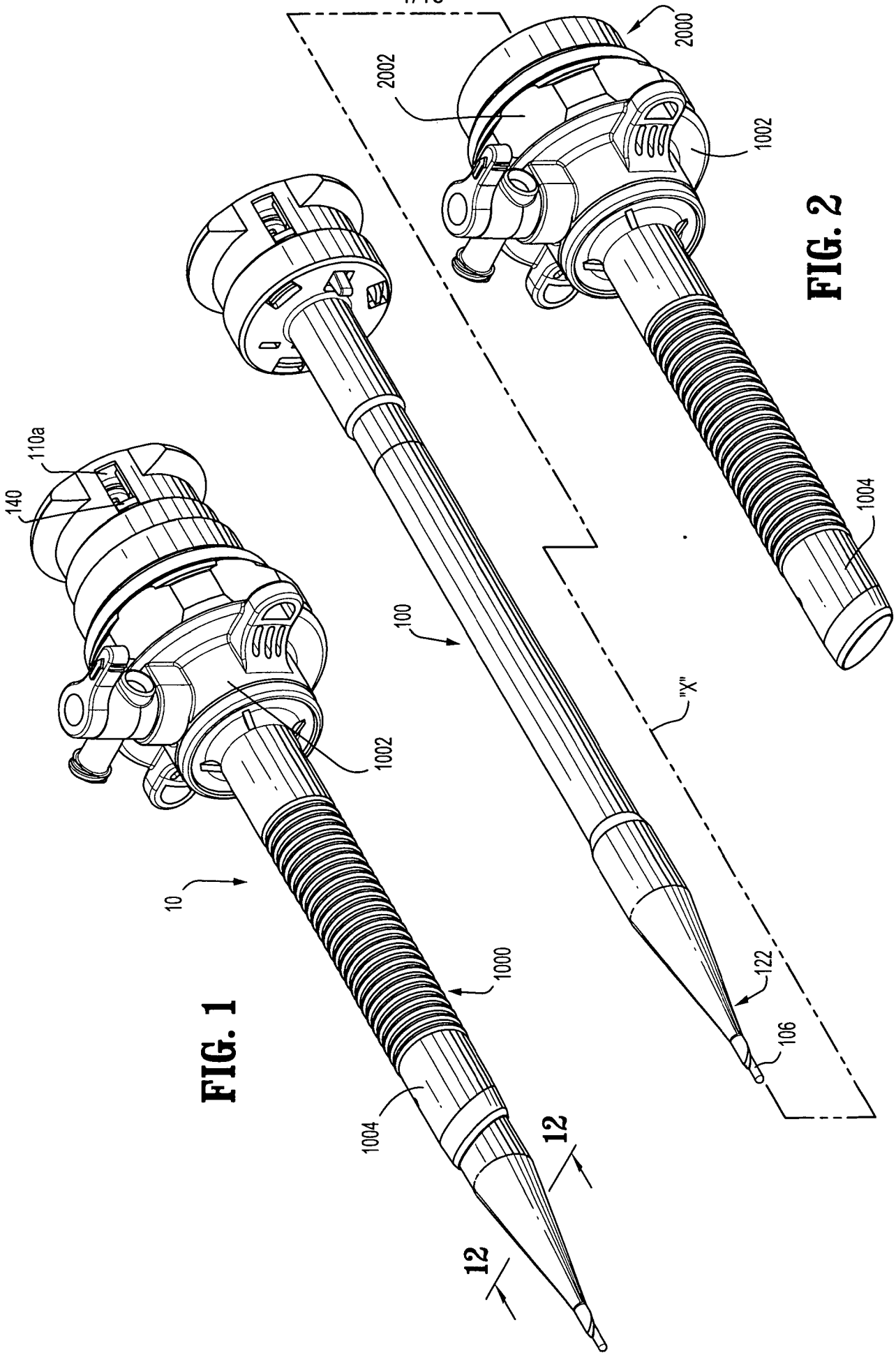
the longitudinal opening of the cannula, to thereby move the latch member to the release position.

9. The surgical system according to claim **8** wherein the release member includes a release button, the release button dimensioned to extend distally beyond the obturator housing, and positioned to engage a cannula housing of the cannula upon mating of the obturator housing and the cannula housing whereby a generally proximally directed force applied by the cannula housing on the release button causes displacement of the release member and movement of the latch member to the release position.

10. The surgical system according to claim **1** wherein the penetrating end includes a tapered portion extending towards a penetrating tip.

11. The surgical system according to claim **10** wherein the penetrating tip defines a beveled edge.

12. The surgical system according to claim **10** wherein the penetrating end includes a cylindrical portion disposed between the penetrating tip and the tapered portion.


2000
2002
1002
1004
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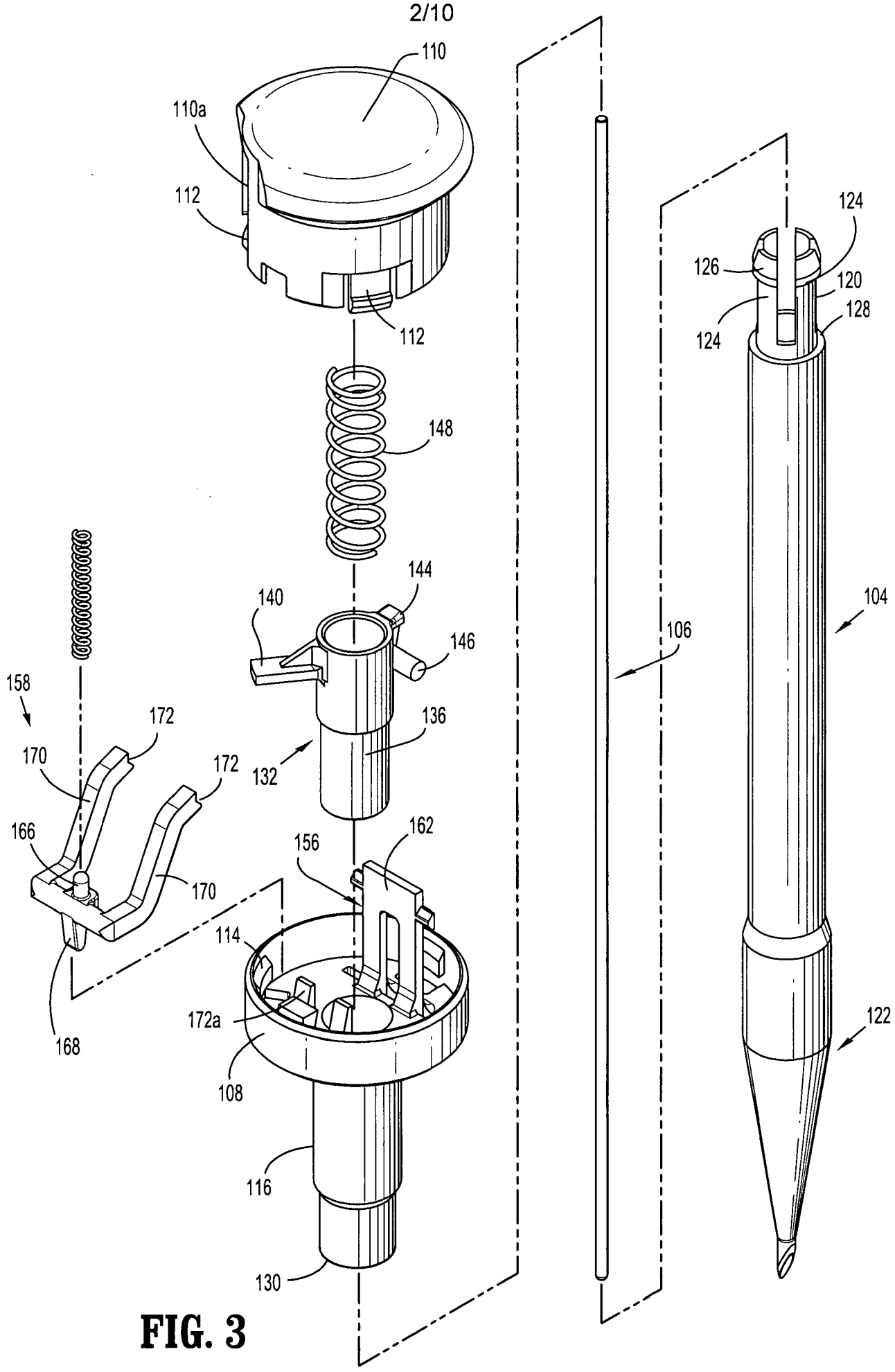
"X"
122
106
110a
140
1002
10
1000
1004
12
12

FIG. 2

FIG. 1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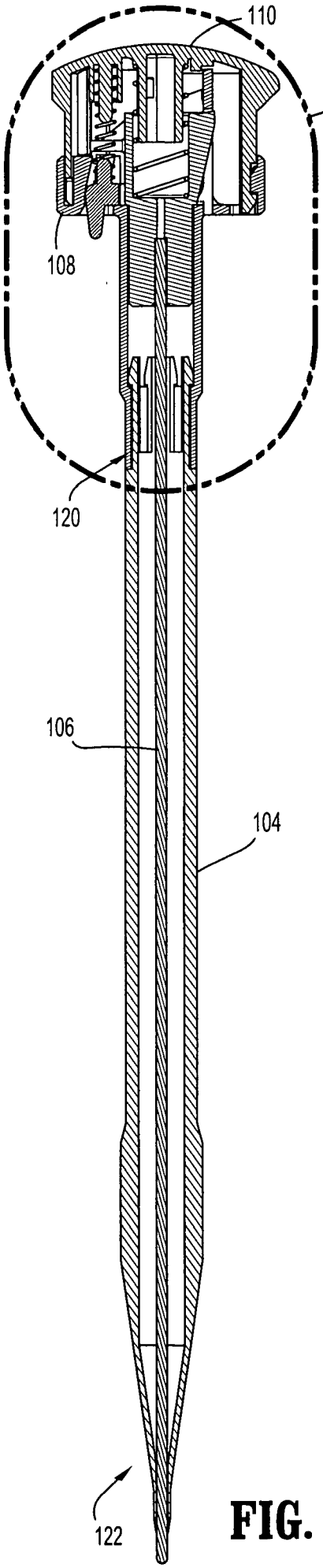
104
122

FIG. 3


110
5
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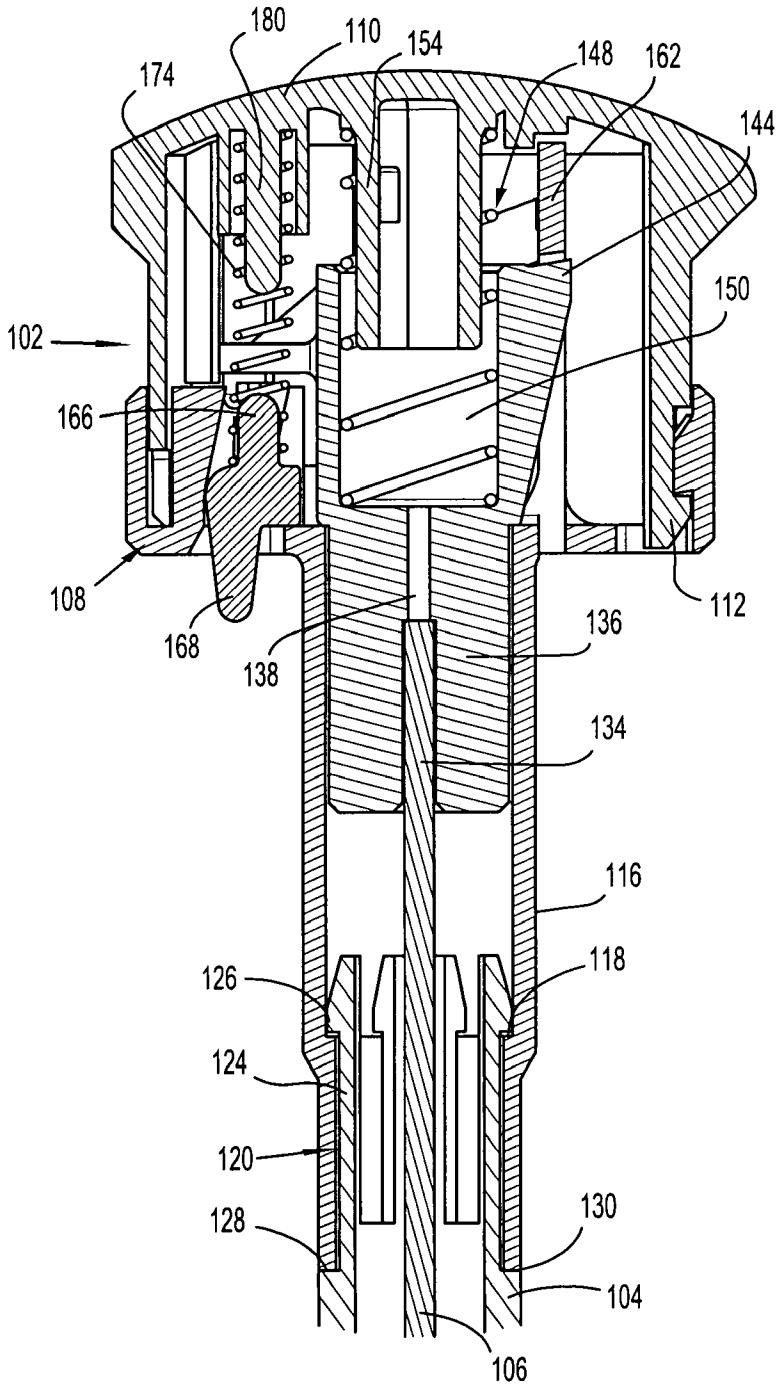
120
106
104
122

FIG. 4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162
174
144
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130
104
106

FIG. 5

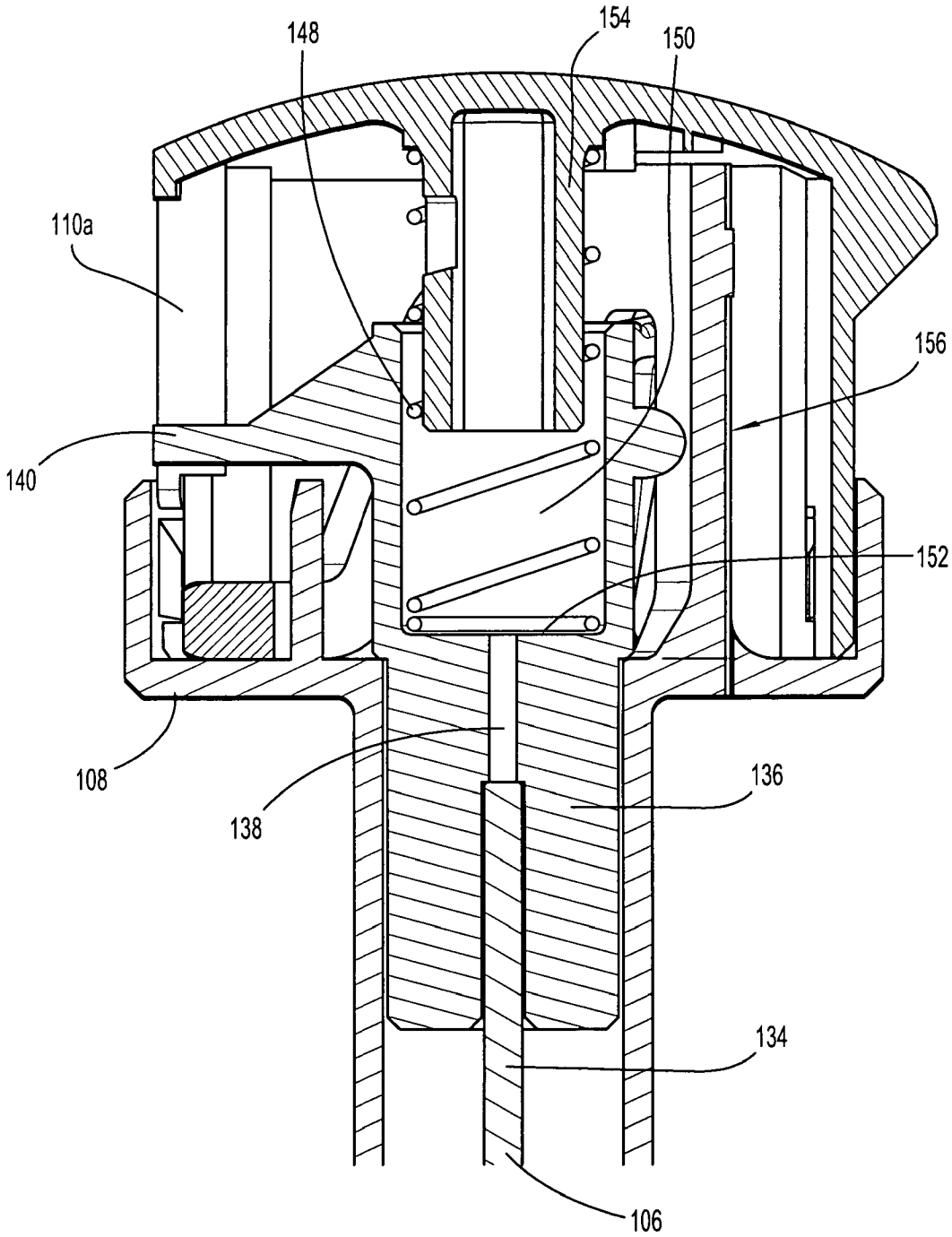


FIG. 6

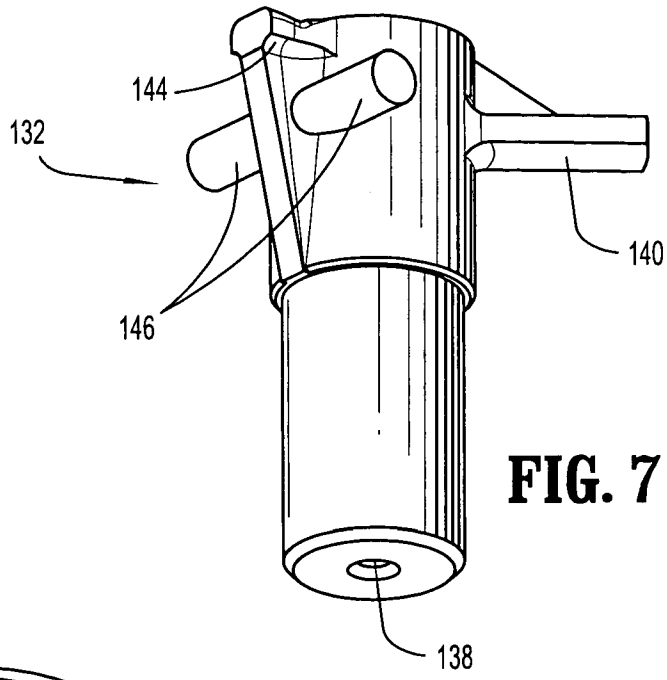


FIG. 7

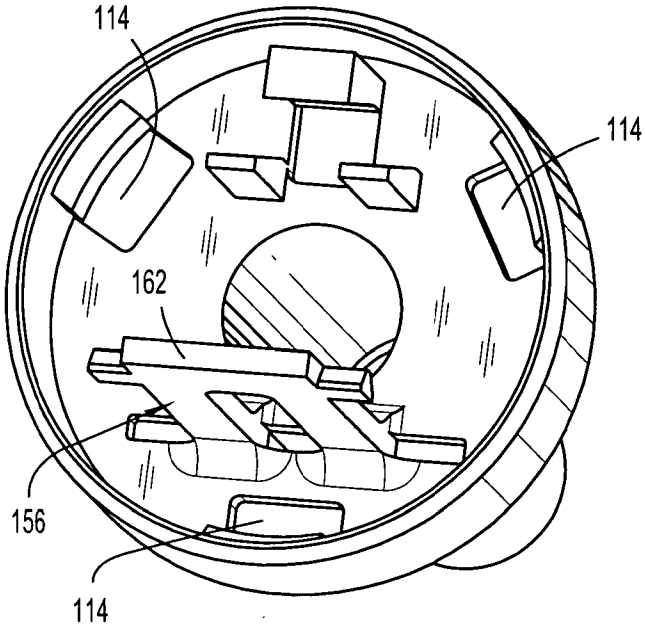


FIG. 9

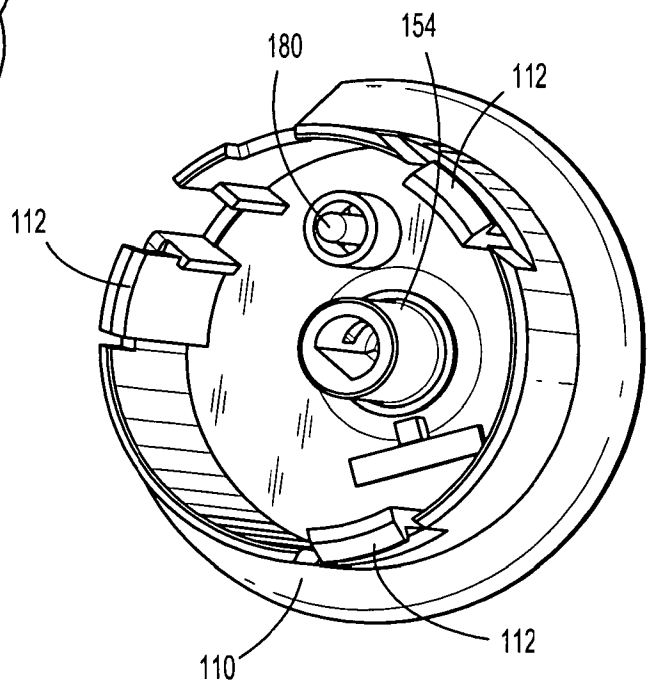


FIG. 8

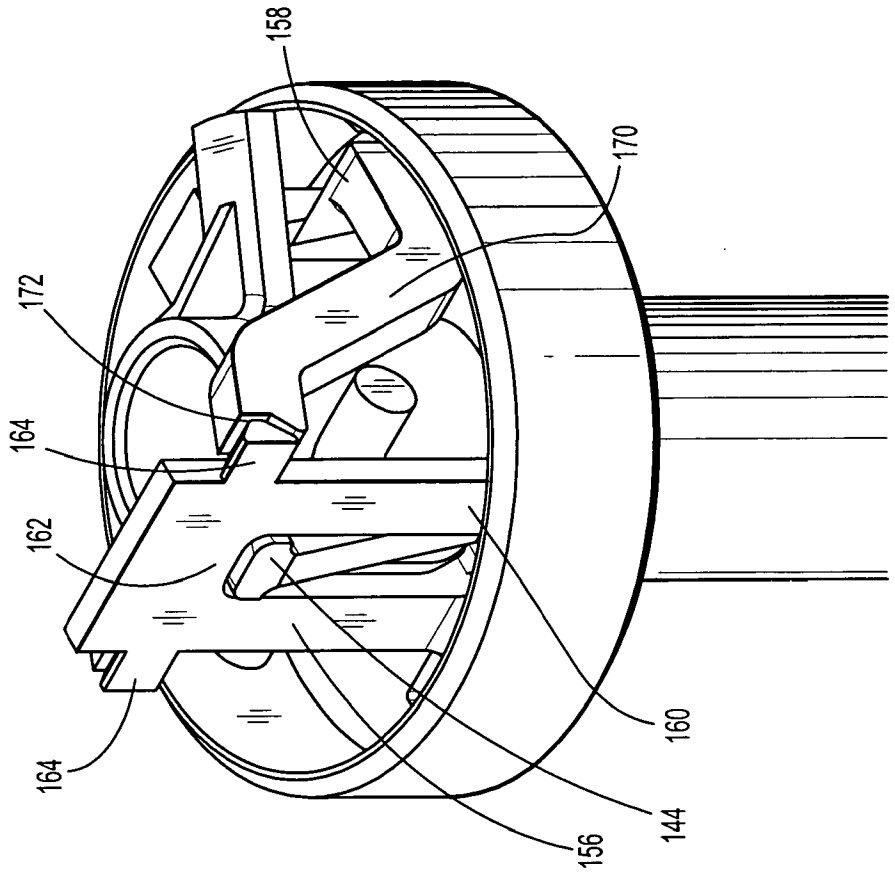

158
170
172
164
162
164
160
144
156

FIG. 11

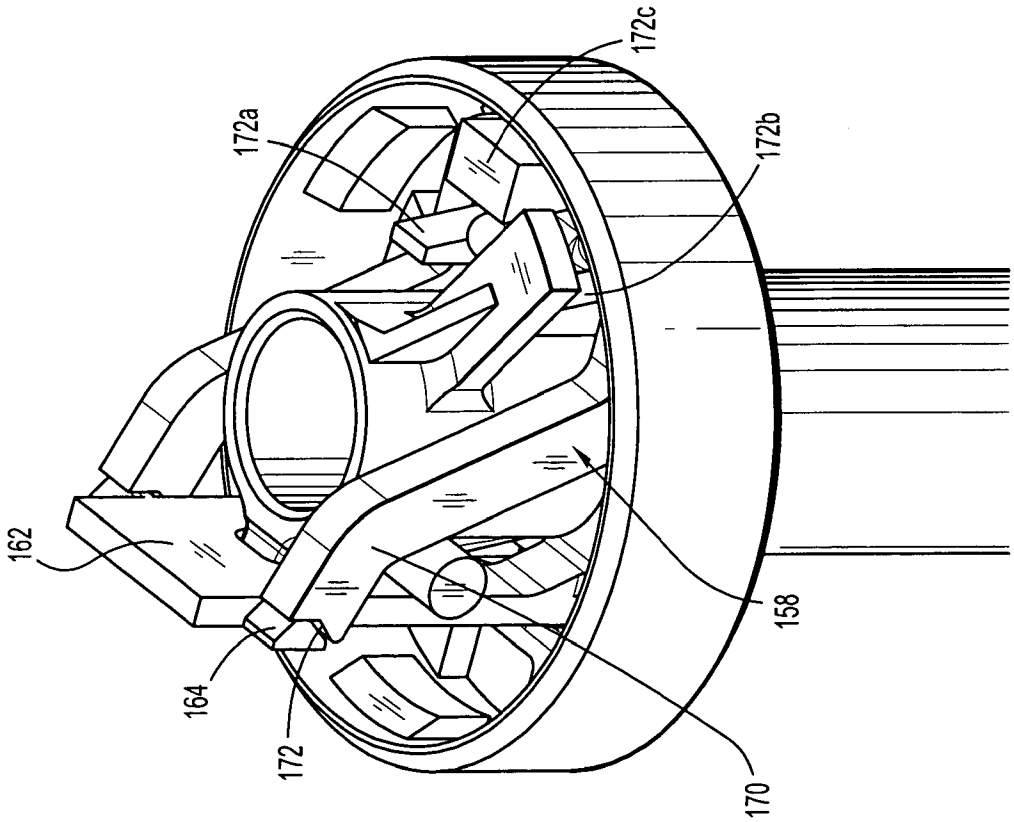

172c
172a
172b
162
164
172
158
170

FIG. 10

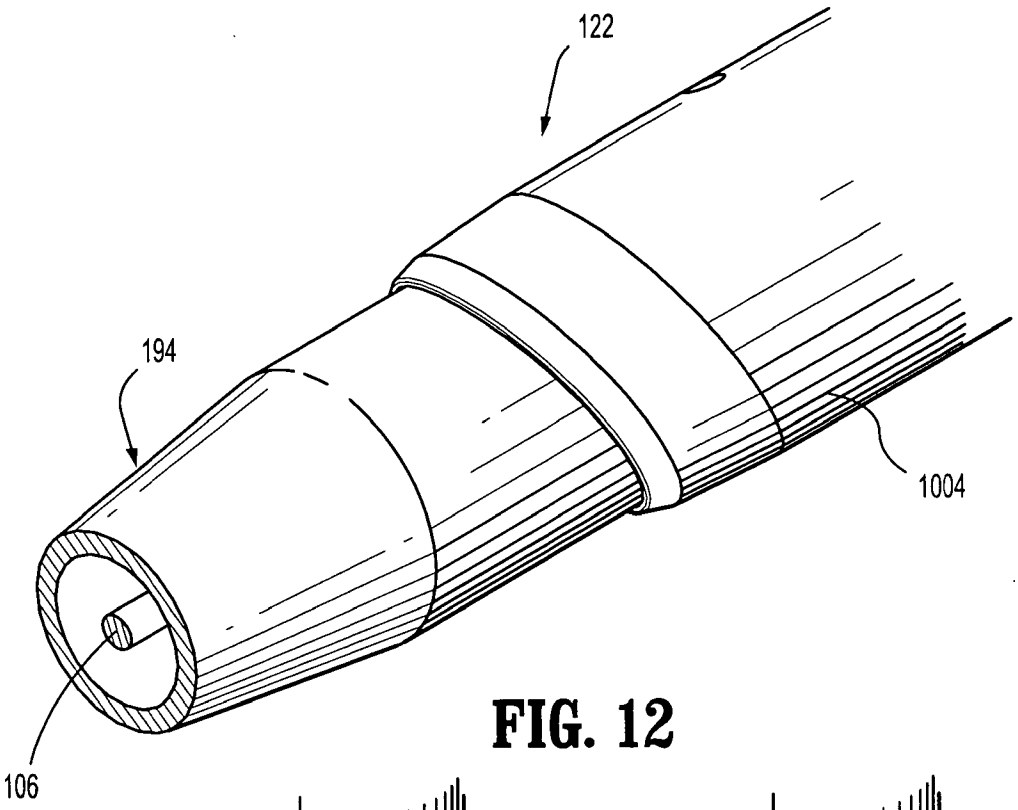


FIG. 12

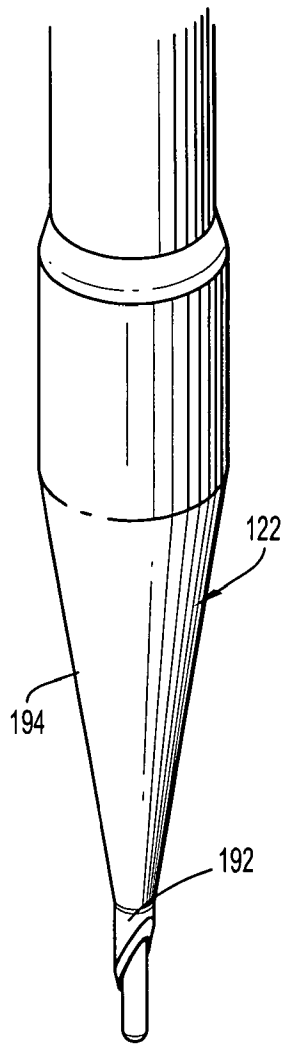


FIG. 13

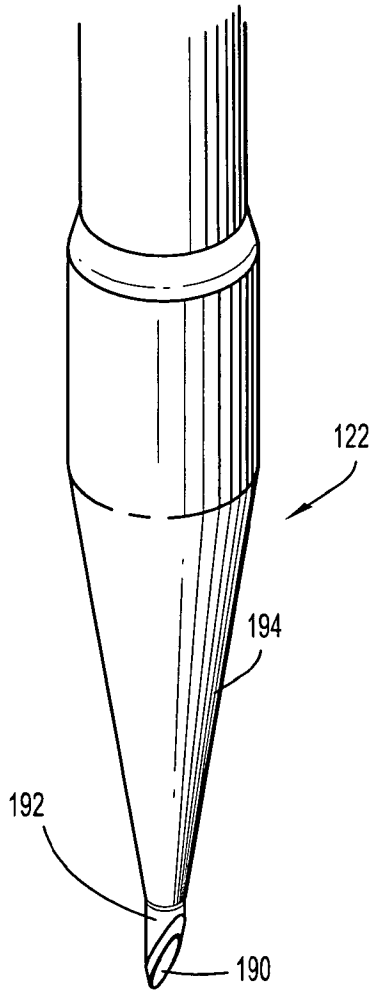


FIG. 14

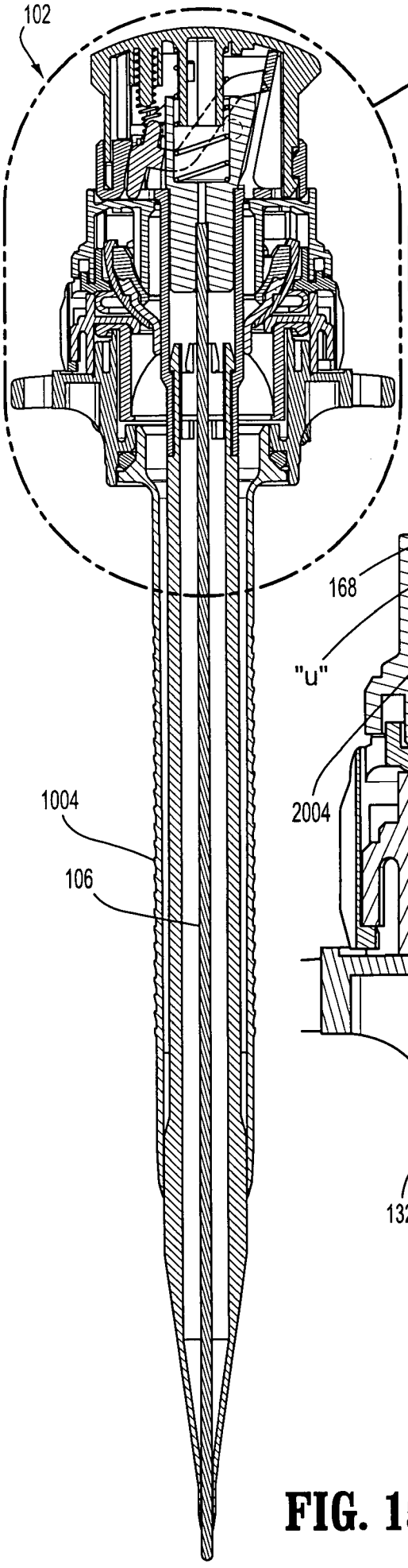

102
16
1004
106

FIG. 15

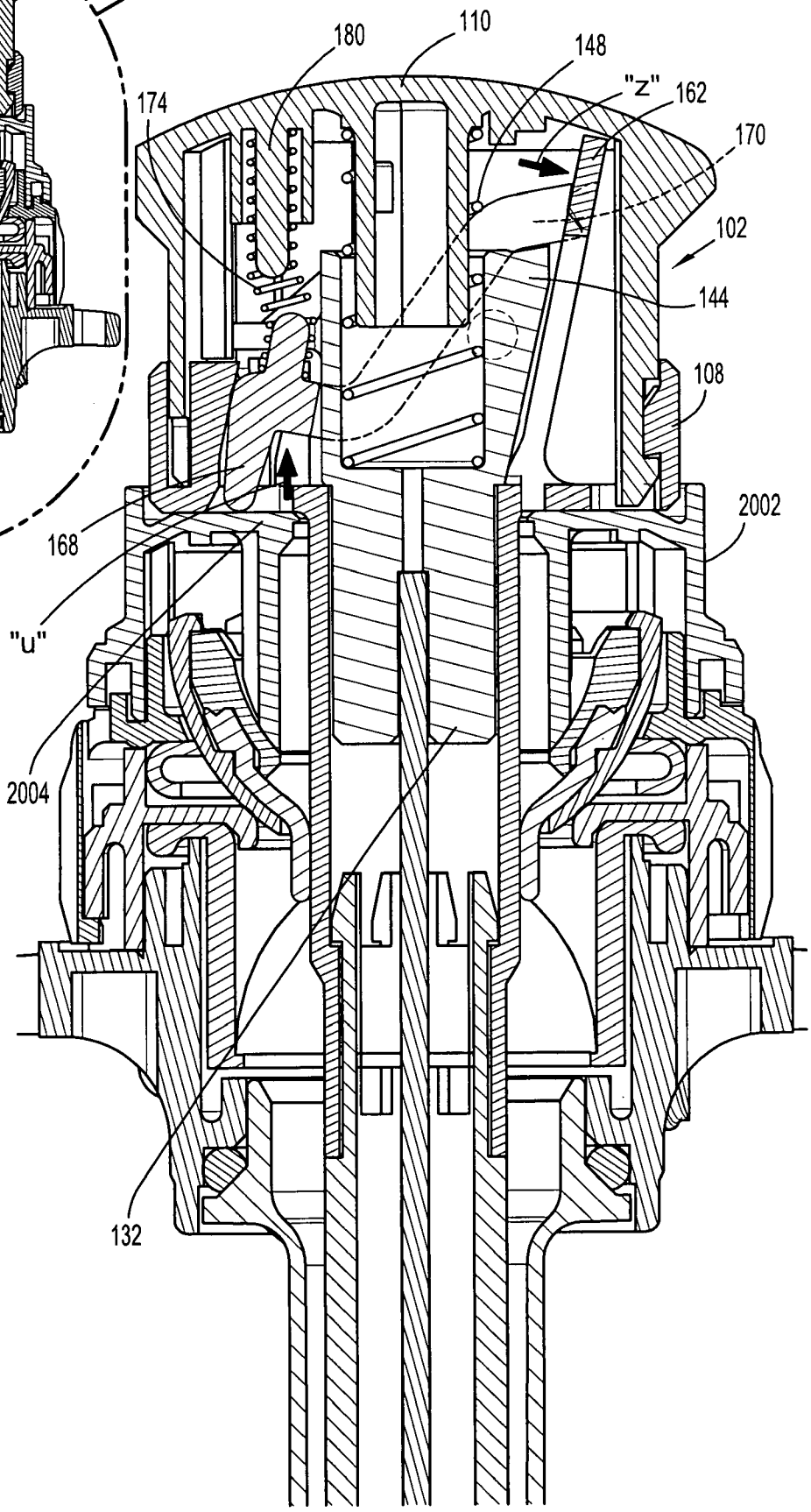

180
110
148
"z"
162
174
170
102
144
108
2002
168
"u"
2004
132

FIG. 16

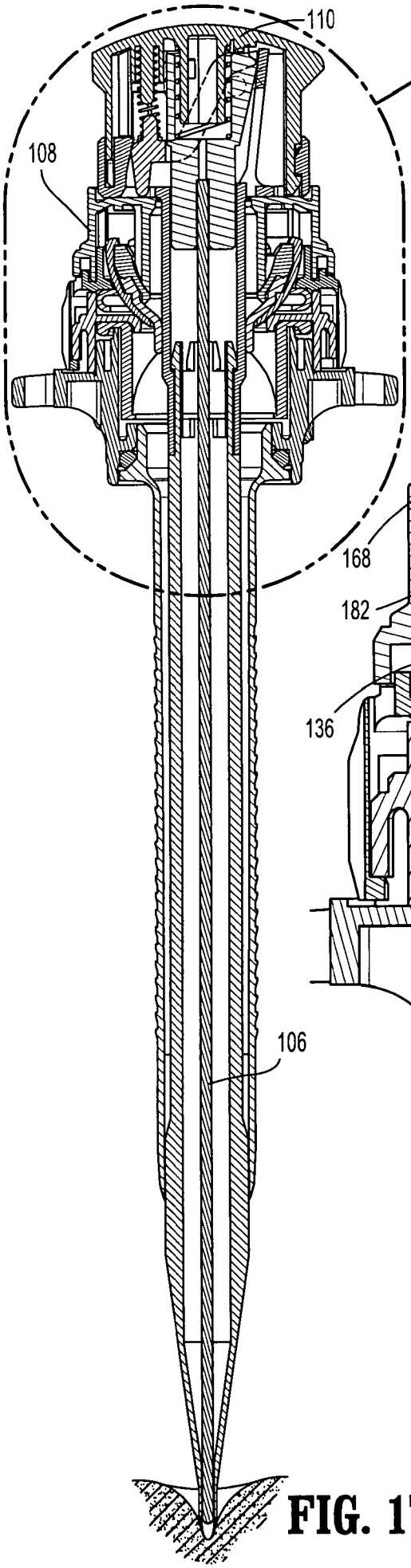
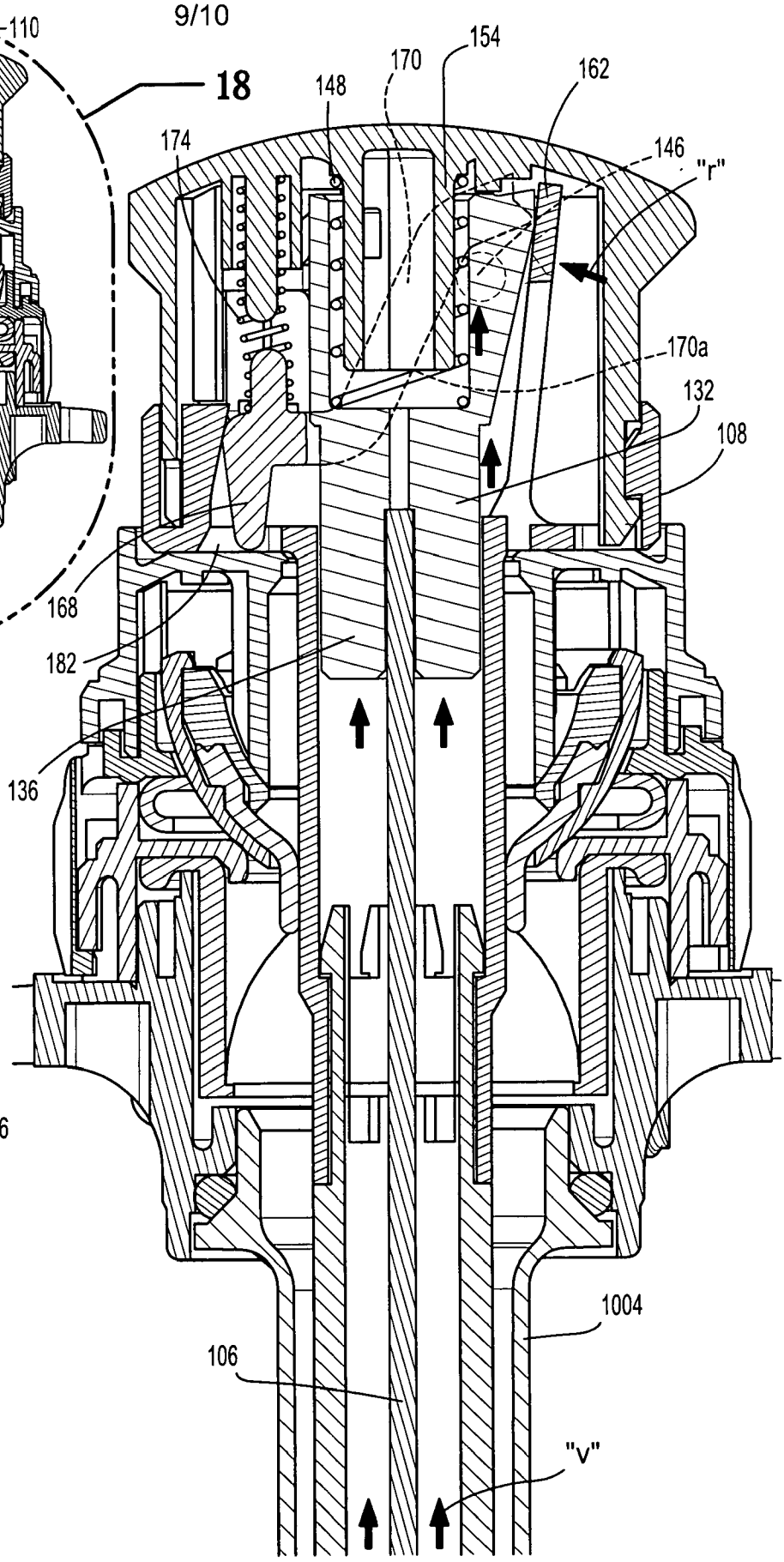

110
108
106

FIG. 17


18
148
170
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162
174
146
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170a
132
108
168
182
136
1004
106
"v"

FIG. 18

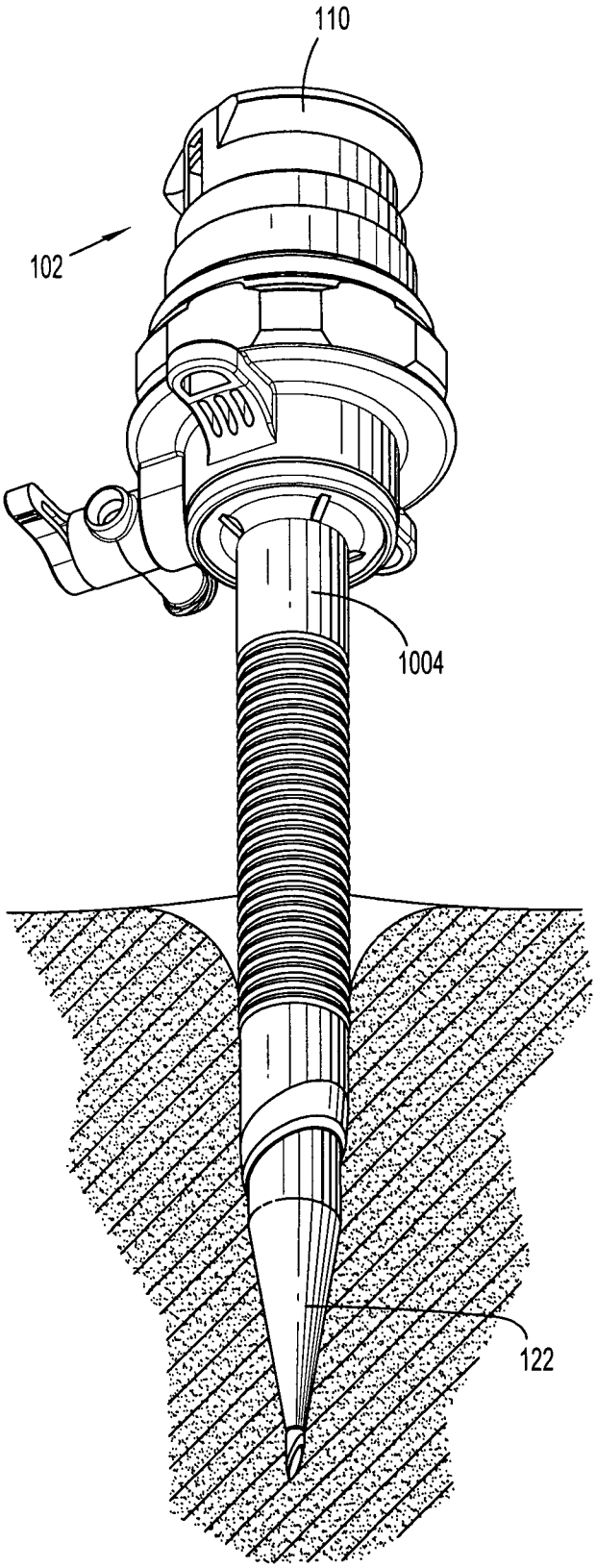

FIG. 19

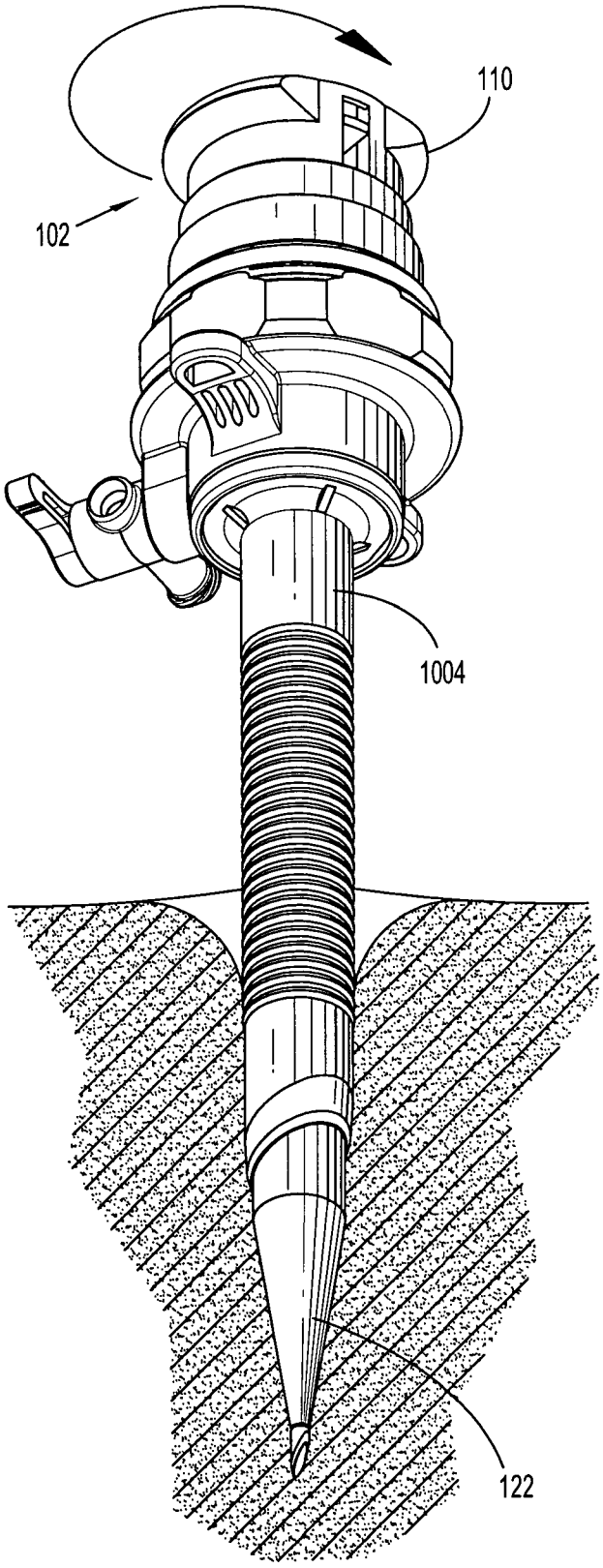

FIG. 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/025560

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 17/34 (2008.04)
USPC - 604/164.12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A61B 17/34 (2008.04)
USPC - 604/164.01, 164.12, 264; 606/167, 185

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 5,320,608 A (GERRONE) 14 June 1994 (14.06.1994) entire document	1-5 -------- 6-12
Y	US 6,319,266 B1 (STELLON et al) 20 November 2001 (20.11.2001) entire document	6-9
Y	US 5,980,493 A (SMITH et al) 09 November 1999 (09.11.1999) entire document	10-12

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 March 2008	24 APR 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2005)