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(54) ELECTROSURGICAL DEVICE AND METHOD OF USE

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(73) Assignee: **Meditrina, Inc.**, San Jose, CA (US)

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Publication Classification

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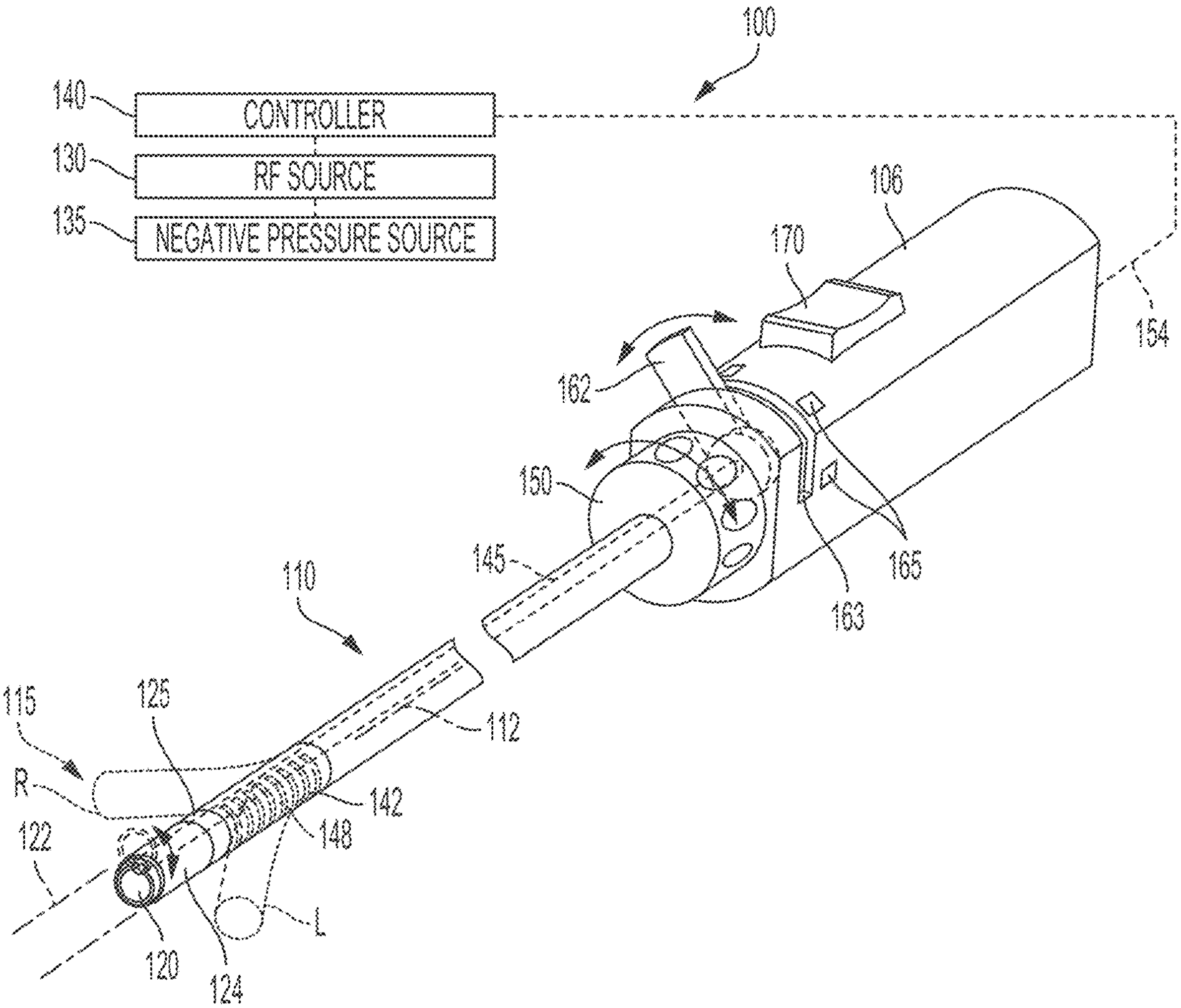
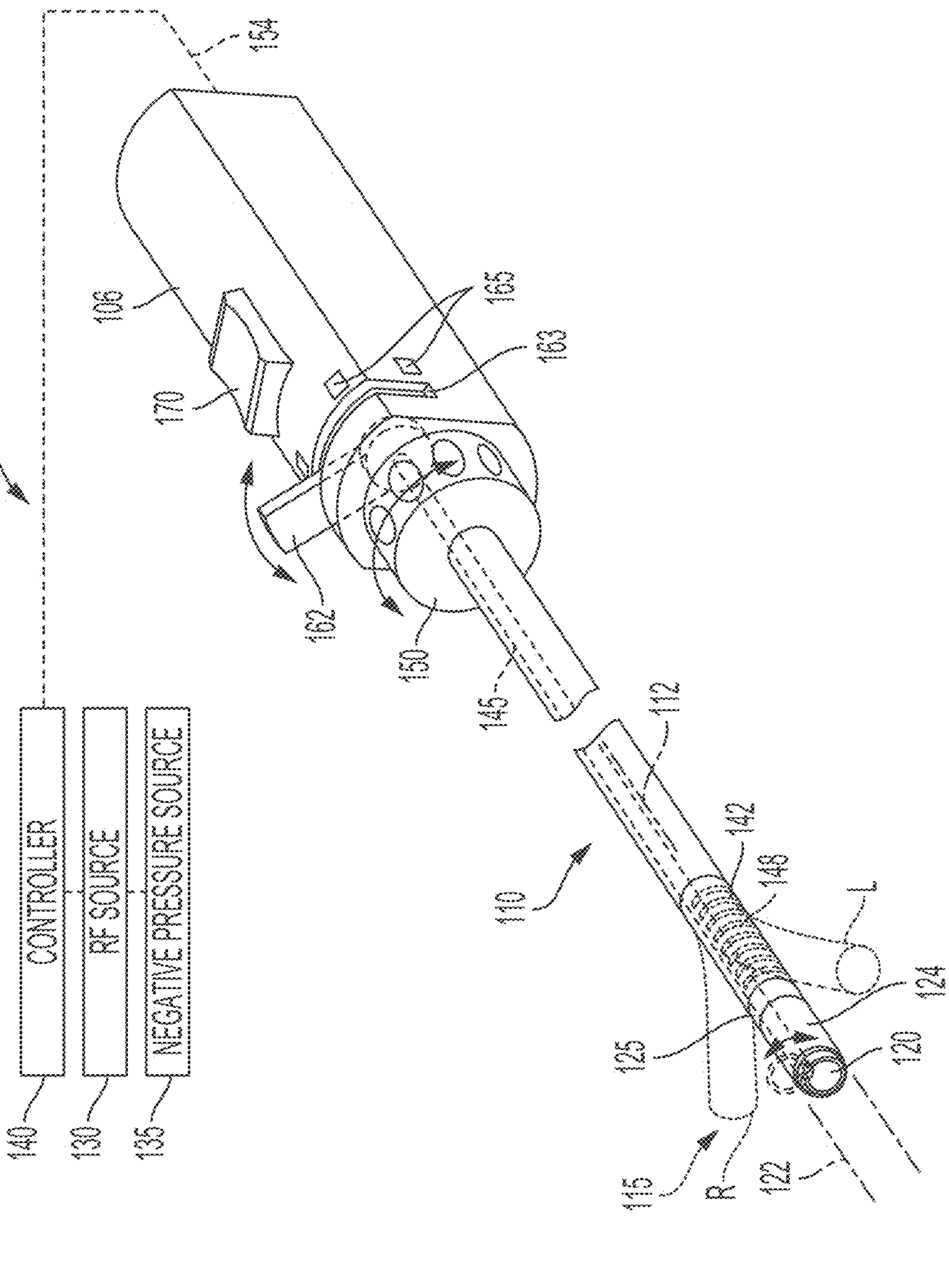
A61B 18/00 (2006.01)
A61B 18/12 (2006.01)

(52) **U.S. Cl.**
CPC ***A61B 18/14*** (2013.01); *A61B 2018/00208* (2013.01); *A61B 2018/00601* (2013.01); *A61B 2018/0091* (2013.01); *A61B 2018/126* (2013.01); *A61B 2018/1407* (2013.01); *A61B 2018/1475* (2013.01); *A61B 2218/007* (2013.01)

(57) **ABSTRACT**

Bipolar electrosurgical devices and methods of use for cutting tissue, for example, in endoscopic urology and gynecology procedures. The electrosurgical device can comprise a handle and a small diameter, elongated shaft adapted for introduction through a working channel of an endoscope. The working end of the device has a form of loop electrode that is extendable outward from the shaft, a selected dimension for cutting tissue at a selected depth.




CONTROLLER
RF SOURCE
NEGATIVE PRESSURE SOURCE
100
106
110
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135
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142
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148
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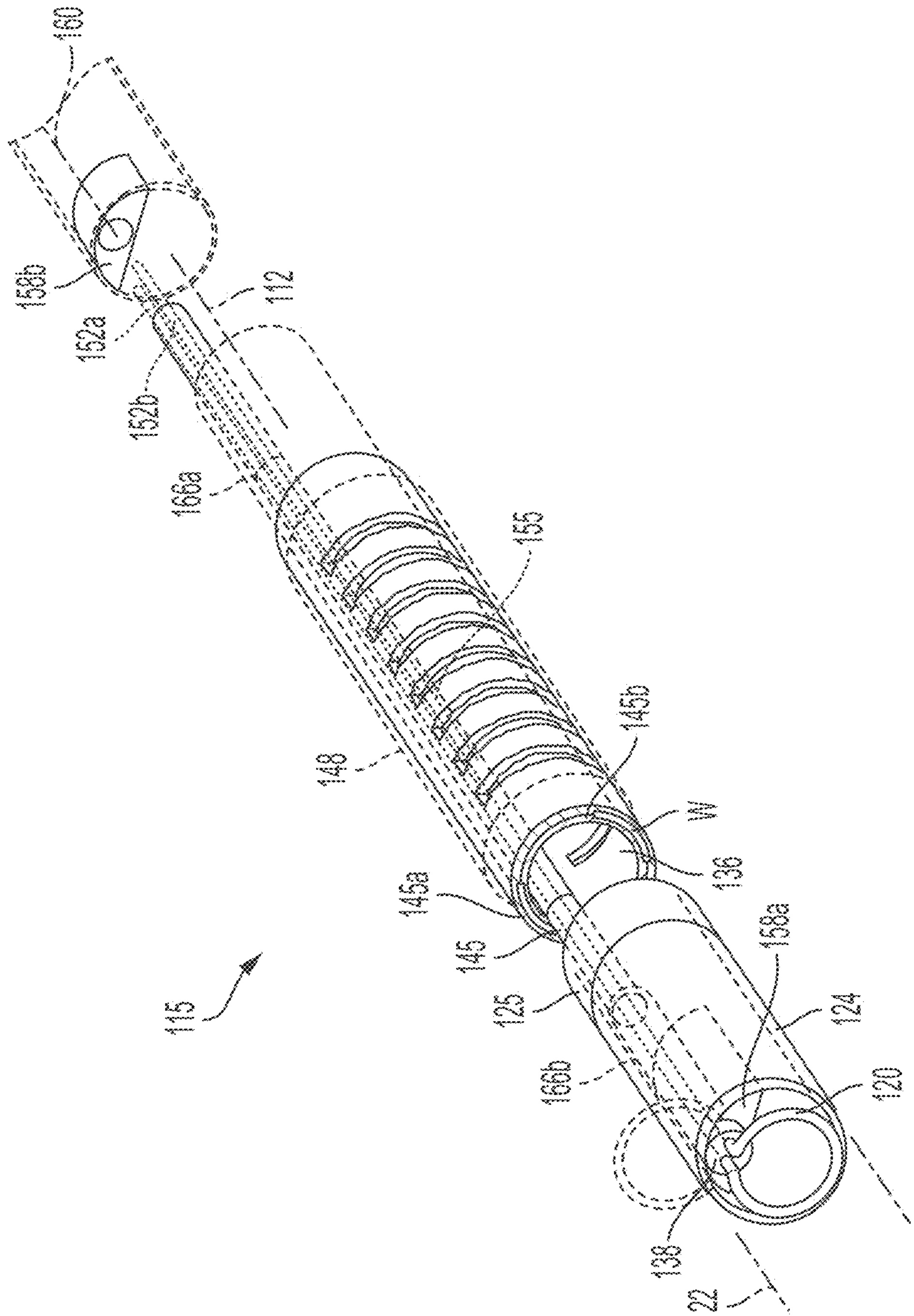
154
162
163
165
170
L
R

FIG. 1


160
156b
152a
112
152b
166a
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145b
W
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158a
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138
122

FIG. 2

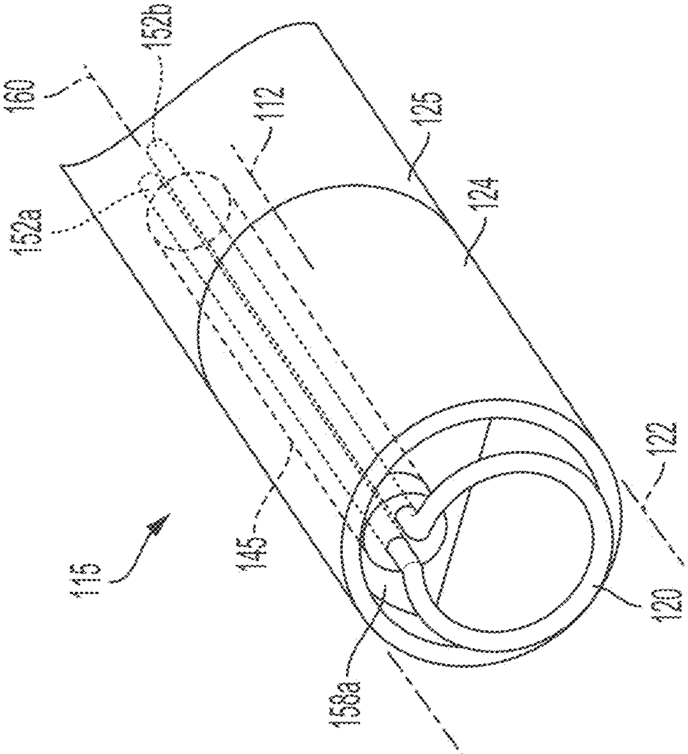
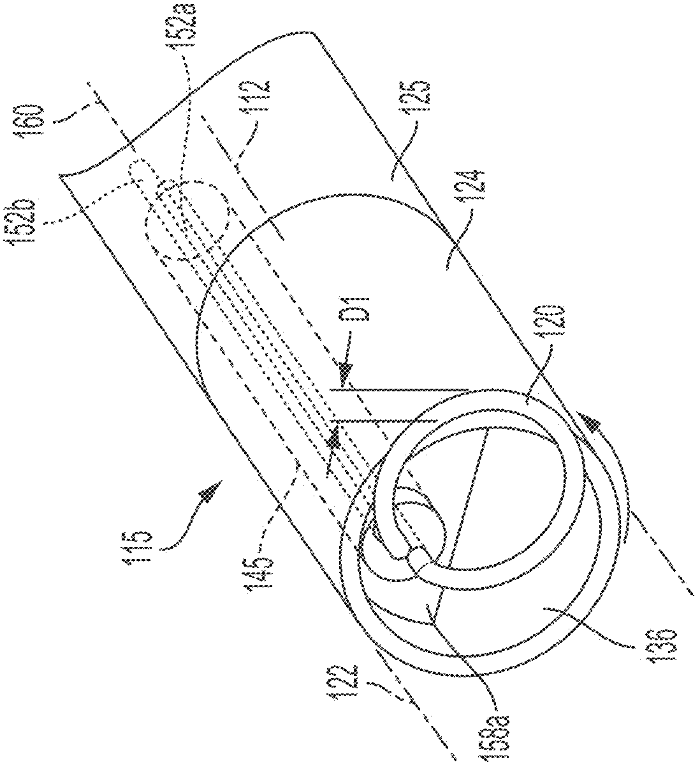

115
145
152a
160
152b
112
125
124
122
120
158a

FIG. 3A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145
122
158a
136
152b
160
152a
112
125
124
D1
120

FIG. 3B

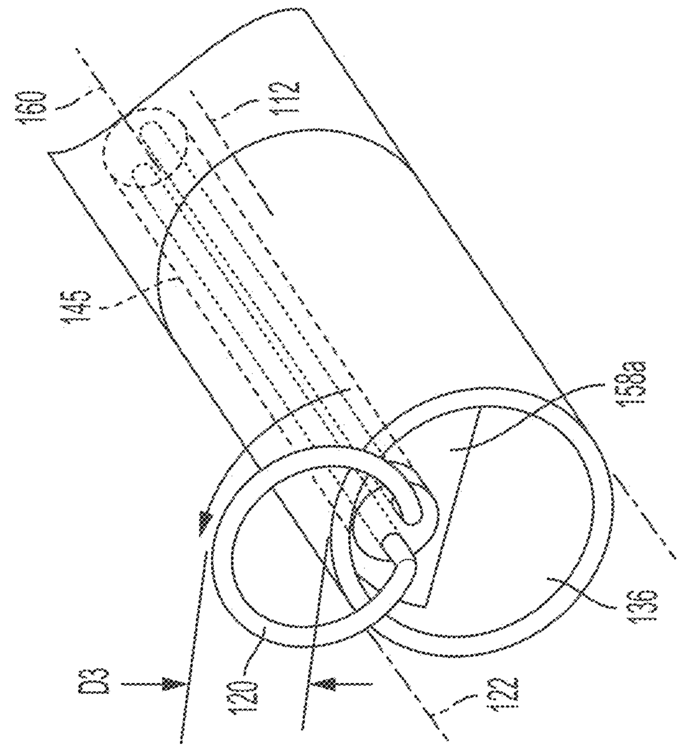


FIG. 3D

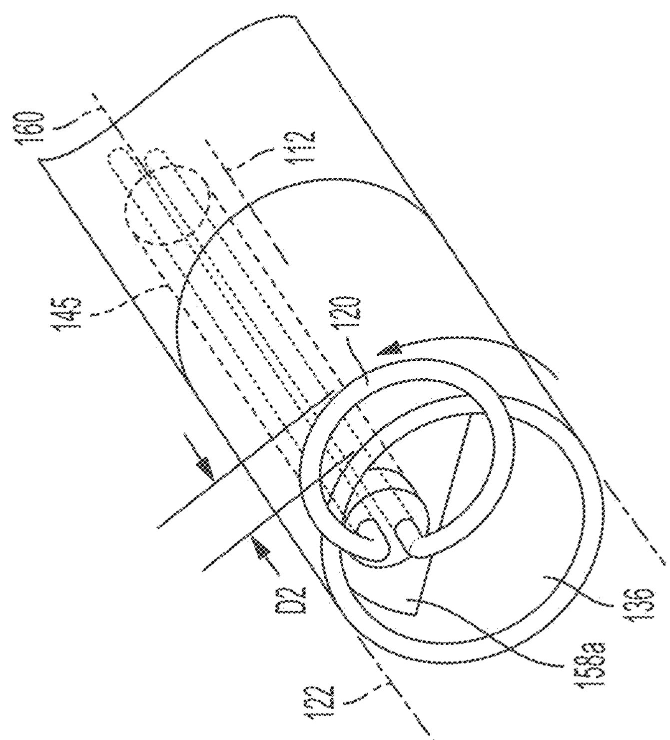
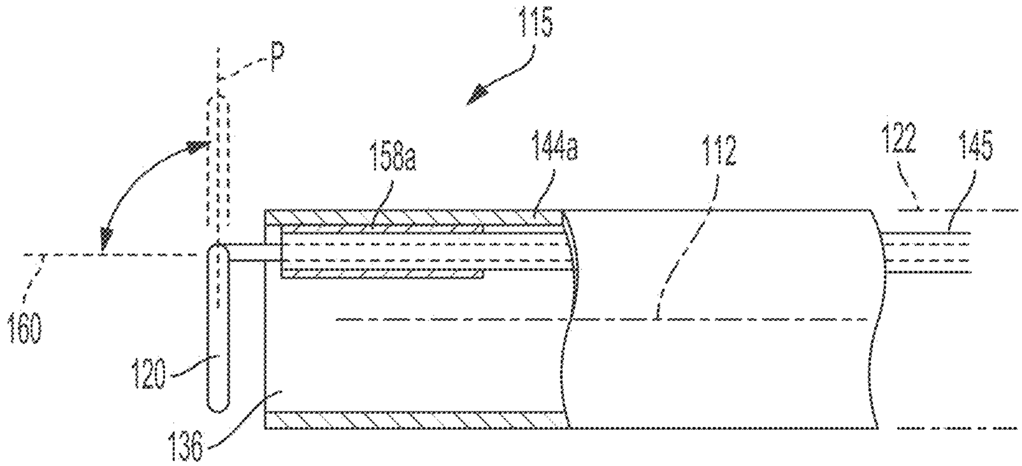


FIG. 3C


115
P
158a
144a
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160
120
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FIG. 4

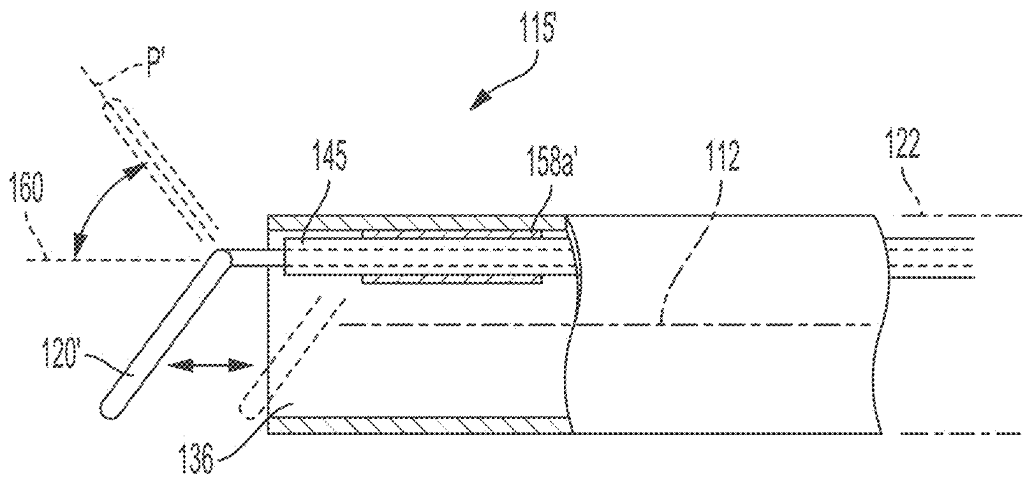

115'
P'
160
145
158a'
112
122
120'
136

FIG. 5

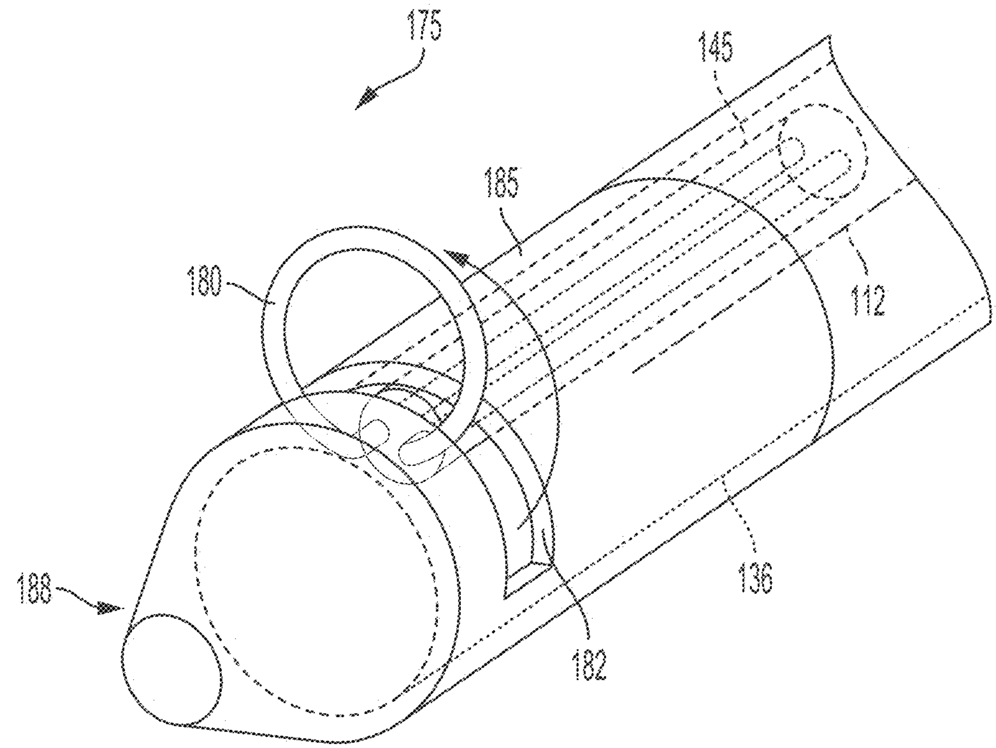
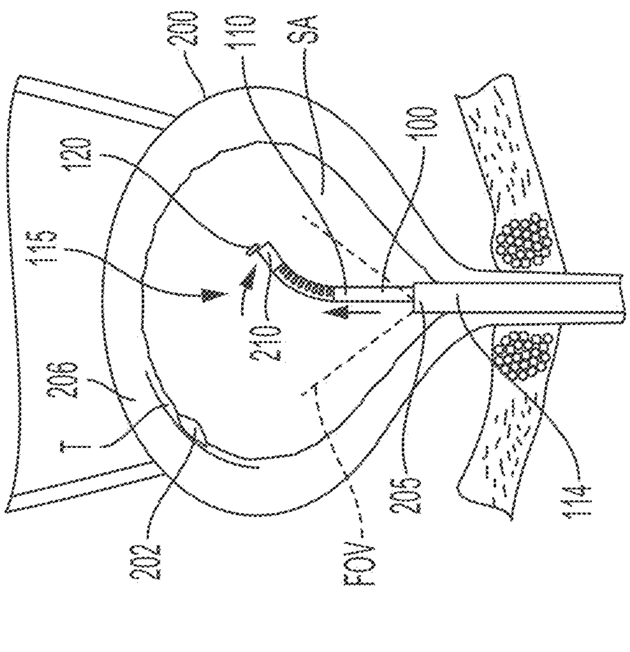


FIG. 6


200
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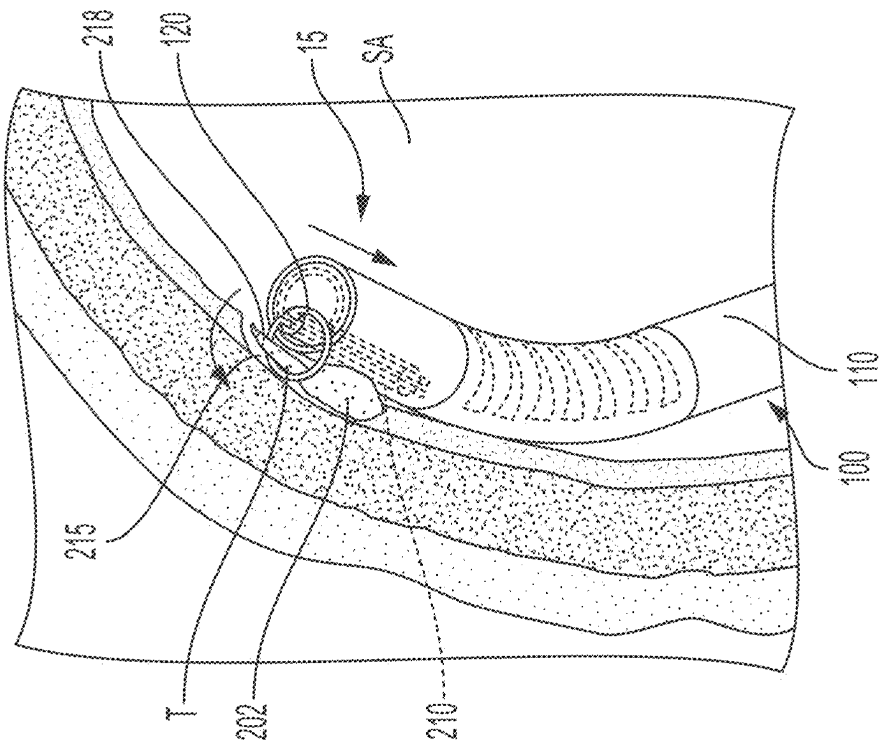
115
100
210
206
T
202
FOV
205
114

FIG. 7A


218
120
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SA
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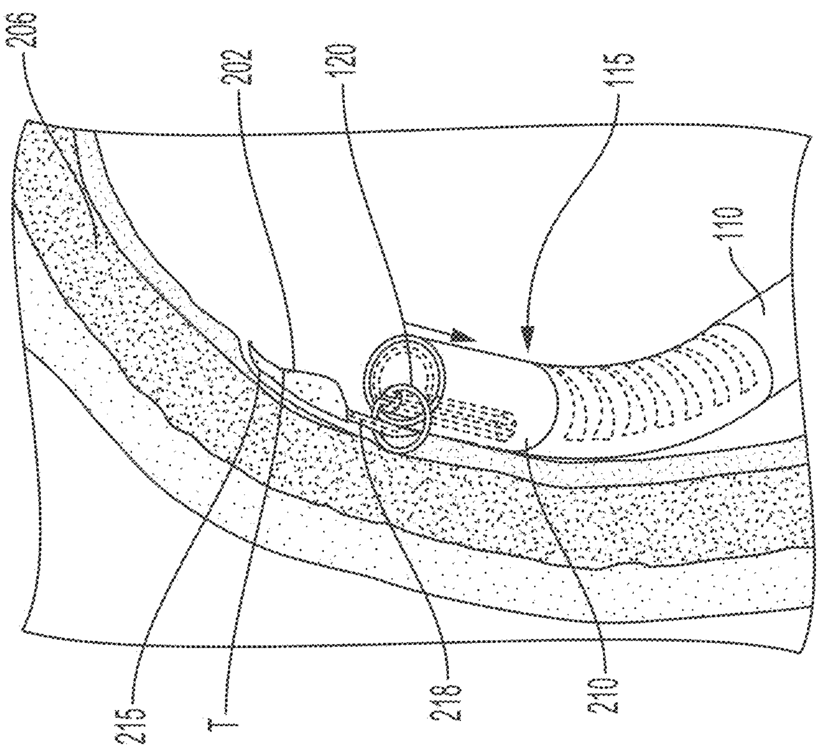
FIG. 7B


206
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T
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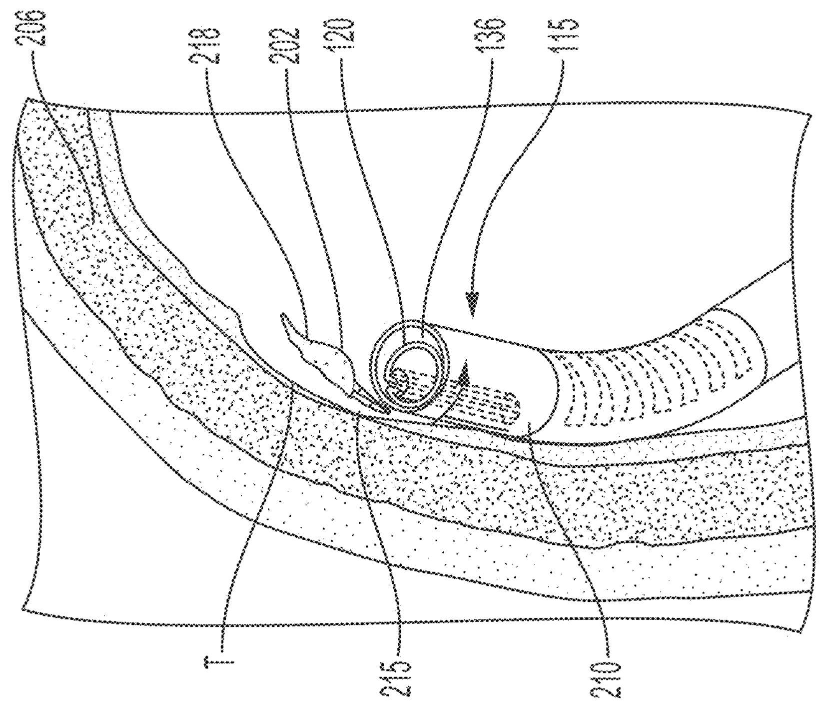
110
210

FIG. 7C


206
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120
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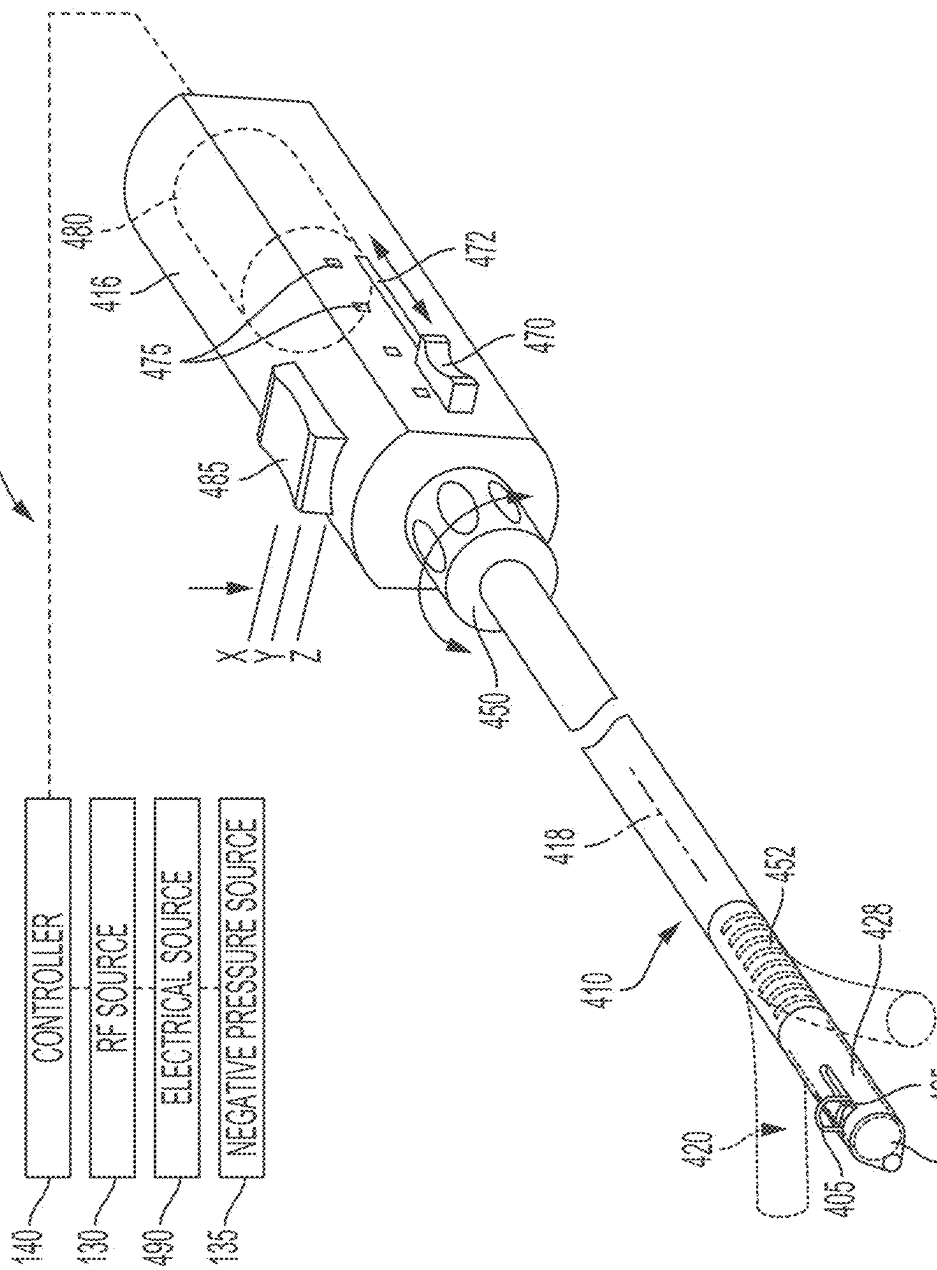
115
T
215
210

FIG. 7D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475
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485
X
Y
Z
450
418
452
428
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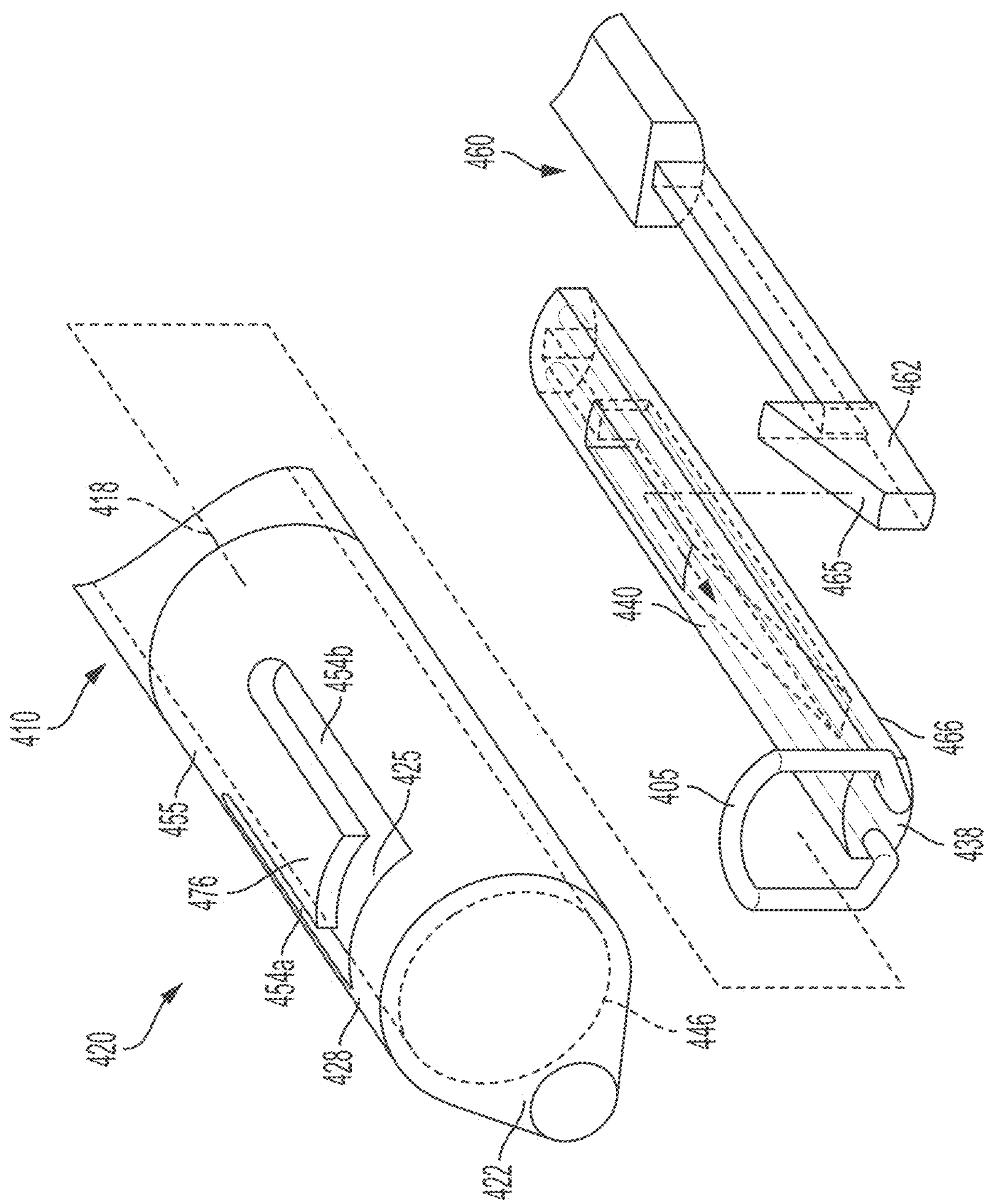
422
405
CONTROLLER
RF SOURCE
ELECTRICAL SOURCE
NEGATIVE PRESSURE SOURCE
140
130
490
135

FIG. 8


460
462
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454b
455
425
476
454a
420
428
446
422

FIG. 9

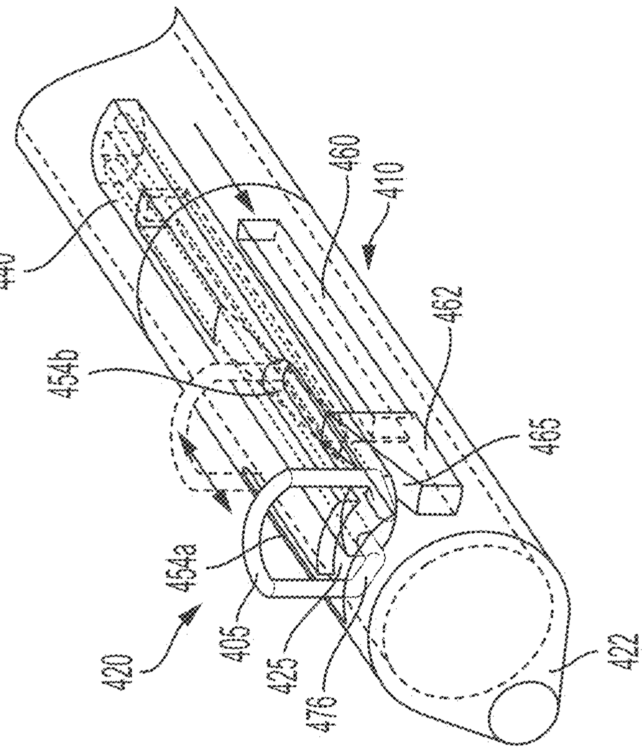


FIG. 10B

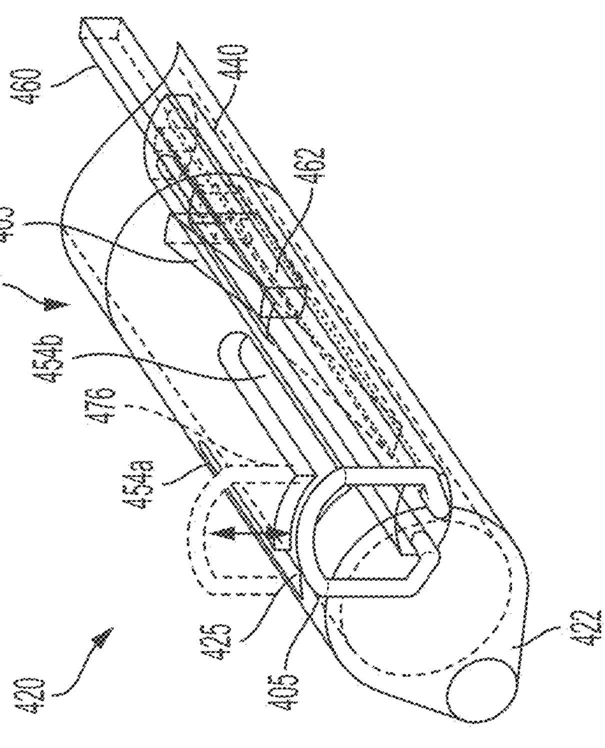


FIG. 10A

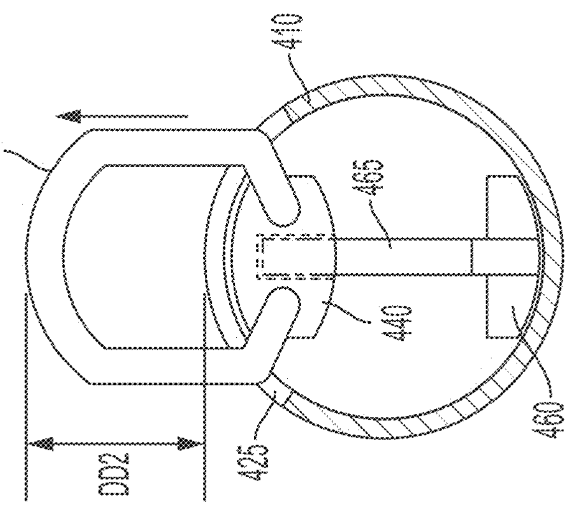


FIG. 11C

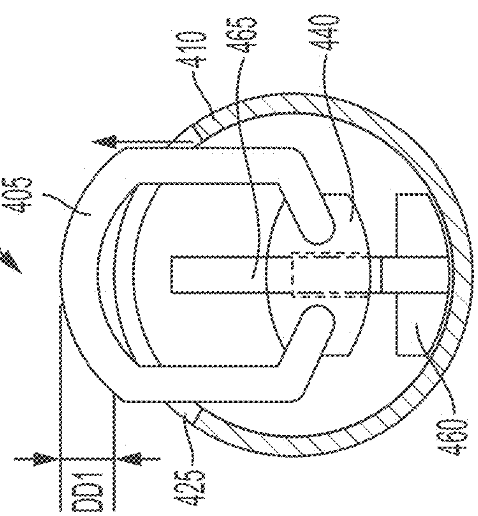


FIG. 11B

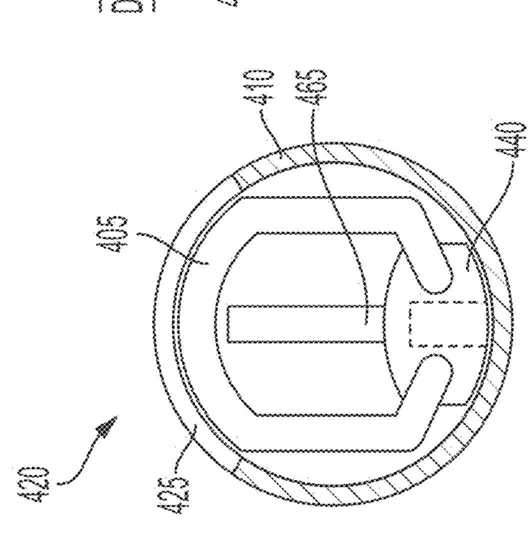
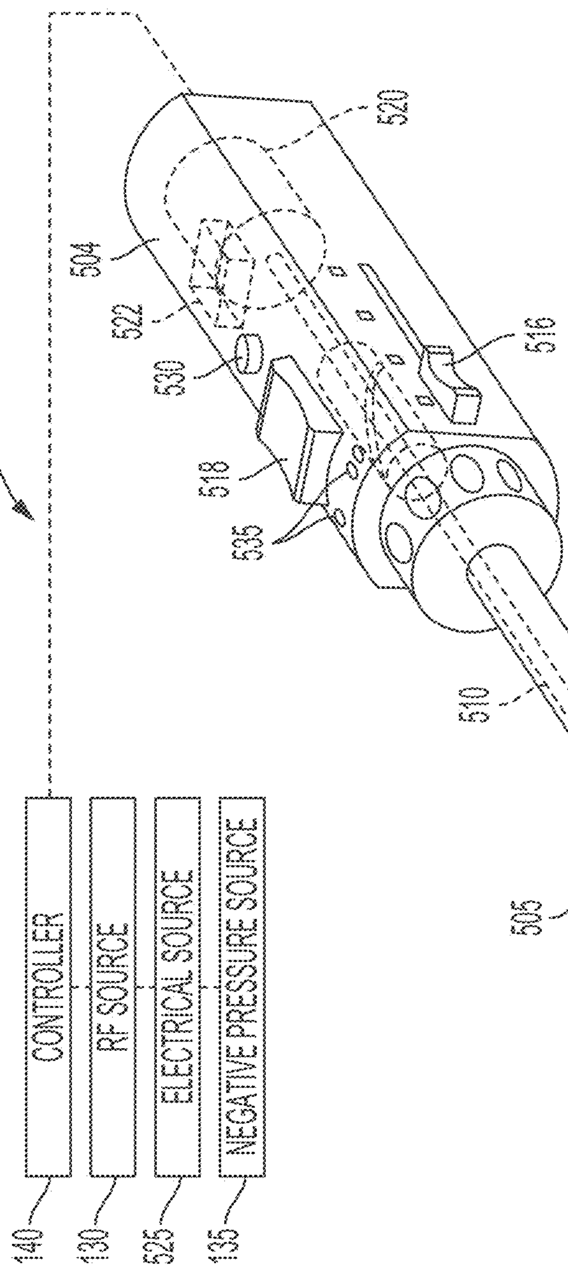


FIG. 11A



500
520
504
522
530
516
518
535
510
505
508
515
506
CONTROLLER
RF SOURCE
ELECTRICAL SOURCE
NEGATIVE PRESSURE SOURCE
140
130
525
135

FIG. 12

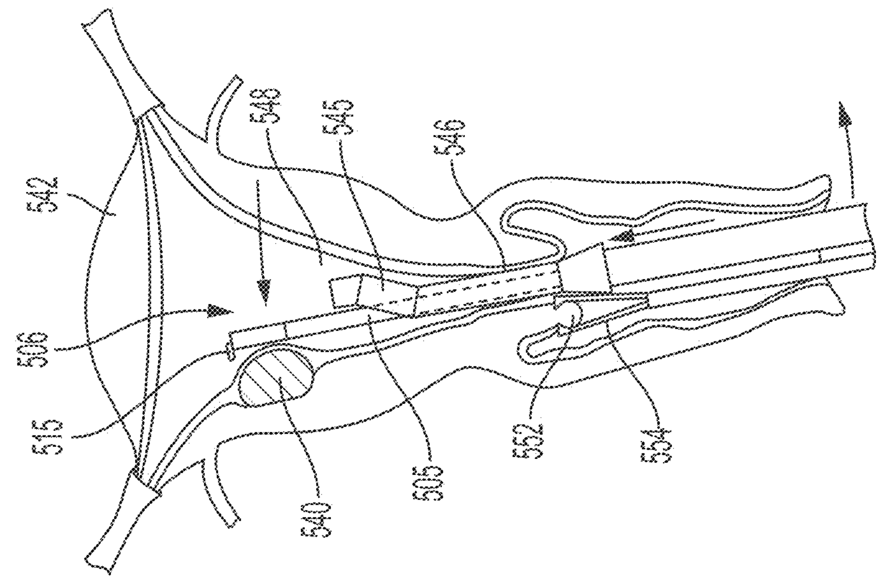


FIG. 13B

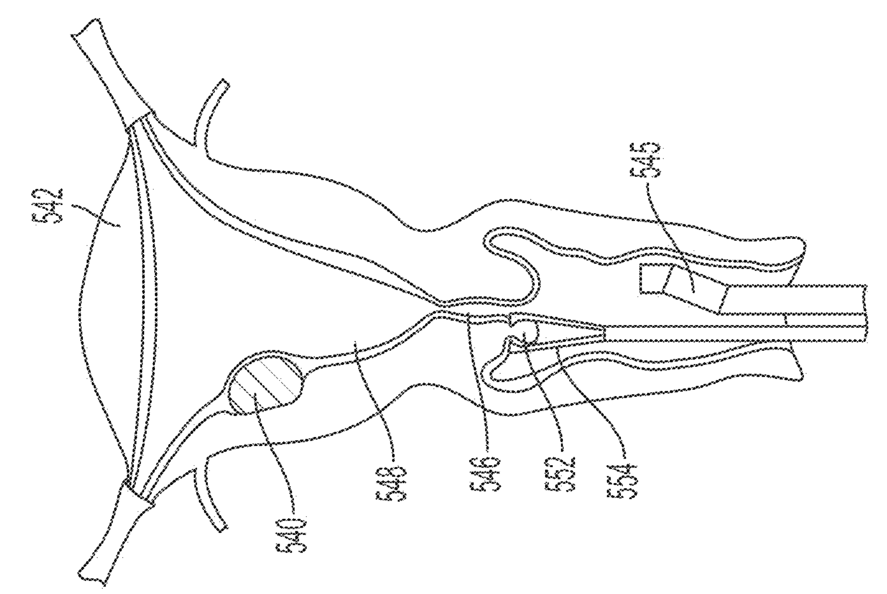


FIG. 13A

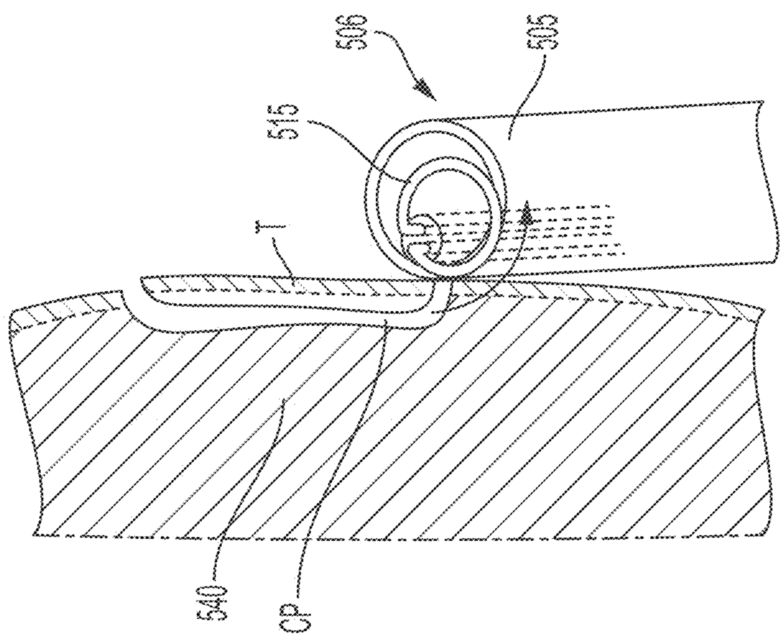


FIG. 13D

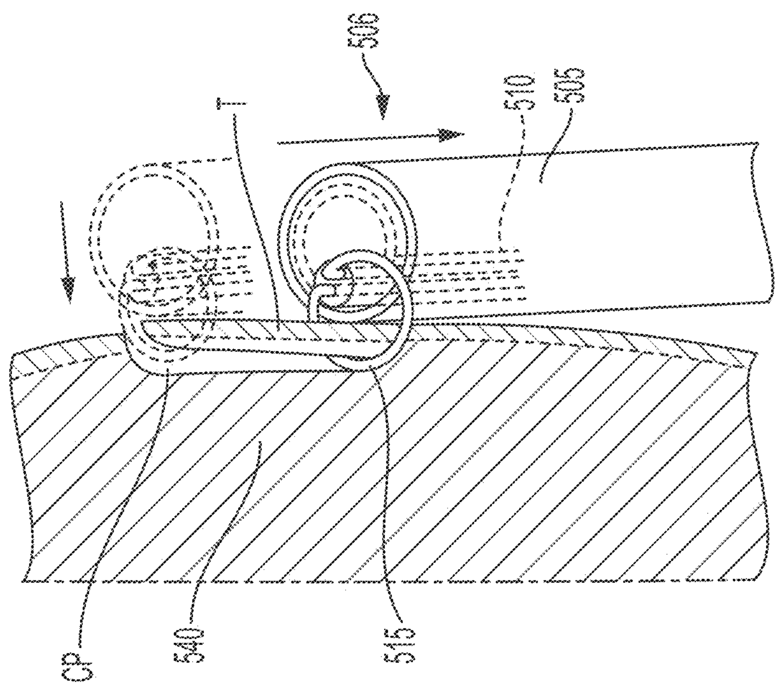


FIG. 13C

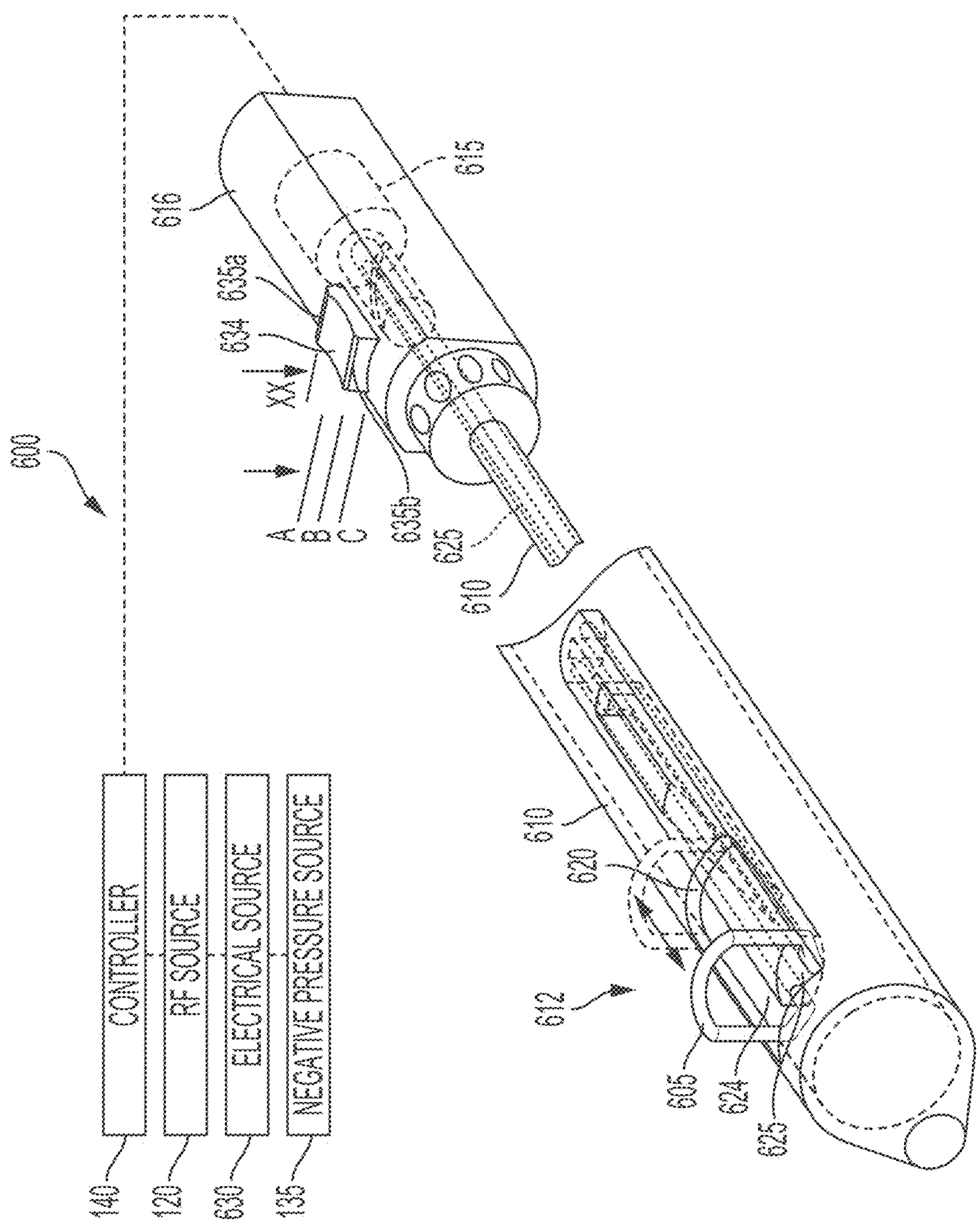

600
CONTROLLER
RF SOURCE
ELECTRICAL SOURCE
NEGATIVE PRESSURE SOURCE
140
120
630
135
616
615
635a
634
XX
A
B
C
635b
625
610
610
620
612
605
624
625

FIG. 14

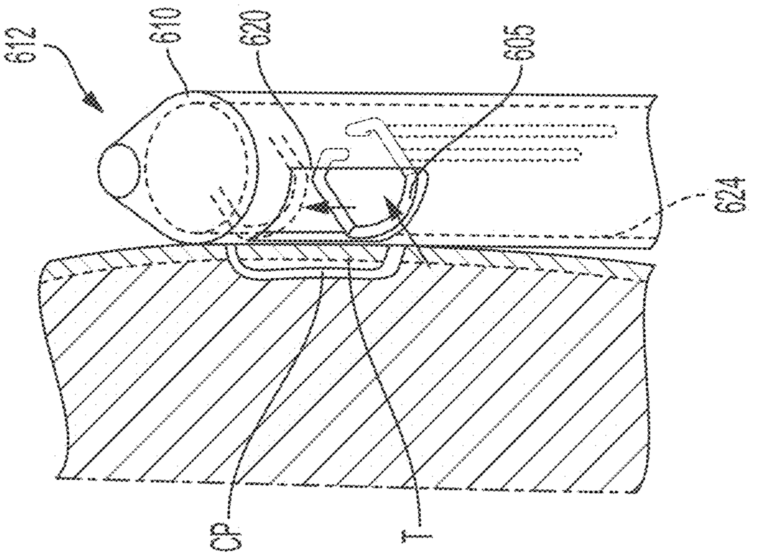


FIG. 15C

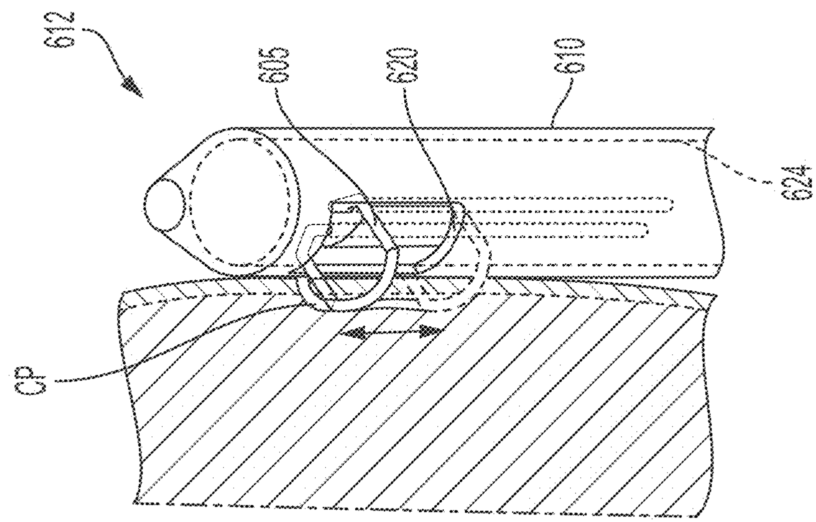


FIG. 15B

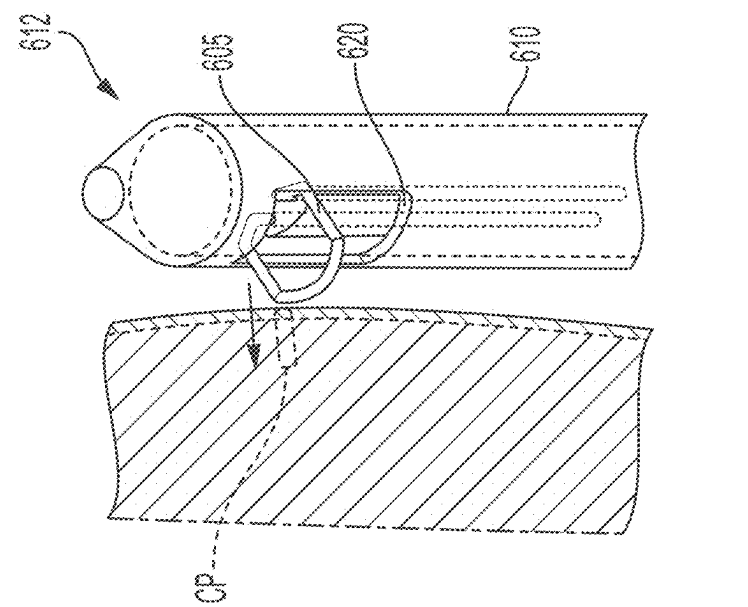


FIG. 15A

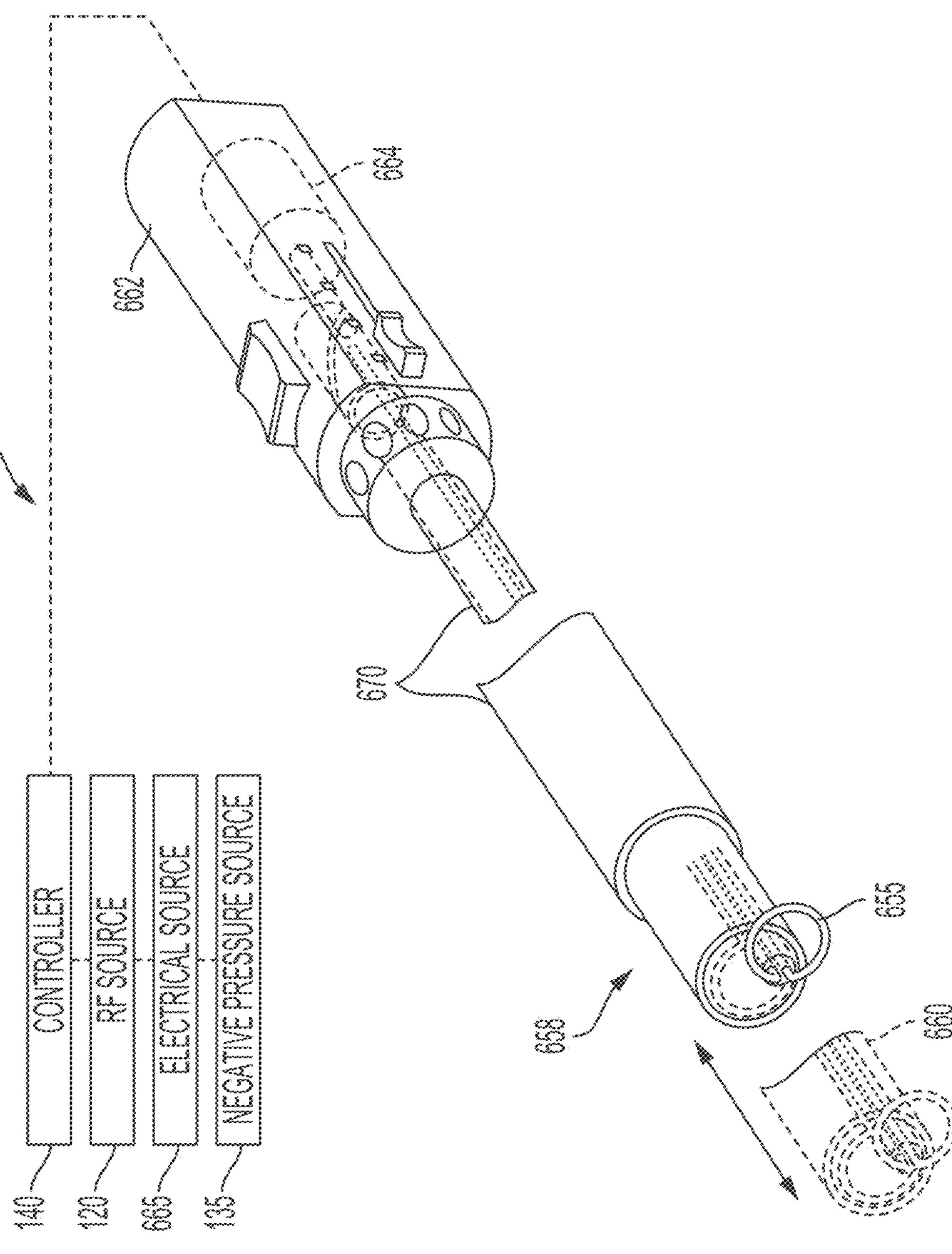

650
662
664
670
658
655
660
CONTROLLER
RF SOURCE
ELECTRICAL SOURCE
NEGATIVE PRESSURE SOURCE
140
120
665
135

FIG. 16

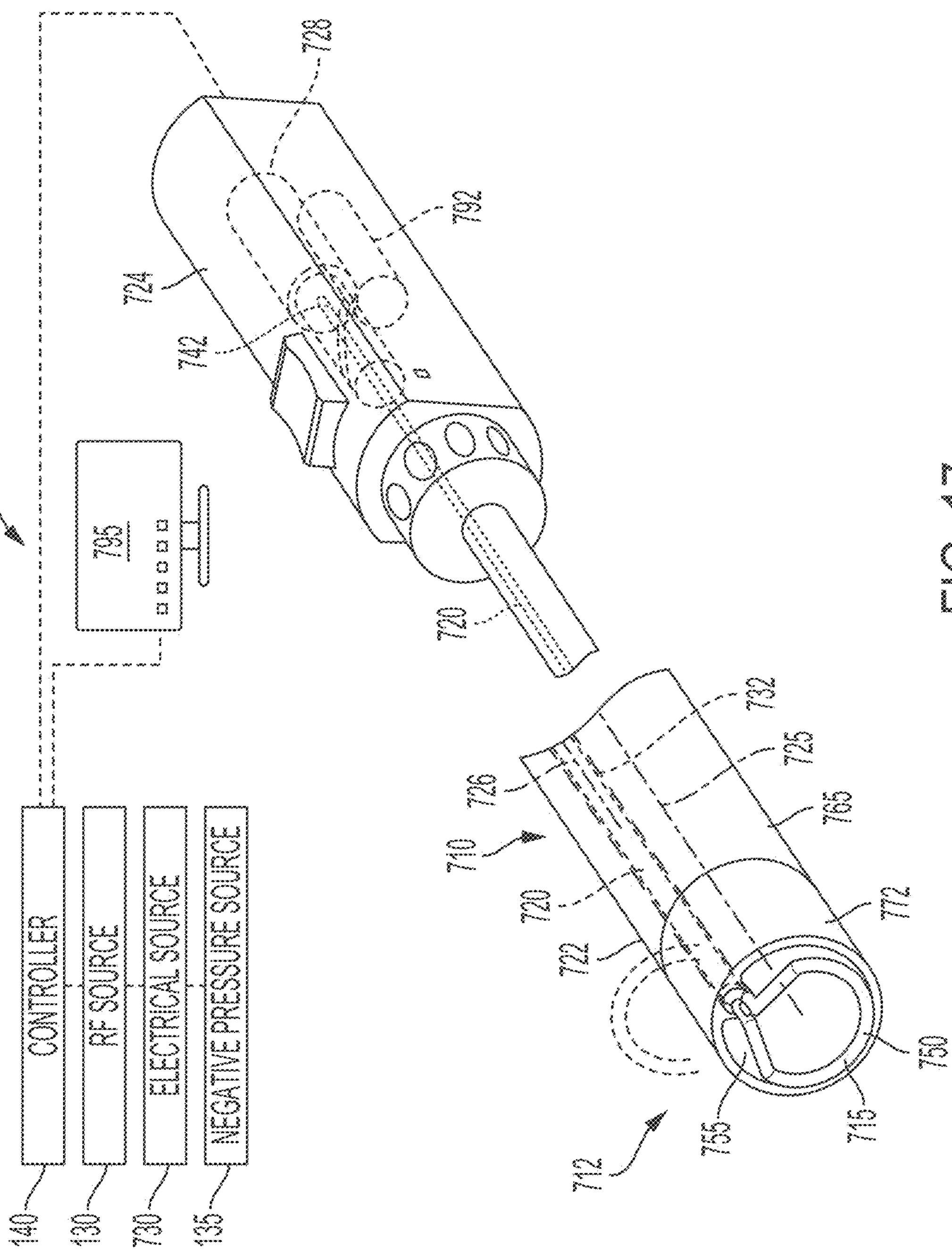

700
728
792
724
742
795
720
CONTROLLER
RF SOURCE
ELECTRICAL SOURCE
NEGATIVE PRESSURE SOURCE
140
130
730
135
732
726
725
765
710
720
772
722
750
755
715
712

FIG. 17

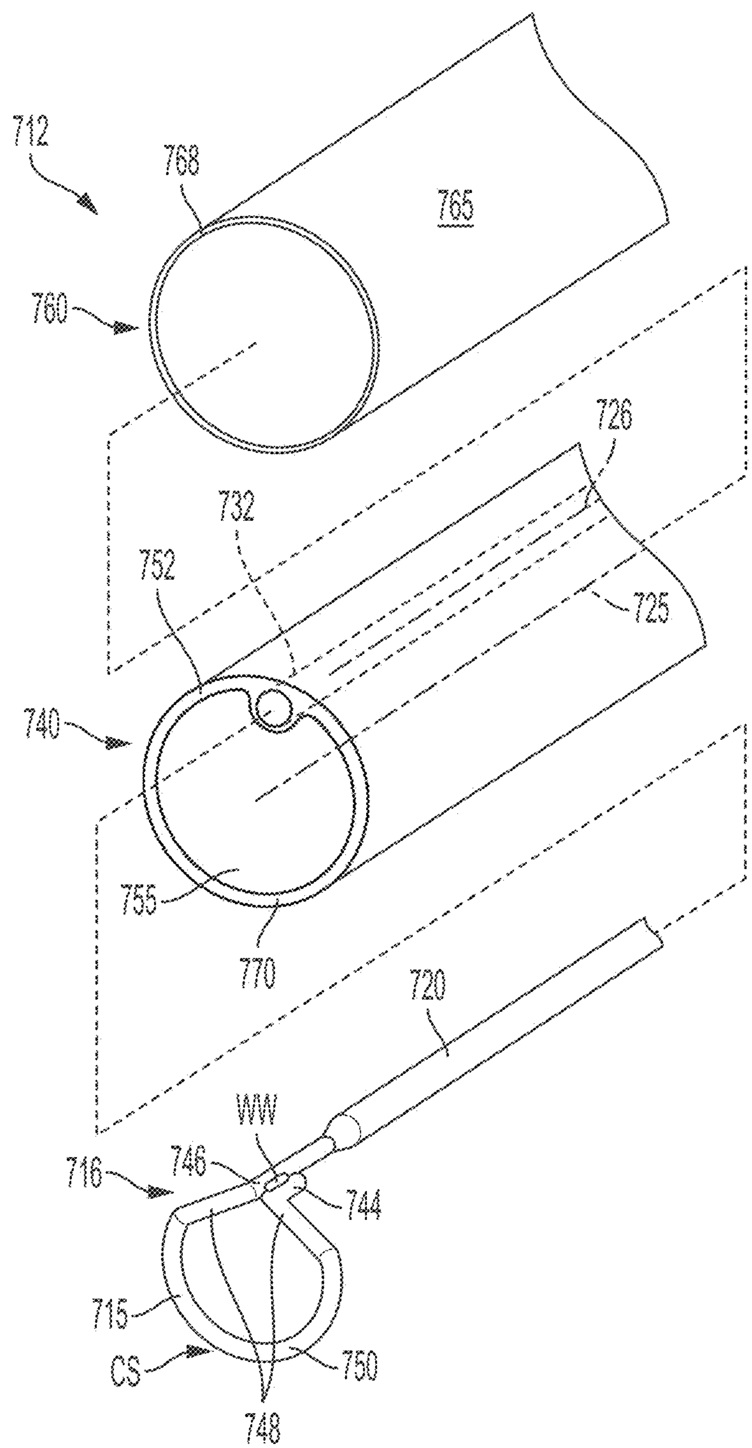

712
768
765
760
726
732
752
725
740
755
770
720
WW
716
746
744
715
CS
750
748

FIG. 18

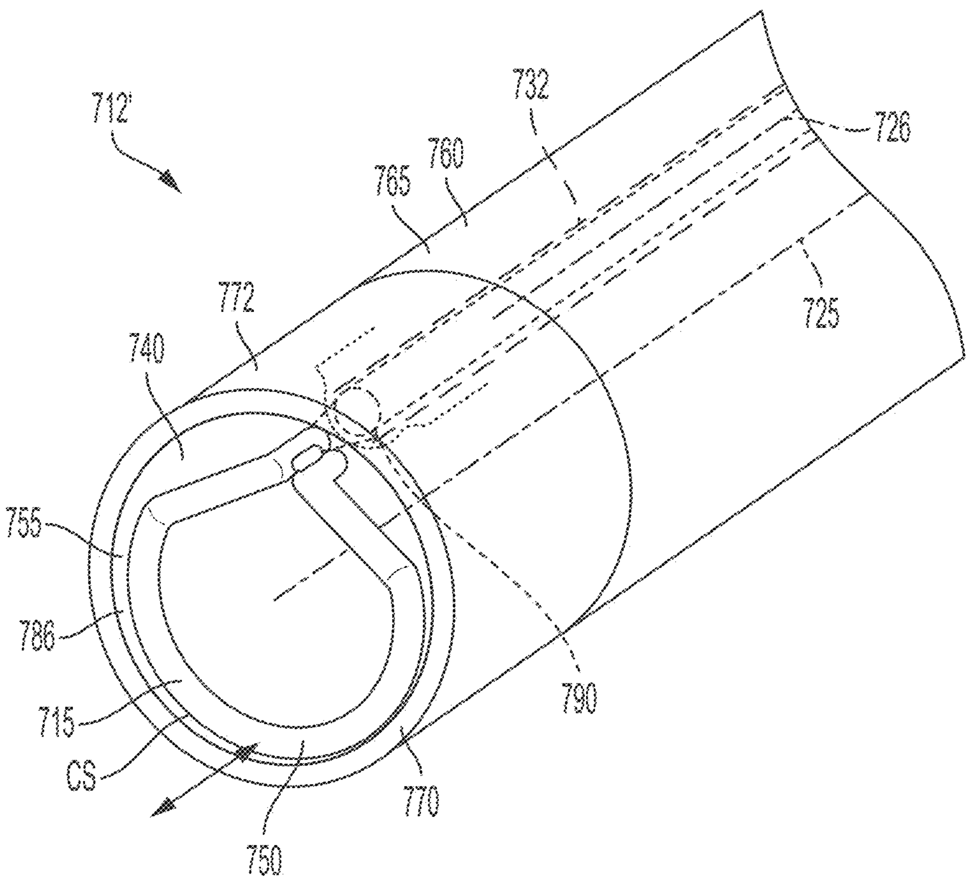


FIG. 19

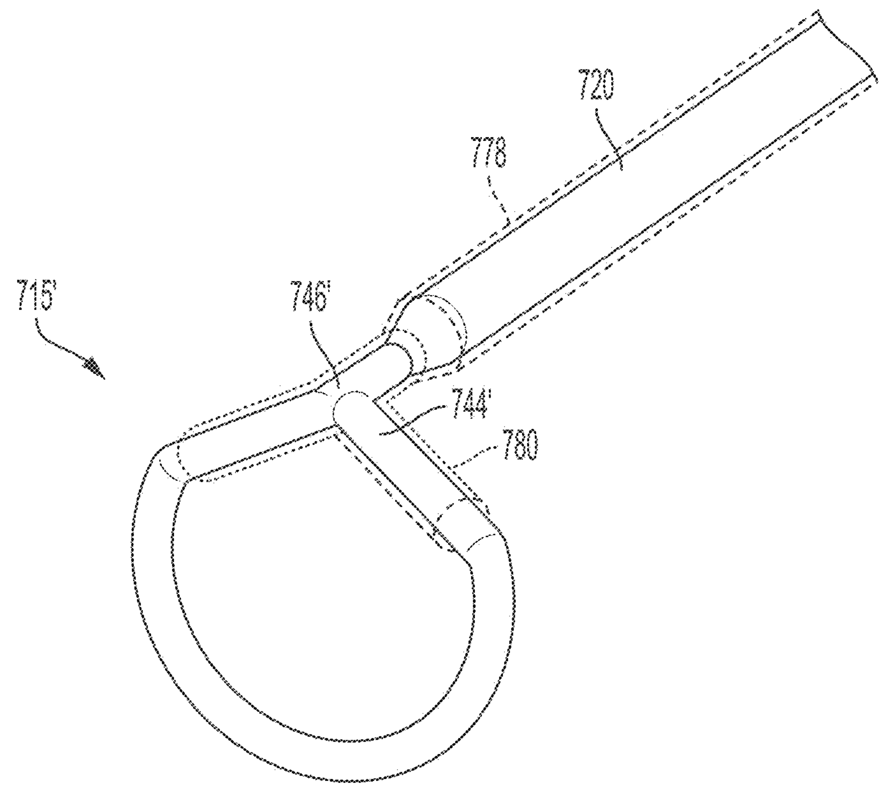


FIG. 20

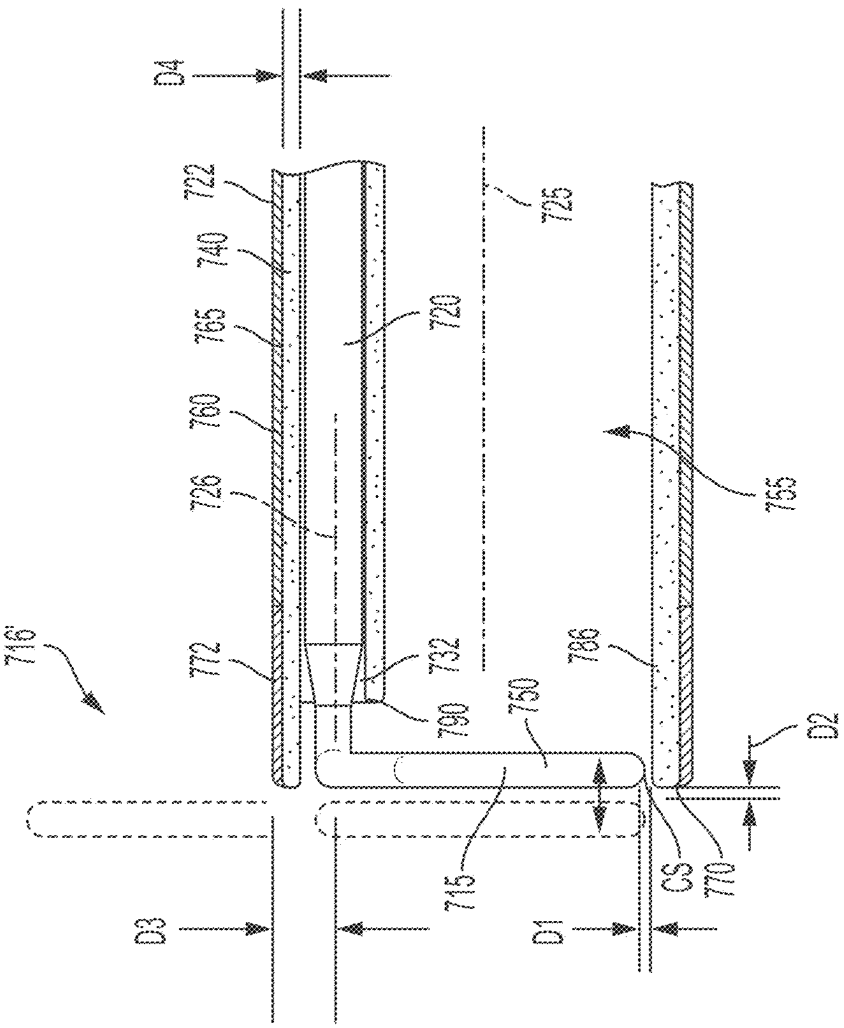

D4
722
740
765
760
726
772
716'
720
725
732
790
750
786
765
D2
715
CS
770
D3
D1

FIG. 22

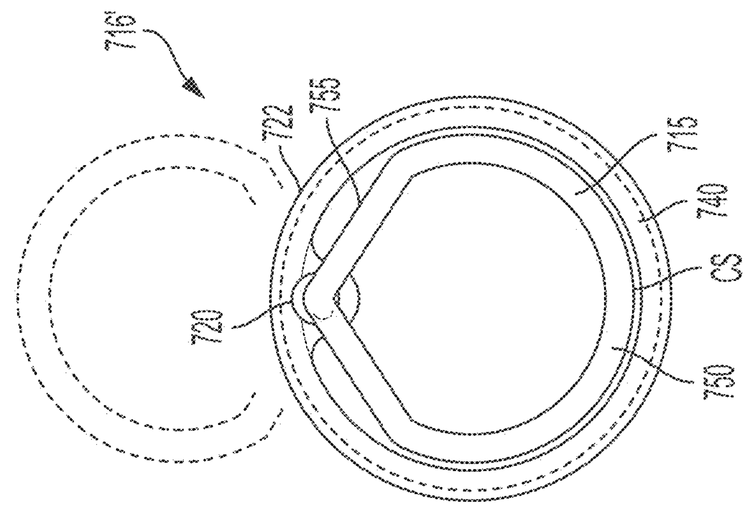

716'
722
755
720
715
740
CS
750

FIG. 21

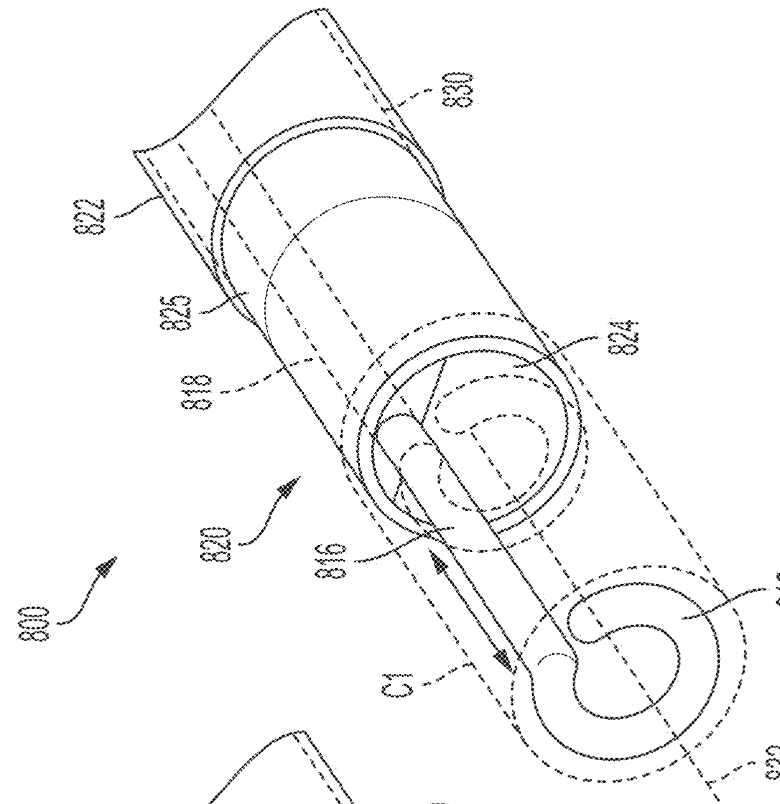


FIG. 23B

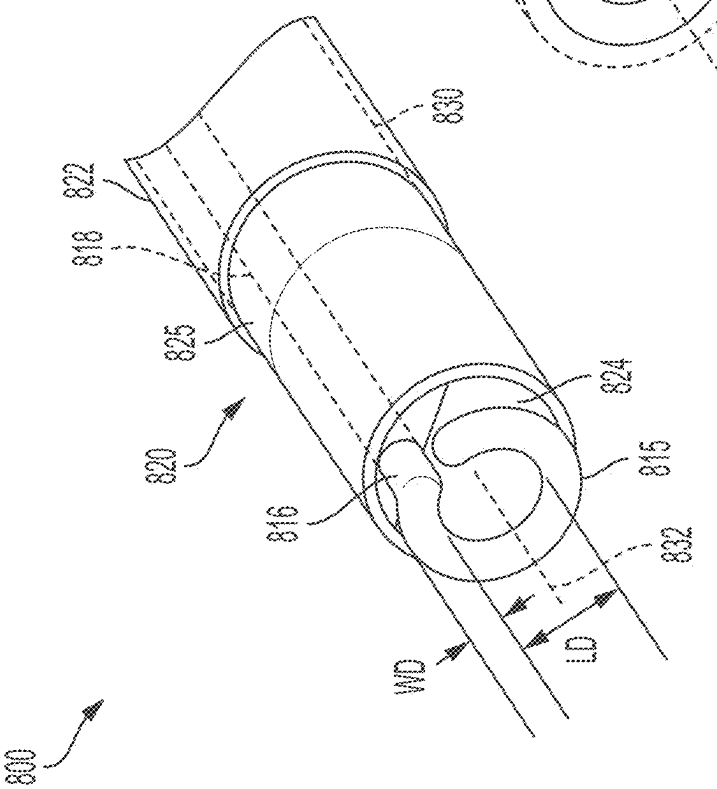


FIG. 23A

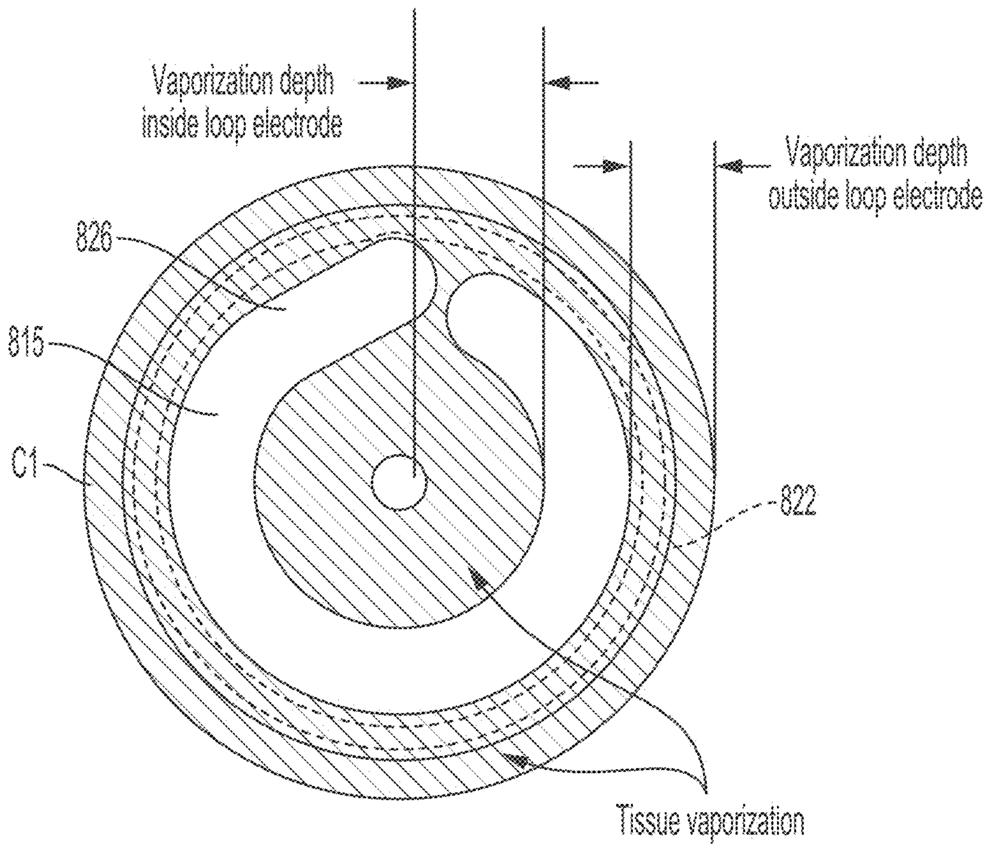

Vaporization depth
inside loop electrode
Vaporization depth
outside loop electrode
826
815
C1
822
Tissue vaporization

FIG. 24

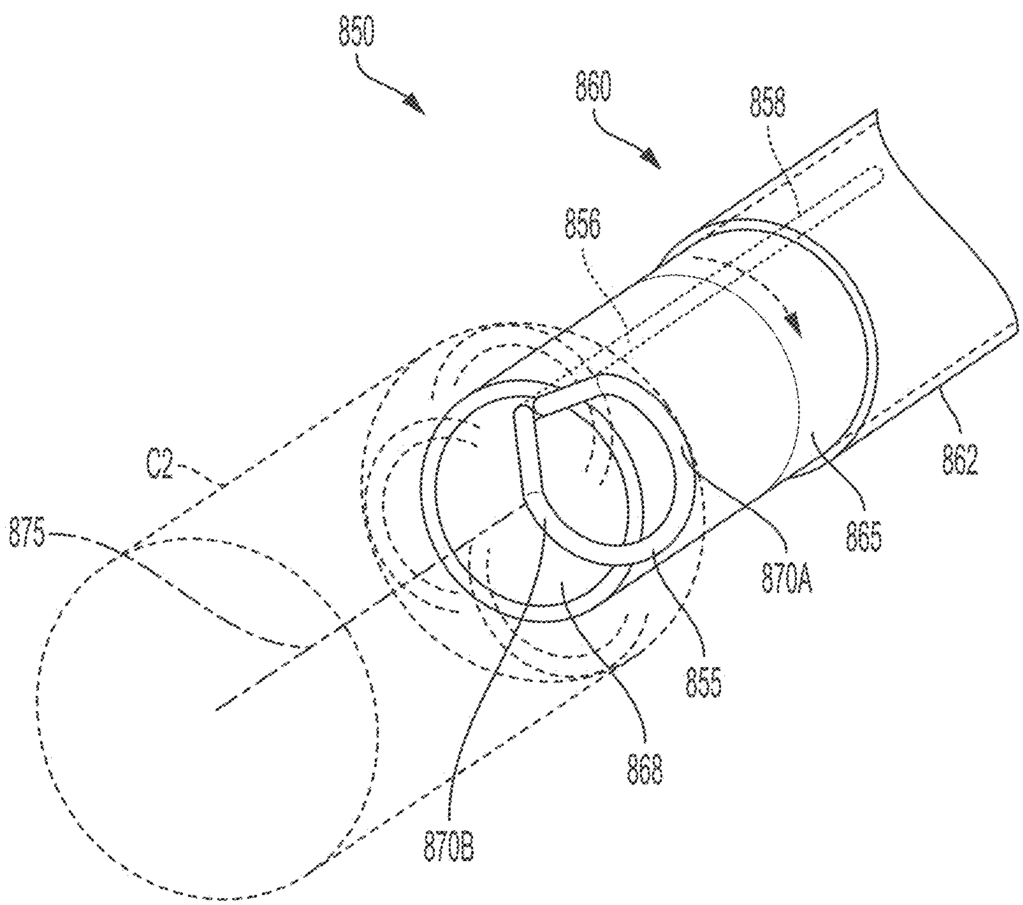


FIG. 25

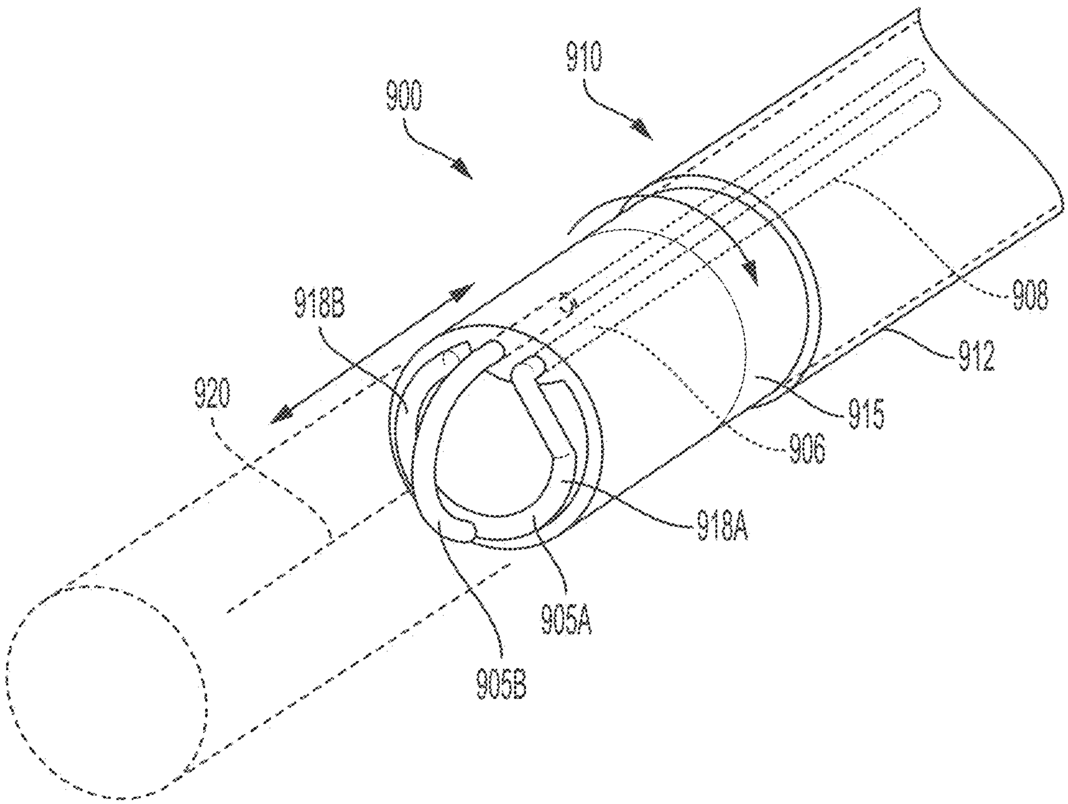


FIG. 26A

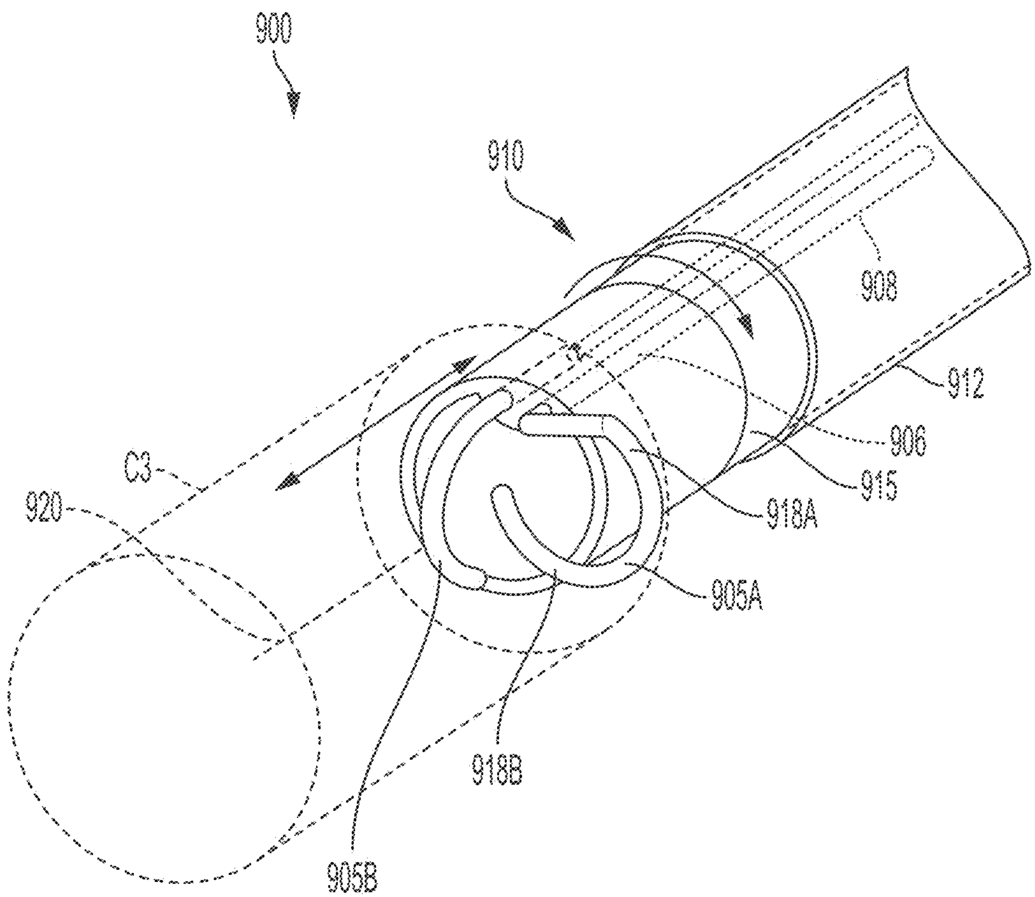


FIG. 26B

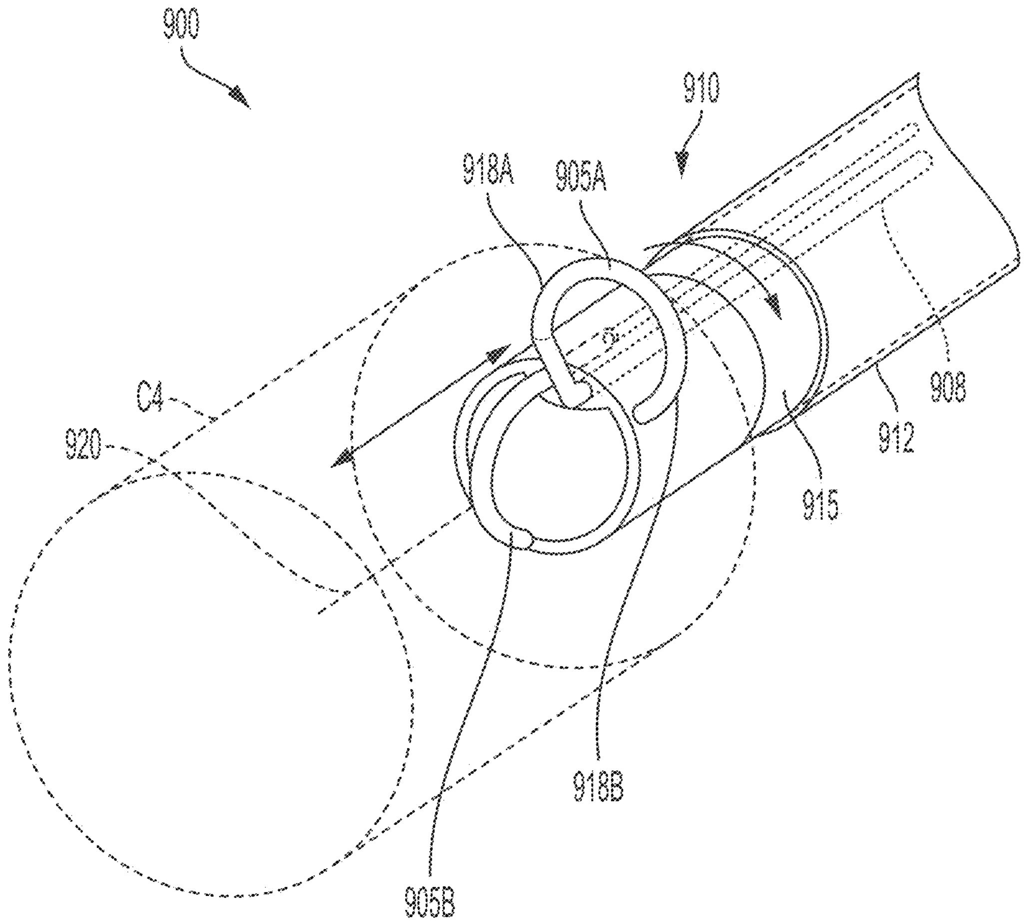


FIG. 26C

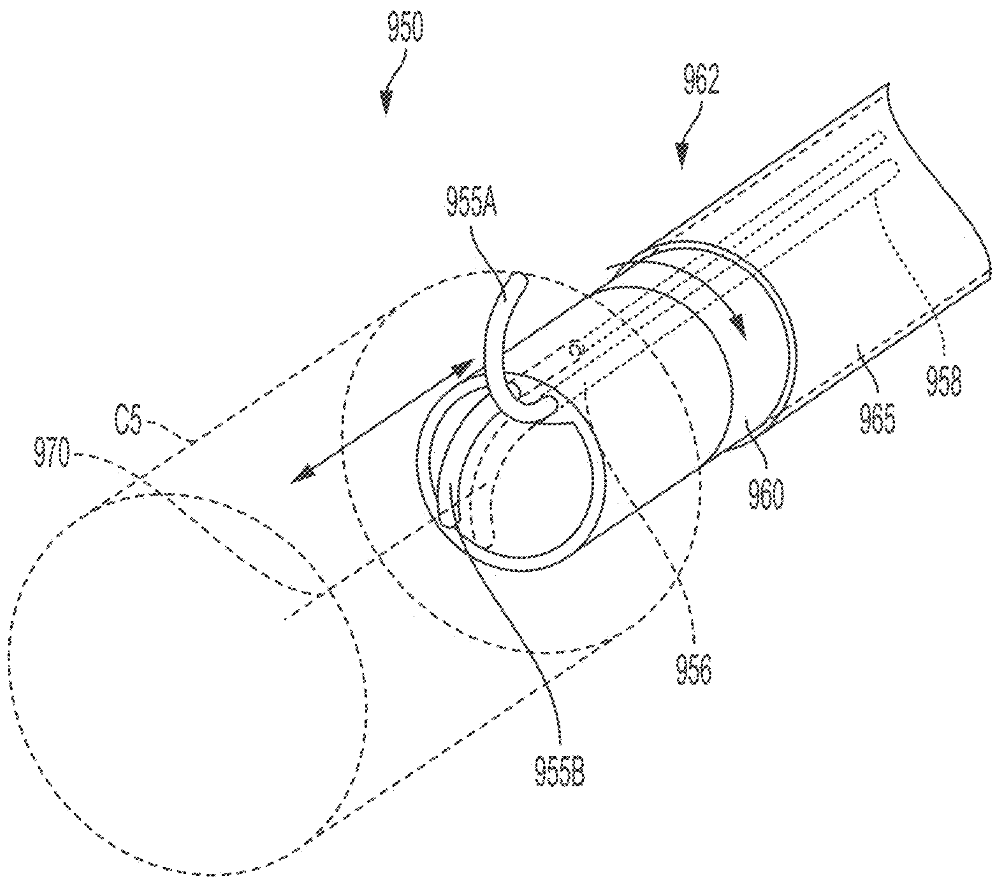


FIG. 27

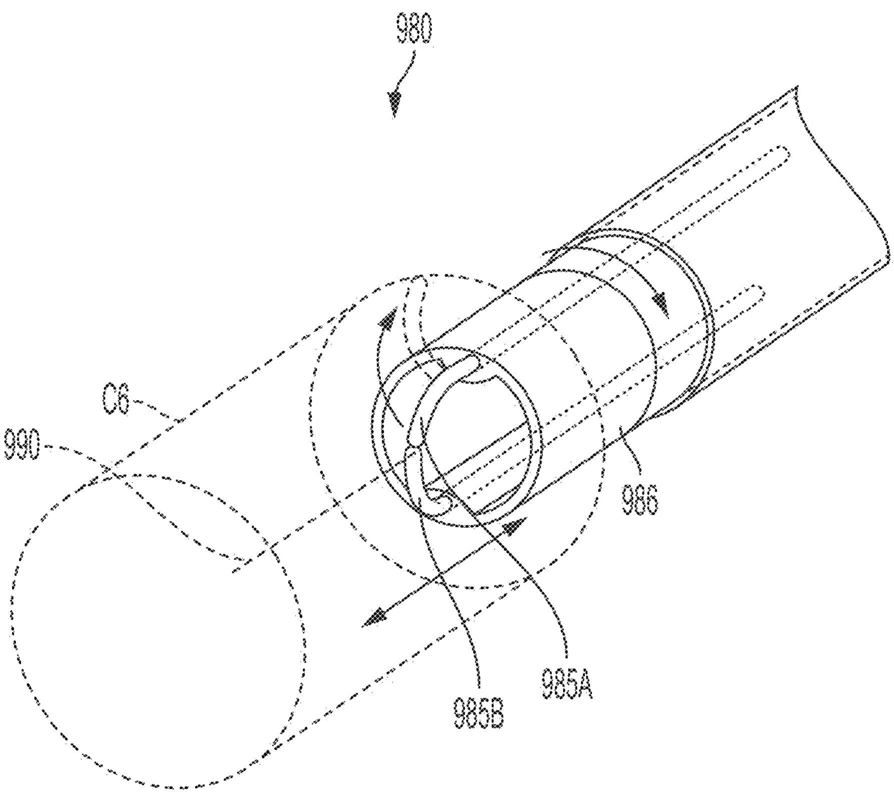


FIG. 28

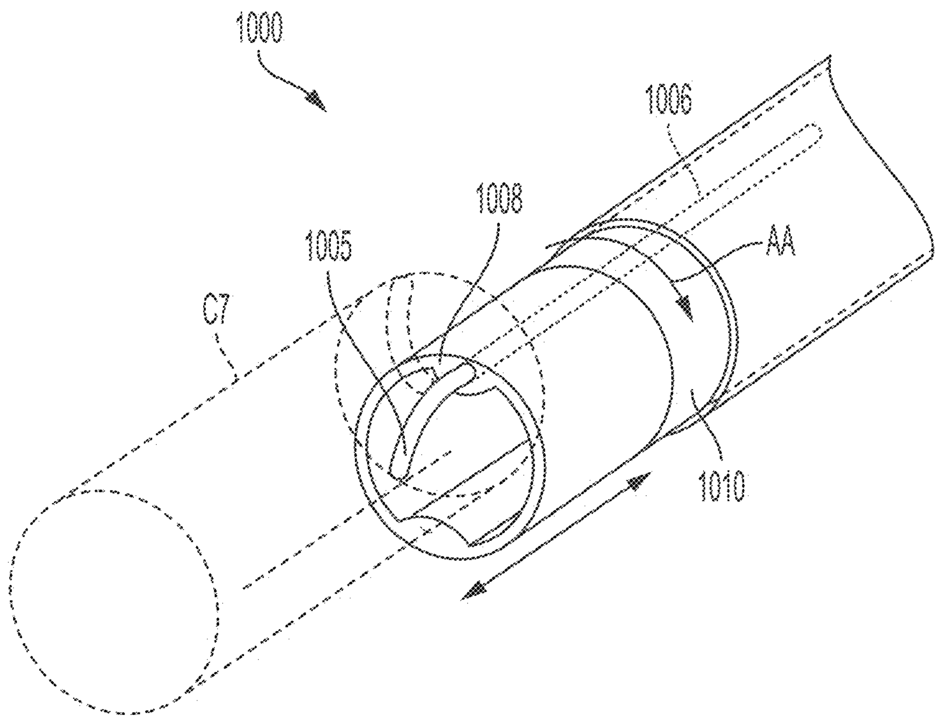
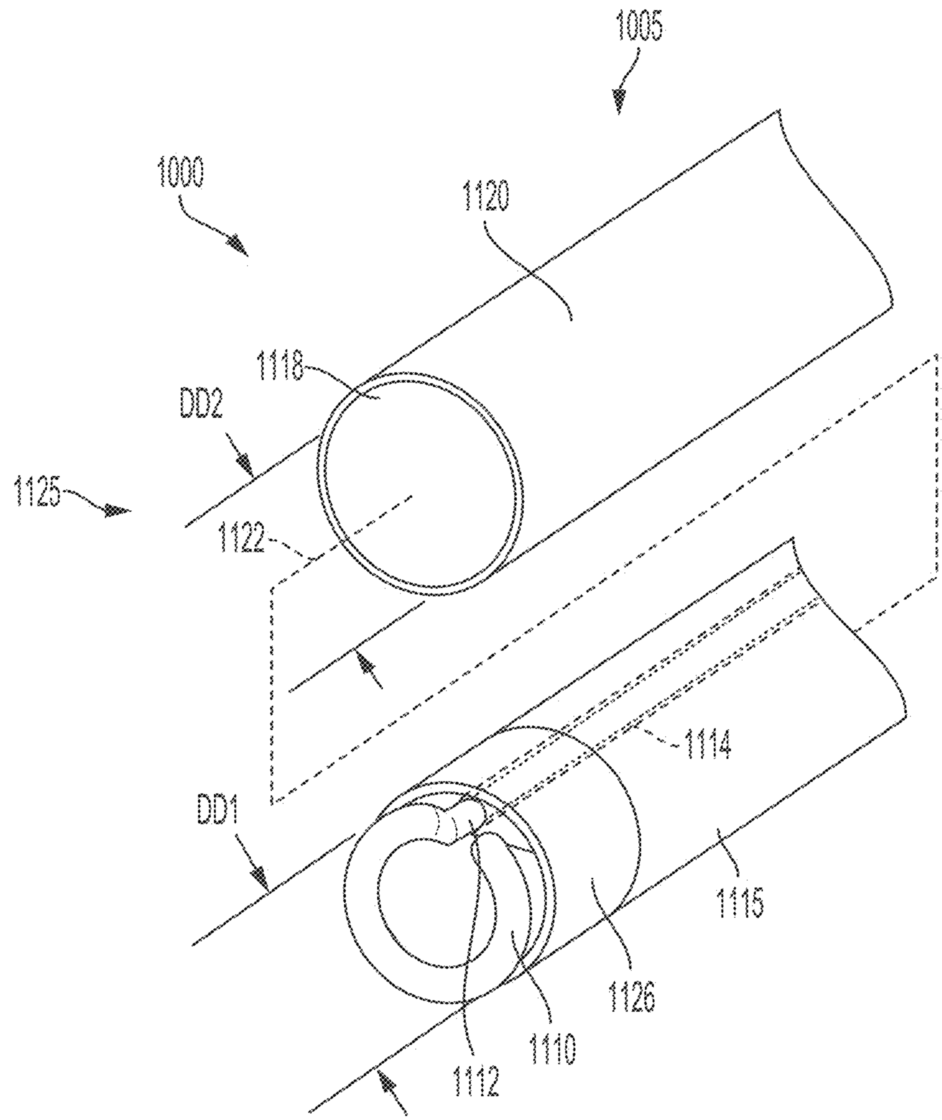


FIG. 29


1005
1000
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DD2
1125
1122
1114
DD1
1115
1126
1110
1112

FIG. 30

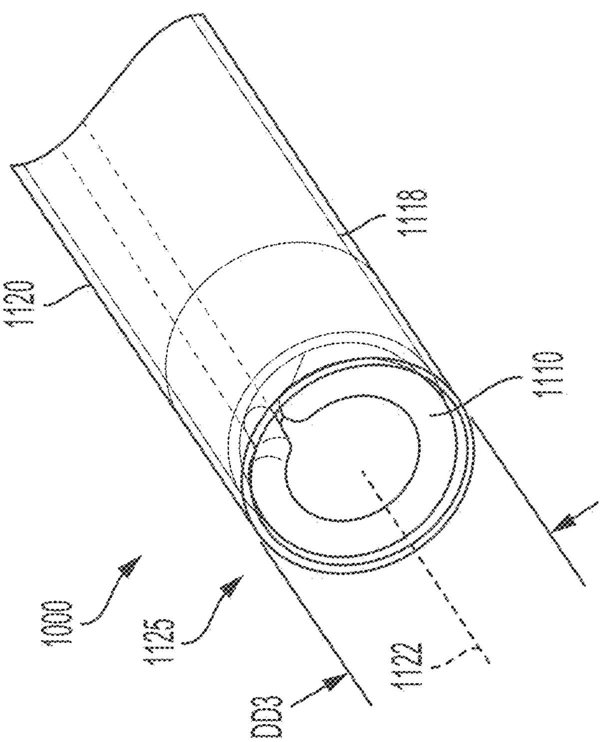


FIG. 31A

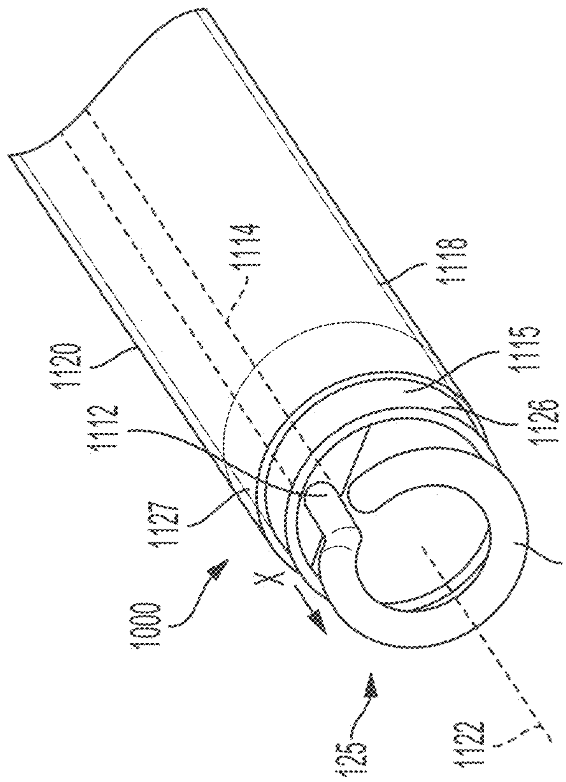


FIG. 31B

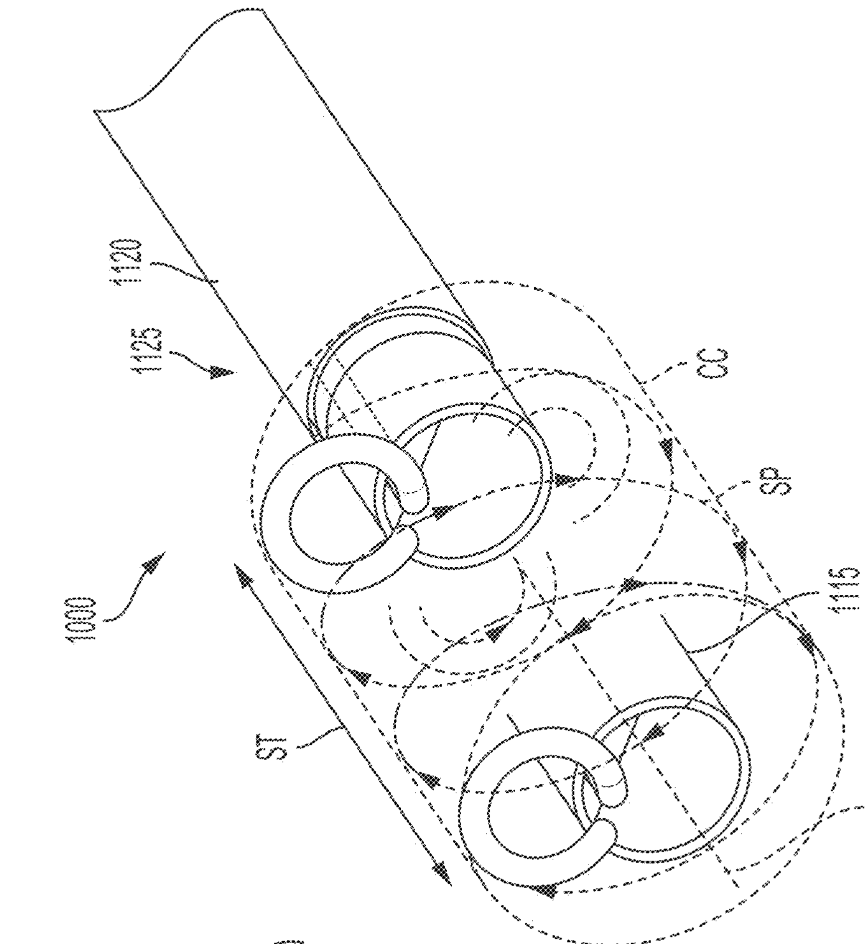


FIG. 31D

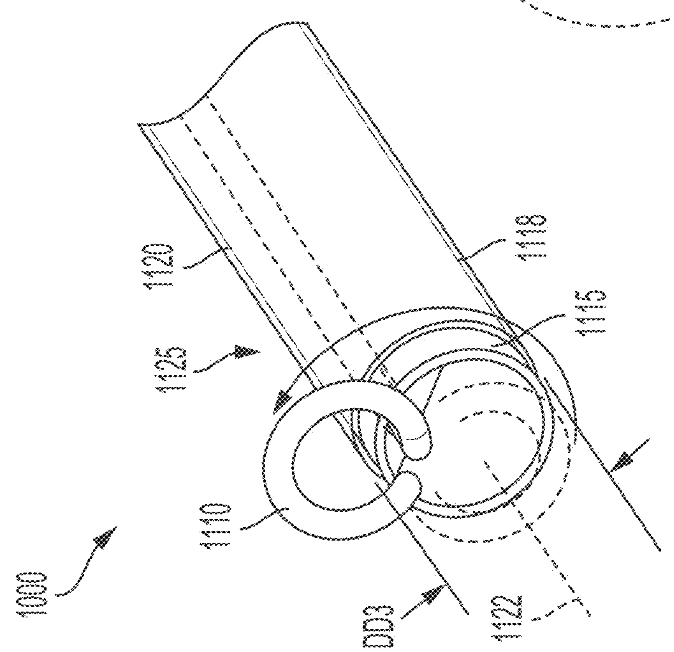
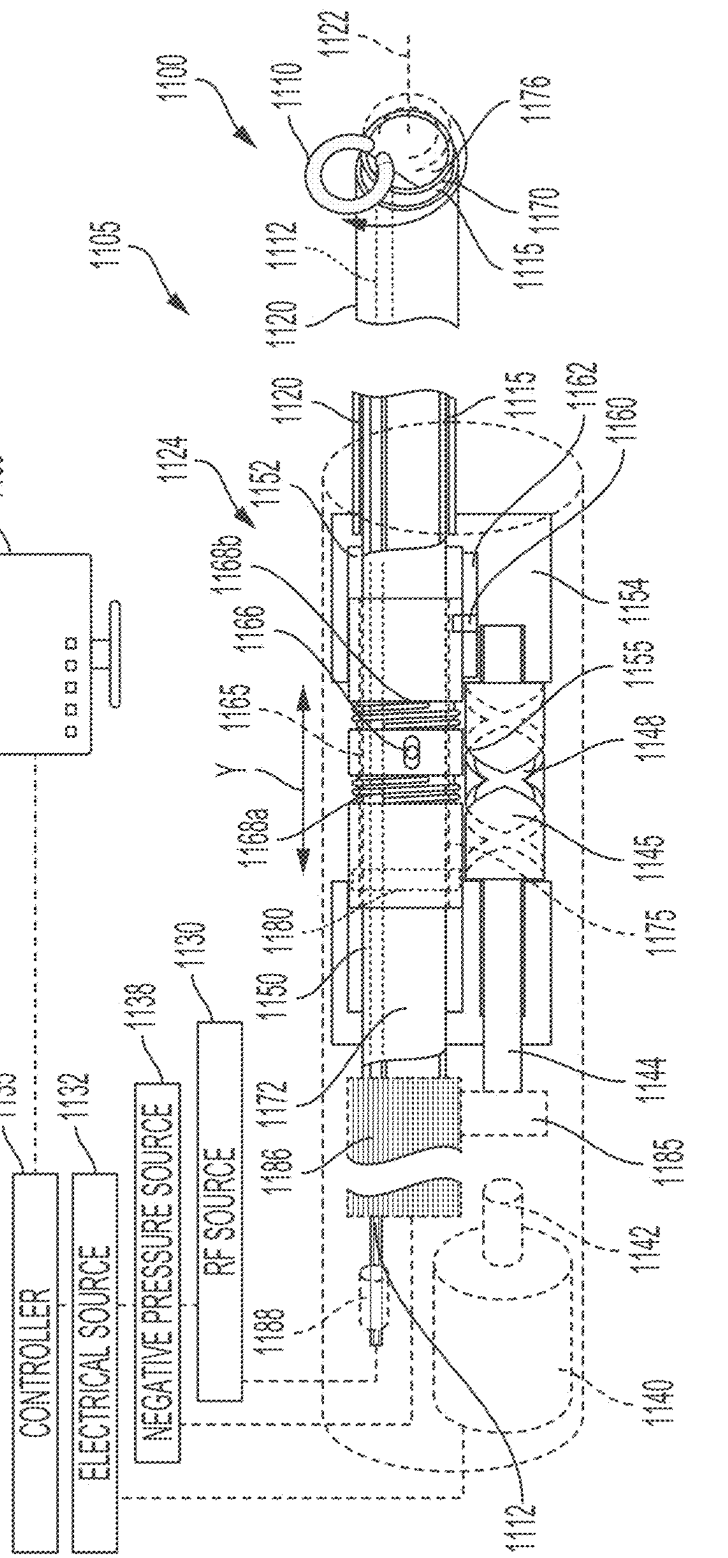


FIG. 31C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1162
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1168b
1166
1165
1148
Y
1168a
1145
1180
1175
1150
1144
1172
1130
RF SOURCE
1138
NEGATIVE PRESSURE SOURCE
1132
ELECTRICAL SOURCE
1135
CONTROLLER
1186
1185
1142
1188
1140
1112

FIG. 32

ELECTROSURGICAL DEVICE AND METHOD OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a non-provisional of U.S. Provisional Application Nos. 63/555,268, filed Feb. 19, 2024, and 63/557,712, filed Feb. 26, 2024, the entireties of which are incorporated by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to bipolar electrosurgical devices and methods of use for cutting tissue, for example, in endoscopic urology and gynecology procedures.

SUMMARY OF THE INVENTION

[0003] Some aspects in accordance with principles of the present disclosure relate to a bipolar electrosurgical device. The electrosurgical device can comprise a handle and a small diameter, elongated shaft adapted for introduction through a working channel of an endoscope. The working end of the device has a form of loop electrode that is extendable outward from the shaft, a selected dimension for cutting tissue at a selected depth.

[0004] For example, a variation of an electrosurgical device include an electrosurgical resection device including: a handle coupled to an introducer member extending about a central axis to a working end, wherein the introducer member has an outer surface that defines an introducer envelope; an electrode shaft, an RF loop electrode carried by the electrode shaft and positioned at the working end extending in a transverse plane that is from 00 to 450 transverse to the central axis; a drive assembly, or deployment mechanism) within the handle and coupled to the electrode shaft, where the drive assembly is configured to be from the handle configured to move the electrode shaft to move the RF loop electrode between a first position within the introducer envelope for introduction into a working space and a second position radially outward from the introducer envelope for resecting tissue.

[0005] Variations of the device and method include a RF loop electrode that is carried at a distal end of an insulative shaft extending through a central passageway in the introducer member,

[0006] Additional variations of the device and method can include a deployment mechanism that is adapted to move the RF loop electrode between the first position and the second position by at least one of rotation of the insulative shaft and lateral movement of the insulative shaft.

[0007] Variations of the deployment mechanism can be further adapted to move the RF loop electrode axially between a distal position and a proximal position in the introducer member.

[0008] The deployment mechanism can be actuated by at least one of a motor drive and manual actuation.

[0009] Variations of the RF loop electrode can include an inflexible wire, or any similar structure.

[0010] In any variation, the RF loop electrode, when in the second position, can be positioned outward of the introducer envelope by at least 1 mm, 2 mm, 4 mm, or any distance therebetween. Unless specifically recited in the claims, the RF loop electrode can be positioned outward of the introducer envelope by any distance.

[0011] In some variations, the present disclosure includes an electrosurgical device further including an RF source coupled to the RF loop electrode, a negative pressure source communicating with the central passageway in the introducer member, a motor drive operatively coupled to the deployment mechanism, and a controller configured to control operating parameters of the RF source, negative pressure source and motor drive.

[0012] Variations of the devices can include including one or more accelerometers carried by the electrosurgical device on any portion of the device, and configured to send signals to the controller relating to movement of the electrosurgical device.

[0013] In some variations, the present disclosure includes an electrosurgical device wherein the introducer member includes an articulating section in the working end that is actuatable from the handle.

[0014] In some variations, the present disclosure includes an electrosurgical device wherein the RF loop electrode includes an active electrode and further including a return electrode carried in the working end.

[0015] In some variations, the present disclosure includes a method of resecting tissue in a working space in a patient, including: providing an introducer having an outer surface that defines an introducer envelope, the introducer extending about a central axis to a working end carrying an RF loop electrode that is moveable between a first position within the introducer envelope and a second position radially outward from a surface of the introducer that defines a selected cutting depth; introducing the working end in the first position through a working channel of an endoscope into the working space; moving the RF loop electrode to the second position; activating the RF loop electrode and translating the RF loop electrode through tissue at the selected cutting depth to thereby cut a tissue strip; and moving the RF loop electrode from the second position to the first position thereby mobilizing the tissue strip.

[0016] Variations of the devices in the present disclosure include a method wherein the RF loop electrode extends in a transverse plane that is from 0 degrees to 45 degrees transverse to a central axis of the introducer in the second position.

[0017] Variations of the methods include selecting the cutting depth by a mechanism in a handle portion of the introducer.

[0018] The methods and devices described herein can include an RF loop electrode that is moved between the first position and the second position in a rotational direction relative to the central axis of the introducer. Alternatively, or in combination, the RF loop electrode is moved between the first position and the second position in a transverse direction relative to the central axis of the introducer.

[0019] The RF loop electrode can be moved between the first position and the second position by at least one of a motor drive and manual actuation.

[0020] In some variations, the present disclosure includes a method wherein the RF loop electrode is translated through tissue by at least one of a motor drive and manual actuation.

[0021] In some variations, the present disclosure includes a method wherein a controller is configured to control movement of the RF loop electrode.

[0022] In some variations, the present disclosure includes a method of sending signals of movement of the introducer or RF loop electrode to the controller using an accelerometer, controlling movement of the RF loop electrode responsive to the signals using the controller.

BRIEF DESCRIPTION OF THE FIGURES

[0023] FIG. **1** is a perspective view of an RF resecting device corresponding to the invention that has a handle connected to an elongate introducer assembly with a bi-polar loop electrode that can be rotatably extended and retracted from the introducer together with a block diagram of a negative pressure source, RF source, and controller operatively coupled to the device.

[0024] FIG. **2** is an enlarged perspective cut-away view of the working end of the RF device of FIG. **1**.

[0025] FIG. **3**A is a perspective view of the working end of the RF device of FIGS. **1** and **2** showing the RF loop electrode in a first retracted position relative to the introducer member of the device.

[0026] FIG. **3**B is another view of the working end of FIG. **3**A showing the RF loop electrode rotated to a position outward from the introducer to provide a first selected cutting depth.

[0027] FIG. **3**C is another view of the working end of FIGS. **3**A-**3**B showing the RF loop electrode rotated outward further to provide a second selected cutting depth.

[0028] FIG. **3**D is a view of the working end of FIGS. **3**A-**3**C showing the RF loop electrode rotated outward further to provide a third selected cutting depth.

[0029] FIG. **4** is a partly sectional side view of the working end of the device of FIGS. **1** to **3**D showing the loop electrode rotatable in a transverse plane relative to the introducer axis.

[0030] FIG. **5** is a side view of another variation of a working end showing an RF loop electrode that is rotatable outward from an introducer, with the form of the electrode defining a non-transverse plane relative to the introducer axis.

[0031] FIG. **6** is a perspective view of another variation of a working end of an RF device wherein the RF loop electrode is rotatable outward from a slot in the introducer.

[0032] FIG. **7**A is a schematic view of an initial step in the method of use for resecting a bladder tumor wherein an endoscope is introduced into a patient's bladder, followed by advancing the RF resecting device of FIG. **1** through a working channel of the endoscope, articulating the working end of the RF device and rotating the loop electrode outward from the introducer to provide a selected cutting depth.

[0033] FIG. **7**B is an enlarged view of a subsequent step of the method of use wherein the RF loop electrode is energized, and the physician cuts a path into the targeted tissue with a margin around the tumor.

[0034] FIG. **7**C is a view of another subsequent step of the method wherein the energized RF loop electrode cuts a path under the tumor as the physician moves the working end.

[0035] FIG. **7**D is a view of the final step of the method wherein the energized RF loop electrode has cut a path fully under the tumor, and the physician rotates the energized loop electrode outwardly to cut, resect and mobilize the tissue chip.

[0036] FIG. **8** is a perspective view of another variation of an RF resecting device with a handle connected to an elongate introducer assembly wherein a bi-polar loop electrode is configured for lateral movement outward from the introducer using a cam mechanism together with a block diagram of a negative pressure source, RF source, electrical source, and controller operatively coupled to the device.

[0037] FIG. **9** is an exploded view of the working end of the RF device of FIG. **8**, showing the RF loop electrode assembly and components of the cam mechanism for deploying the RF loop electrode.

[0038] FIG. **10**A is a transparent perspective view of the working end of FIGS. **8** and **9** with the RF loop electrode in a retracted position.

[0039] FIG. **10**B is a transparent view of the working end of FIG. **10**A with the RF loop electrode in a laterally extended position.

[0040] FIG. **11**A is a sectional view of the working end of FIGS. **8** and **9** with the RF loop electrode in a retracted position.

[0041] FIG. **11**B is a sectional view of the working end of FIG. **11**A with the RF loop electrode in a partially extended position outward from the introducer.

[0042] FIG. **11**C is a sectional view of the working end of FIGS. **11**A-**11**B with the RF loop electrode in a fully extended position outward from the introducer.

[0043] FIG. **12** is a perspective view of another variation of an RF resecting device with an elongate introducer carrying a bi-polar loop electrode together and an accelerometer in the handle coupled to a controller and motor drive for moving the loop electrode in response to signals from the accelerometer.

[0044] FIG. **13**A is a schematic view of an initial step in an endoscopic method of using the resecting device of FIG. **12** in a fibroid resection procedure.

[0045] FIG. **13**B is a subsequent step of the method of FIG. **13**A showing advancement of the resecting device through a working channel of an endoscope and rotation outward of the loop electrode from the introducer member to a cutting position.

[0046] FIG. **13**C is an enlarged view of a subsequent step of the method wherein the energized RF loop electrode cuts a path into tissue as the physician moves the working end.

[0047] FIG. **13**D is the final step of the method wherein the energized RF loop electrode has cut a path under a strip of tissue, and the accelerometer signals the motor drive to rotate the loop electrode to fully resect and mobilize the tissue strip.

[0048] FIG. **14** is a perspective view of another variation of an RF resecting device with a deployable bi-polar RF loop electrode deployable from a window in the introducer member wherein a motor drive is configured to move the loop electrode outward, inward, and axially in the window.

[0049] FIG. **15**A is a schematic view of an initial step in using the resecting device of FIG. **14**, preparing to cut into tissue with a deployed, energized RF loop electrode.

[0050] FIG. **15**B is a subsequent step of the method of FIG. **15**A, wherein the energized RF loop electrode is motor-driven to cut an elongated path in tissue as the physician holds the working end in a stable position.

[0051] FIG. **15**C is a subsequent step of the method of FIGS. **15**A-**15**B, wherein the motor drive rotates the energized RF loop electrode to fully resect a strip of tissue and then return the de-energized loop electrode to a default position.

[0052] FIG. **16** is a perspective view of another variation of an RF resecting device with a working end carrying a deployable bi-polar loop electrode wherein the working end is motor-driven to axially reciprocate in an outer sleeve coupled to a handle.

[0053] FIG. **17** is a perspective view of another variation of an RF resecting device with a working end carrying a deployable bi-polar loop electrode wherein the introducer member comprises an extrusion of a polymeric material partly surrounded by a thin-wall metal sleeve.

[0054] FIG. **18** is an exploded view of the components of working end of the device of FIG. **17**.

[0055] FIG. **19** is an enlarged perspective view of a working end similar to that of FIG. **17**.

[0056] FIG. **20** is a perspective view of a variation of an RF loop electrode.

[0057] FIG. **21** is an end view of a working end similar to that of FIG. **19**.

[0058] FIG. **22** is a cut-away view of the working end of FIG. **21**.

[0059] FIG. **23**A is a perspective view of another variation of a working end of an RF resecting device carrying an axially-extendable RF loop electrode.

[0060] FIG. **23**B is a perspective view of the working end of FIG. **23**A with the RF loop extended distally from an introducer sleeve illustrating the dimension of a tissue core than can be when the electrode is extended axially.

[0061] FIG. **24** is an end view of the working end of FIGS. **23**A and **23**B.

[0062] FIG. **25** is a perspective view of another variation of a working end of an RF resecting device with an RF loop electrode that is rotatable outward from the introducer sleeve and the introducer sleeve is axially-extendable.

[0063] FIG. **26**A is a perspective view of another variation of a working end of an RF resecting device with an RF loop electrode that is rotatable outward from the introducer sleeve and a secondary fixed electrode with the introducer sleeve being axially-extendable and rotatable.

[0064] FIG. **26**B is a view of the working end of FIG. **26**A with the RF loop electrode rotated outward approximately 90° illustrating the dimension of a tissue core that can be cut when the introducer sleeve is extended axially.

[0065] FIG. **26**C is another view of the working end of FIGS. **26**A and **26**B with the RF loop electrode rotated outward approximately 180° illustrating the dimension of a tissue core that can be cut when the introducer sleeve is extended axially.

[0066] FIG. **27** is a perspective view of another variation of a working end of an RF resecting device with a first arc-shaped electrode that is rotatable outward from the introducer sleeve and a secondary fixed electrode wherein the introducer sleeve is axially-extendable and rotatable to cut a core in tissue.

[0067] FIG. **28** is a perspective view of another variation of a working end of an RF resecting device with a first arc-shaped electrode that is rotatable outward from the introducer sleeve and a second arc-shaped fixed electrode wherein the introducer sleeve is axially-extendable and rotatable to cut a core in tissue.

[0068] FIG. **29** is a perspective view of another variation of a working end of an RF resecting device with a single arc-shaped electrode that is rotatable outward from the introducer sleeve wherein the electrode is rotatable by a motor drive and the introducer sleeve is axially-extendable and rotatable to cut a core in tissue.

[0069] FIG. **30** is a perspective view of another variation of a working end of an RF resecting device with the cutting sleeve de-mated from the outer introducer sleeve.

[0070] FIG. **31**A is a perspective view of the working end of FIG. **30** with the RF loop electrode in a first position retracted into the bore of the outer introducer sleeve.

[0071] FIG. **31**B is a view of the working end of FIG. **31**A with the RF loop electrode in a second position with the cutting sleeve and/or RF loop electrode extended distally from the bore of the introducer sleeve.

[0072] FIG. **31**C is a view of the working end of FIG. **31**B with the RF loop electrode rotated outwardly to a cutting position outward of the introducer envelope.

[0073] FIG. **31**D is a view of the working end of FIG. **31**C illustrating a motor-driven spiral cutting path of the RF loop electrode to resect a cylindrical core in tissue.

[0074] FIG. **32** is a schematic view of a handle of the resecting device of FIGS. **31**C-**31**D.

DETAILED DESCRIPTION

[0075] FIGS. **1** and **2** illustrate an electrosurgical tissue resecting device **100** comprising a handle **106** coupled to an elongated introducer member **110** extending about central axis **112** and having a diameter of 3 mm to 10 mm. The length of the introducer **110** can be highly elongated and suited for introduction through the working channel of an endoscope **114** (see FIG. **5**A). In a variation, the introducer member **110** has a working end **115** shown in FIG. **2** carrying an RF active loop electrode **120** that is extendable outwardly by a deployment mechanism to be positioned outward of the cylindrical introducer envelope **122** of the introducer member **110**. A distal portion of the working end **115** has an electrically insulative coating **124**, with the adjacent proximal portion comprising a return electrode **125**.

[0076] In the variation of FIG. **1**, the RF resecting device **100** is operatively connected to a remote RF source **130** that is coupled to the active and return electrodes **120** and **125**, a negative pressure source **135** that communicates with an interior passageway **136** in the introducer **110** (FIG. **2**). The controller **140** is adapted to control the operating parameters of the RF source **130** and the negative pressure source **135**.

[0077] The variation of FIG. **1** has an introducer member **110** with an articulating or deflecting section **142** in the working end **115**, shown in more detail in FIG. **2**. Typically, the deflectable section comprises an assembly of co-axial thin-wall slotted sleeves with outer sleeve **144*a*** and inner sleeve **144*b*** shown in the cut-away view of FIG. **2**. Such slotted sleeve assemblies are known in the art, for example, as shown in U.S. Pat. No. 10,058,336 by Truckai et al., issued Aug. 28, 2018. The slotted sleeves **144*a*** and **144*b*** are fixed to one another with weld W (FIG. **2**) at the distal end of the assembly, and the inner slotted sleeve **144*b*** can be moved axially relative to the outer slotted sleeve **144*a*** to deflect the deflectable section **142** as shown in dashed lines in FIG. **1** between left and right deflections indicated at L and R. A thin-wall flexible polymeric sleeve **148** encases the slotted sleeve assembly and is shown as a dashed line in FIG. **2**. In this variation, a rotatable hub **150** at the proximal end of the introducer member **110** adjacent the handle **106** is rotated clockwise or counter-clockwise to deflect the working end **115** in the left and right deflections, L and R, as shown in FIG. **1**. The rotatable hub **150** is operatively coupled to a proximal end to the inner sleeve **144*b*** within the handle **106** with a helical coupling so that rotation of the hub

150 moves the inner sleeve axially relative to axis **112** in either the proximal or distal direction to deflect the working end as shown in FIG. **1**.

[0078] FIG. **2** further illustrates the components coupled to the moveable loop electrode **120** carried by the working end **115**. The active loop electrode **120** extends distally from the distal end **138** of a rotatable, electrically insulated electrode shaft **145** that is carried within the interior passageway **136** of the introducer member **110**. The electrode shaft **145** extends entirely through the passageway **136** to the handle **106** and is rotatable by a rotation mechanism that is further described below. The loop electrode **120** has first and second electrical leads **152***a* and **152***b* that extend through the electrode shaft **145** to the handle **106** and are coupled by an electrical cable **154** to the RF source **130** (FIG. **1**). The electrode shaft **145** is configured with a flexible section **155** extending through the deflecting section **142** of the introducer **110** that comprises that a flexible drive shaft as known in the art. Such a flexible drive shaft can comprise a helical spring member, as is known in the art of flexible drive shafts. The electrical leads **152***a*, **152***b* within the electrode shaft **145** are small diameter insulated wires and are flexible. The electrode shaft **145** is rotatable within a plurality of collars fixed in the walls of introducer member **110** with collars **158***a* and **158***b* shown in FIG. **2**. A plurality of such collars may be spaced apart in the passageway **136**. The rigid portions of the introducer member **110** may have a continuous bore that carries the electrode shaft **145** in a wall of the inner sleeve **144***b*. As can be understood from FIGS. **1** and **2**, the rotatable electrode shaft **145** has an off-center axis **160** that is offset from and parallel to the central axis **112** of the introducer member **110**. Thus, it can be understood that rotation of the off-center electrode shaft **145** around axis **160** will rotate the loop electrode **120** from a first position within the cylindrical introducer envelope **122** of the introducer member **110** to selected other positions where the loop electrode **120** is positioned outward of the cylindrical introducer envelope **122** as shown in FIGS. **2** and **3**B-**3**D. In FIG. **1**, it can be seen that an actuator arm **162** is coupled to the electrode shaft **145** and is moveable in an arc in slot **163** in the handle to move the loop electrode **120** radially outwardly and inwardly. As can be seen in FIG. **1** the handle **106** can include markings **165** near the slot **163**, indicating the position of the electrode **120**. An actuator or power button **170** is provided in the handle **106** to energize the RF loop electrode **120** as described below in a method of use.

[0079] Referring again to FIG. **2**, the distal portion of the outer sleeve **144***a* has the electrically insulative coating **124** that can comprise a polymeric or ceramic layer. In another variation, the distal portion of the outer sleeve **144***a* can be dipped in an epoxy to provide the insulative coating **124**. The insulative coating **124** is adapted to space apart the RF loop electrode **120** from the return electrode **125**, which can comprise exposed portions of the outer sleeve **144***a*. In FIG. **2**, it also can be seen that the inner sleeve **144***b* may only extend within the outer sleeve **144***a* distally beyond the deflecting section **142** to the region of weld **144**. Thus, the distalmost section of working end **115** would comprise only the outer sleeve **144***a*. Accordingly, the diameter of the electrode shaft **145** may have a smaller diameter portion **166***a* in the introducer section having both outer and inner sleeves **144***a*, **144***b* and a slightly large diameter portion **166***b* in the distalmost section of the working end **115** that comprises only the outer sleeve **144***a*.

[0080] FIGS. **3**A-**3**D are enlarged views of the working end **115** of the device **100** with the loop electrode **120** in various deployed positions with FIGS. **3**B top **3**D showing the electrode rotated outwardly from the introducer member **110** by the rotatable deployment mechanism. In FIG. **3**A, the loop electrode **120** is in a first 0° position or introducer position where the electrode **120** does not extend outside the envelope **122** of the introducer and thus is configured for introduction through the working channel of an endoscope **114** (FIG. **6**A). FIG. **3**B shows the electrode shaft **145** after being rotated approximately 60° wherein the RF loop electrode **120** at its maximum outward point now extends outwardly of the introducer surface a dimension indicated as D**1**, which can be from 1 mm to 3 mm in this variation. Now, turning to FIG. **3**C, the electrode shaft **145** is shown after being rotated by about 120° from the initial 0° position, where the depth of cutting depth of the RF loop electrode **120** is indicated at D**2**, which can be from 2 mm to 5 mm in this variation. FIG. **3**D shows electrode shaft **145** after being rotated 180° from the initial 0° position, where the cutting depth of the RF loop electrode **120** is indicated at D**3**, which can be from 3 mm to 6 mm in this variation.

[0081] FIG. **4** is a side view of the working end **115** of FIGS. **2** and **3**A-**3**D showing the RF loop electrode **120** angled from the electrode shaft **145** in a transverse direction or 90° direction from the axis **160** of the electrode shaft. When rotated as shown in FIGS. **3**B-**3**D, the RF loop electrode **120** in all resecting positions rotates in a transverse plane P, as shown in FIG. **4**.

[0082] FIG. **5** is a side view of a variation of a working end **115'** that has an RF loop electrode **120'** extending in plane P' away from the electrode shaft **145** in a non-transverse angle in a range between 45° and 90° away from axis **160** of the electrode shaft **145**. Thus, the scope of the invention and method of the invention includes an RF loop electrode that can be moved outward from the introducer envelope **122** and define a transverse plane P (FIG. **4**) or a non-transverse plane P' as in FIG. **5** that is less than 90° but more than 45° relative to axis **160** of the electrode shaft **145** or the parallel axis **112** of the introducer member **110**. In FIG. **5**, the loop electrode **120'** also is extendable and retractable in the interior passageway **136** in the first non-rotated position with collar **158***a*' moved proximally in the passageway **136**.

[0083] FIG. **6** illustrates another variation of a working end **175** that is similar to the working end **115** of FIGS. **1** to **4** described previously, except the variation of FIG. **6** is configured with a loop electrode **180** that rotates out of a slot **182** in an outer sleeve **185** that has a closed tip **188**. In all other respects, the variation of FIG. **6** operates the same as the variation of FIGS. **1** to **4**.

[0084] Now, turning to FIGS. **7**A-**7**D, a method of the invention, is shown in an exemplary procedure of introducing the resecting device **100** of FIGS. **1** to **4** into a patient's bladder **200** to resect a bladder tumor **202**. FIG. **7**A shows an endoscope **114** being introduced into the patient's bladder **200** with saline SA introduced through the endoscope and within the bladder to distend the bladder as is known in the art. The introducer member **110** of the tissue resecting device **100** is introduced through the working channel of endoscope **114**, wherein the field of view FOV of the image sensor **205** allows for viewing targeted tissue T of the bladder wall **206** and the bladder tumor **202**. FIG. **7**A further shows the working end **115** of the resection device **100** being articulated and the RF loop electrode **120** being moved into a cutting position outward of the outer surface **210** of the articulated introducer member **110**, which can be any selected cutting depth as shown in FIGS. **3**B to **3**D that is determined by observations of the tumor **202** by the physician. The working end **115** is articulated to an angled position that is suited for alignment with the portion of the bladder wall **206** that has the tumor **202**. The articulation of the working end **115** and the outward movement of the loop electrode **120** are accomplished by the physician moving the actuators in the handle **106** as described above (FIGS. **1** and **2**).

[0085] As an example. FIG. **7**B shows that the physician has selected a cutting depth as in FIGS. **3**B to **3**D, and the cutting depth is approximately the estimated depth of the tumor **202**. In FIG. **7**B, the physician then activates the RF loop electrode **120** by pressing power button **170** in the handle (FIG. **1**) and cuts a path **215** into the bladder wall **206** near the tumor **202** until the surface **210** of the introducer member **110** is pressed against the bladder wall. In FIG. **7**B, it can be understood that the physician translates the working end **115** in a proximal direction over the targeted tissue T, which includes a margin around the tumor **202** wherein the loop electrode **120** starts to cut a tissue chip **218** at the selected depth.

[0086] FIG. **7**C illustrates a subsequent step wherein the physician translates the working end **115** further over the targeted tissue T with the loop electrode **120** cutting through or under the tumor **202** to further cut the tissue chip **218** and provide a margin on the opposing side of the tumor. Thus, in FIG. **7**C, the physician has cut a path **215** completely under the bladder tumor **202**. FIG. **7**D then shows the physician rotating the RF loop electrode **120** from the outward cutting position toward the 0° position of FIG. **3**A to thereby cut off the tissue chip **218** so that the tissue chip is entirely mobilized. The tissue chip **218** then may be extracted from the bladder **200** by suction through the interior passageway **136** in the introducer member **110** or by other means.

[0087] In FIGS. **7**B to **7**D, the resection of such a bladder tumor **202** is shown in a single cut with the RF loop electrode **120**. It should be appreciated that in a typical procedure, the steps of the method shown in FIGS. **7**B-**7**D can be repeated a number of times with suitable lesser cutting depths to resect a tumor with suitable margins.

[0088] Now, turning to FIG. **8**, another variation of a resecting device **400** is shown, which is similar to the device **100** of FIGS. **1** and **2**, except the resecting device **400** has an RF loop electrode **405** that can be actuated to move outward from the introducer member **410** in a transverse direction by means of a cam mechanism described below. In FIG. **8**, it can be seen that the resecting device **400** has a handle **416** coupled to the elongate introducer member **410** extending about longitudinal axis **418** to a working end **420**. The working end **420** has a closed tip **422** as in the variation of FIG. **6** but could have an open end as in the variation of FIGS. **1** and **2**. The RF active electrode **405** is movable outward from a partly circumferential slot **425** in the outer sleeve **428** of the working end **420**. The resecting device **400** again is coupled to RF source **130**, negative pressure source **135**, and controller **140**, as described above.

[0089] FIG. **9** is an exploded and partly transparent view of a distal portion of the introducer member **410**, showing components of the cam mechanism that is adapted for moving the RF loop electrode **405** inward and outward from the introducer member **410**. In FIG. **9**, it can be seen that the RF loop electrode **405** is carried at the distal end **438** of an electrode shaft **440** that extends through a passageway **446** in the introducer member **410** to the handle **416** (FIG. **8**). The introducer member **410** has a rotatable hub **450** that is adapted for articulating the articulating section **452** (FIG. **8**) as described in the previous variation.

[0090] FIG. **9** shows that the outer sleeve **428** of the introducer member **410** is configured with the partly circumferential slot **425** from which the RF loop electrode **405** can be extended outwardly and retracted inwardly. The introducer member **410** further has axial slots **454***a* and **454***b* that are dimensioned to receive axial movement of the RF loop electrode **405** when the electrode has been moved to an outward cutting position. The distal section of the outer sleeve **428** has an insulative coating **455**, as described in the previous variation.

[0091] In FIG. **9**, it can be seen that a cam mechanism comprises an elongated shaft **460** that extends from the handle **416** to a distal wedge-shaped member **462** with an angled cam surface **465**. The wedge-shaped member **462** is adapted to slide axially in a slot in the electrode shaft **440**. It can be understood that when the wedge-shaped member **462** with its angled cam surface **465** is moved in the distal direction, the cam surface **465** will contact the adjacent surface **466** of electrode shaft **440** and move the loop electrode **405** transverse relative to the axis **418** of the introducer member **410**. In FIG. **8**, it can be seen that a slider grip **470** in the handle **416** is coupled to the elongated shaft **460** and is adapted to slide in slot **472** in the handle **416** to move the cam surface **465** distally to thereby move the RF loop electrode **405** outwardly from the introducer member **410**. The handle **416** further includes indicators **475** at various positions of the slider grip **470**, which correspond to different cutting depths of the RF loop electrode **405** as it extends outwardly from the surface **476** of the introducer member **410**.

[0092] Now, turning to FIG. **10**A, a transparent view of the working end **420** is shown with the elongate shaft **460** and cam surface **465** in a proximal position with the electrode shaft **440** and RF loop electrode **405** in a corresponding retracted position within the envelope of the introducer member **410**. FIG. **10**B shows the elongate shaft **460** and cam surface **465** in a distal extended position, which moves the electrode shaft **440** upwardly and the loop electrode **405** outwardly from the slot **425** in the introducer member **410**. It can be understood that the loop electrode **405** can be extended outwardly from slot **425** in any selected dimension and maintained in such a position during use for any selected cutting depth.

[0093] Another aspect of the invention is shown in FIGS. **8** and **10**B and comprises a motor drive **480** carried in handle **416** that is adapted to reciprocate the assembly of the electrode shaft **440** and the elongate shaft **460** carrying the cam surface **465**. As can be seen in FIG. **10**B, the loop electrode **405** can be reciprocated in axial slots **454***a* and **454***b* in the introducer member **410**. Thus, a method of use allows the physician (i) to articulate the working end **420** as needed for a procedure, (ii) then energize the RF loop electrode **405** and press it into targeted tissue to cut a path, (iii) then maintain the working end **420** in a fixed location pressed against the targeted tissue, and (iv) then actuate the motor drive **480** to reciprocate the loop electrode **405** back and forth to cut an underlying path in the targeted tissue similar to that shown in FIGS. **6**B and **6**C. Thereafter, the physician can lift the loop electrode **405** away from the targeted tissue with the RF electrode energized to mobilize the tissue chip.

[0094] In the variation of FIGS. **8** to **10**B, the device **400** can be actuated stepwise by first pressing the power button **485** (FIG. **8**) from position X to Y, which energizes the RF loop electrode **405** and then can cut into the targeted tissue as described above. Next, the physician can press the power button **485** from position Y to position Z, which will reciprocate the energized loop electrode **405** in a single stroke back and forth. The physician can then release the power button **485** from position Z to position Y, and with the RF electrode **405** still energized, the physician can lift the working end **420** away from the tissue to cut the end of the tissue chip. In other variations, the controller **140** may reciprocate the loop electrode **405** back and forth a selected number of times to cut tissue. As can be seen in FIG. **8**, the controller **140** also is coupled to an electrical source **490** that energizes the motor drive **480** in the handle **416**. Thus, the controller **140** controls the RF source **130**, the negative pressure source **135** as described previously, as well as the operating parameters of the motor drive **480**. In some variations, the RF electrode can comprise a curved shape, an angled shape, a linear shape, or a combination thereof.

[0095] Now, turning to FIGS. **11**A to **11**C, sectional views of the working end of **420** of the device **400** of FIGS. **8** to **10**B are shown with the RF loop electrode **405** in various positions. In FIG. **11**A, the loop electrode **405** is in a constrained position within the envelope of the introducer member **410**. The loop electrode **405** and electrode shaft **440** are urged into this initial constrained position by a leaf spring or other spring means (not shown) within the passageway **446** of the introducer member **410**. FIG. **11**B shows the cam surface **465** after being moved distally, which causes the electrode shaft **440** and loop electrode **405** to move outwardly to provide a selected cutting depth indicated by a DD**1** that can range from 1 millimeter to 4 mm as described previously. FIG. **11**C shows the cam surface **465** moving the electrode shaft **440** and loop electrode **405** outwardly for a maximum cutting depth DD**2**, which can range from 3 mm to 10 mm.

[0096] Now, turning to FIG. **12**, another variation of a resecting device **500** is shown, which is similar to the device **100** of FIGS. **1** and **2**, except it can be operated in first and second modes comprising a manual mode and a controller-assisted mode, respectively. The device **500** has a handle **504** coupled to an introducer member **505** extending to a working end **506**. The introducer **505** has an interior passageway **508** carrying a rotatable electrode shaft **510**, as described in previous variations. A distal RF loop electrode **515** is rotatable outward from the introducer member **505**, as described in previous variations. In this variation, the manual mode of operation is the same as described above in the device of FIG. **1**, with the drive assembly comprising a sliding grip **516** operable to move the loop electrode **515** outwardly to provide a selected cutting depth (see FIGS. **3**B-**3**D). The mechanism of the sliding grip **516** includes electrical contacts (not shown), which are coupled to the controller **140** to signal the selected cutting depth to the controller for purposes described below relating to the second controller-assisted mode of operation. After selecting a cutting depth, the physician then would resect targeted tissue by (i) pressing the actuator button **518** to energize the loop electrode **515**, (ii) then cutting a path into tissue and then translating the loop electrode through the targeted tissue to cut a strip of tissue, and (iii) then lifting the still-energized loop electrode **515** outwardly to thereby resect and mobilize the tissue strip (see FIGS. **7**B-**7**D).

[0097] In the second controller-assisted mode, a motor drive **520** is used to rotate the loop electrode **515**. As can be seen in FIG. **12**, the handle **504** carries motor drive **520** that is coupled to the rotatable electrode shaft **510** and is configured to rotate the electrode shaft and loop electrode **515** in response to signals from an accelerometer **522**. FIG. **12** shows accelerometer **522** carried in the handle **504**, which is coupled to the controller **140**. The controller **140** is also operatively coupled to an electrical source **525** that powers the electric motor drive **520**. Referring to FIG. **12**, the handle **504** has a switch **530** that allows the physician to toggle between the first and second modes of operation. The handle **504** further carries LEDs **535** that visually indicate selection of the first or second mode of operation.

[0098] In a variation, the accelerometer **522** sends signals to the controller **140** relating to movement of the device **500** or working end **506** during a resection procedure, wherein the controller **140** is configured with algorithms to determine any form of movement of the device **500**, such as starting or stopping movement, or rate of change of movement of the device and the loop electrode **515**. Responsive to such signals from the accelerometer **522**, the controller **140** can change an operating parameter such as power delivered from RF source **130** to the loop electrode **515** and/or rotational movement of the loop electrode provided by the motor drive **520**.

[0099] Now, turning to FIGS. **13**A to **13**D, the controller-assisted mode of operation, is illustrated in a gynecology procedure to resect a fibroid **540** in a patient's uterus **542**. A variation of a method is shown using accelerometer **522** and controller **140** to assist in mobilizing a strip of tissue T (FIGS. **13**C-**13**D). In the device of FIGS. **12** and **13**A, the introducer member **505** does not include an articulating section as in previous variations. This is for convenience only, and the introducer member **505** optionally has such an articulating section. In FIGS. **13**A to **13**D, a resecting device **500** with a straight, rigid introducer member **505** is suitable for resecting a fibroid, and an articulating working end is typically not needed.

[0100] In FIG. **13**A, the physician is preparing to introduce an endoscope **545** through the patient's cervical canal **546** into the uterine cavity **548**, with the cervix **552** being stabilized with a tenaculum **554**. The endoscope **545** is of the type having an expandable working channel as disclosed in commonly-owned U.S. Pat. No. 11,432,717 titled "Endoscope and Method of Use" authored by Truckai et al. FIG. **13**B shows the endoscope **545** after introduction into the uterine cavity **548** with the resecting device **500** advanced through a working channel of the endoscope **545**. FIG. **13**B further illustrates the working end **506** of resecting device **500** being angled toward the fibroid **540**, and the physician also adjusts the sliding grip **516** (FIG. **12**) to select a cutting depth of the loop electrode **515**. The physician has actuated the switch **530** in the handle **504** to operate in the second controller-assisted mode (FIG. **12**).

[0101] Now, turning to the enlarged view of FIG. **13**C, the physician energizes the RF loop electrode **515** by pressing power button **518** and cuts into the fibroid **540**, or adjacent tissue, creating an inward cutting path CP and then translates the working end **506** proximally with the introducer surface in contact with tissue to extend the cutting path CP at the selected cutting depth through or under the fibroid **540** cutting a strip of tissue T. At the time the physician presses the power button **518**, the controller logs signals from the accelerometer **522** which indicate movement of the working end **506** and loop electrode **515**. A controller algorithm can determine that the working end **506** is being translated axially relative to the axis of the resecting device **500** and endoscope **545** (FIG. **13**B). FIG. **13**D then illustrates that the physician has cut an elongated cutting path CP at the selected depth and then stops movement of the working end **506**. The control algorithm then in response to signals from the accelerometer **522** that movement of the electrode **515** has stopped, actuates the motor drive **520** to rotate the loop electrode **515** inwardly to cut off the end **550** of the tissue strip T. In this mode of operation, the loop electrode **515** remains energized as it moves to an inward position of FIG. **13**D to cut off the tissue strip, and the controller algorithm then turns off the power to the electrode, and further the motor drive **520** rotates the de-energized loop electrode outwardly to the previously selected cutting depth. After these sequential steps, the working end **506** and loop electrode **515** are ready to repeat the cutting sequence described above to resect additional tissue strips to complete the resection of fibroid **540**.

[0102] Now, turning to FIG. **14**, another variation of a resecting device **600** is illustrated that is similar to device **400** of FIGS. **8** to **10**B, except that the controller **140** is adapted to control an automated mechanism to reciprocate an RF loop electrode **605** and move the loop electrode **605** inwardly and optionally outwardly in the introducer member **610** of the device. This variation has an advantage in a method of use wherein the working end **612** is pressed against targeted tissue and held stationary while the loop electrode **605** is moved by a motor drive **615** to resect a strip of tissue in a partly automated manner. The method of using the previous variations typically required the physician to move or translate the loop electrode through tissue to resect a tissue strip.

[0103] More in particular, referring to FIG. **14**, the resecting device **600** has a handle **616** coupled to introducer member **610** that extends to the working end **612** with an elongated window **620** therein. The loop electrode **605** reciprocates and moves outwardly and inwardly from window **620**. The introducer **610** has an interior passageway **624** carrying an electrode shaft **625** of the same type as in device **400** of FIGS. **8** and **9**. The electrode shaft **625** and loop electrode **605** of FIG. **14** also is actuated by the same cam mechanism as fully described above and shown in FIGS. **8** and **9**. The handle **616** carries the motor drive **615** powered by electrical source **630** that is configured to move the assembly of the electrode shaft **625**, cam mechanism, and loop electrode **605** to resect strips of tissue. The motor drive **615** has an output shaft coupled to linear drive and rotation mechanisms known in the art to move the electrode shaft assembly together with the cam mechanism to axially translate the entire loop electrode assembly.

[0104] In a variation, an actuator button **634** in the handle **616** is configured to perform multiple functions, including selecting the cutting depth of the loop electrode **605**. In FIG. **14**, the proximal end **635***a* of the actuator button **634** can be depressed multiple times to toggle through a plurality of cutting depths that are adjusted by the motor drive **615**, for example, from two to five different selected cutting depths of 1 mm to 5 mm. A plurality of LEDs can be provided (not shown) on the handle **616** to indicate the selected cutting depth, while the physician can also observe the cutting depth of the loop electrode endoscopically. In a non-deployed or default position, the loop electrode **605** and electrode shaft **625** are positioned distally and inward relative to the window **620**.

[0105] Turning to FIGS. **15**A to **15**C, a method of use is illustrated wherein the working end **612** is positioned in a saline-distended working space WS. In FIG. **15**A, the physician uses the actuator button **634**, as described above, to select a cutting depth. Thereafter, the physician depresses the distal end **635***b* of the actuator button **634** from A to B, which moves the loop electrode **605** outwardly to the selected cutting depth and energizes the loop electrode (FIG. **14**). The physician then moves the loop electrode **605** into tissue to cut a cutting path CP as indicated by the dashed line in FIG. **15**A until the outer surface of the introducer contacts tissue, as depicted in FIG. **15**B.

[0106] FIG. **15**B illustrates a subsequent step of the method where the physician depresses the distal end **635***b* of the actuator button **634** from B to C, which signals to controller **140** to actuate the motor drive **615** to move the loop electrode **605** proximally to extend the cutting path CP at the selected cutting depth. FIG. **15**C illustrates a continued cutting step wherein the motor drive **615** moves the loop electrode **605** inwardly into the window **620** of introducer member **610** to fully resect and mobilize the tissue strip T as the loop electrode **605** reaches its retracted, proximal position. Typically, the strip of tissue T would be aspirated into the internal passageway **624** by the negative pressure source **135** and extracted to a tissue trap (not shown) as is known in that art. FIG. **15**C further illustrates that the controller **140** would (i) de-energize the loop electrode **605** when the electrode reaches its retracted, proximal position and then (i) operate the motor drive **615** to move the loop electrode **605** to its distal default position. Thereafter, the physician repeats the above steps to resect additional tissue strips to complete a procedure.

[0107] The resecting device **600** of FIG. **14** also can be used with a controller **140** configured to operate the loop electrode **605** in a more fully automated manner. For example, the system could be configured so that the physician positions the working end **612** and window **620** against the targeted tissue and then press the actuator button **634** to initiate the following steps: (i) the controller **140** energizes the loop electrode **605**, (ii) the motor drive is then activated so the cam mechanism moves the loop electrode **605** outward from the window **615** to cut a cutting path transversely into the tissue to the selected cutting depth, (iii) the motor drive **615** is then activated to cause axial translation of the loop electrode assembly to extend the cutting path axially within the tissue, (iv) the motor drive then retracts the loop electrode **605** inward into the window **615** to cut off the strip of tissue; and (v) the electrode is de-energized, and motor drive returns the loop electrode to the default, distal position. Thereafter, the above steps can be repeated in the same sequence. In this method, pressing the actuator button **634** could initiate a single sequence of steps as described above or simply continue the series of steps until the power button is released. This method would allow that physician to resect multiple strips of tissue without having to translate the resecting device inward and outward of the working channel in the endoscope.

[0108] FIG. **16** illustrates another variation of a resecting device **650**, which is similar to the device **100** of FIGS. **1** to 3D with an RF loop electrode **655** that can be rotated outwardly and inwardly from the working end **658** relative to the envelope of the introducer assembly **660**. The variation or FIG. **16** includes a handle **662** carrying a motor drive **664** that is powered by electrical source **665**. In this variation, the motor drive **664** is adapted to reciprocate the entire working end **658** in an outer sleeve **670** of the introducer assembly **660**. This variation has an advantage in a method similar to that of device **600** of FIGS. **14-15**, wherein the physician can move the loop electrode **655** into and out of a tissue surface without manually moving the working end **658** axially. Instead, the variation of FIG. **16** uses the motor drive **664** to reciprocate the working end **658** and loop electrode **655**. In this method of use, the physician can maintain the device axially motionless relative to the endoscope (cf. FIGS. **13**C-**13**D), which is an advantage. In this variation, the selected cutting depth is adjusted by the sliding grip **672**, as described previously. In a variation, the reciprocation mechanism in the handle **662** can be a form of linear actuator known in the art with a reversible motor drive.

[0109] Now, turning to FIGS. **17** and **18**, another variation of a resecting device **700** is illustrated that is similar to device **100** of FIGS. **1** to 3D, except that the introducer member **710**, working end **712**, and RF loop electrode **715** are designed to maximize the cutting depth of the loop electrode **715** when deployed relative to the diameter of the introducer member. As can be seen in FIG. **18**, a unitary electrode member **716** comprises loop electrode **715** at the distal end of an electrode shaft **720** that extends through the introducer member **710**. The increased cutting depth of the loop electrode **715** is attained by reducing the diameter of the electrode shaft **720** and positioning the electrode shaft **720** close to the introducer envelope **722**, which is defined by the outer surface of the introducer member **710**. The method of using the resecting device **700** is similar to the methods described above.

[0110] More, in particular, FIG. **17** illustrates the resecting device **700** with a handle **724** coupled to introducer member **710** that extends about longitudinal axis **725** to the working end **712**. The loop electrode **715** is shown in FIG. **17** in a default or inward position for introduction into a working space and is adapted for deployment outwardly from the introducer member **710** and introducer envelope **722** by rotation of the electrode shaft **720** about its axis **726** as described previously. The deployment mechanism comprises a motor drive **728** carried within the handle **724** configured to rotate the electrode shaft **720**, but manual deployment is also possible, as in previous variations.

[0111] The motor drive **728** in the handle is powered by electrical source **730** that is similar to previous variations. The resecting device **700** and motor drive **728** are again operatively connected to an RF source **130**, negative pressure source **135**, and controller **140** that function as described in previous variations.

[0112] Now referring to FIG. **18**, the components of the introducer member **710** and working end **712** are shown in exploded view. In this variation, the electrode member **716** is configured with loop electrode **715** that extends distally from electrode shaft **720**. FIGS. **17** and **18** show the electrode shaft **720** extending through a channel **732** in an extruded central core sleeve **740** of the introducer member **710**. The electrode shaft **720** extends through channel **732** to the handle **724**, where a proximal end **742** of the electrode shaft is operatively coupled to the motor drive **728** (FIG. **17**). In a variation shown in FIG. **18**, the electrode member **716** can comprise a tungsten wire with shaft **720** having a first diameter and the distal loop electrode **715** having a second reduced diameter. In a variation, the introducer member **710** is elongated for introduction through a working channel of an endoscope, and it can be understood that the electrode shaft **720** is required to resist twisting and, therefore, has a suitable torque-resistant diameter which is greater than 0.015" and often greater than 0.018". In this variation, the tungsten wire portion comprising the loop electrode **715** has a diameter less than 0.015" and often less than 0.012". The unitary electrode member **716**, as shown in FIG. **18** can be fabricated by providing a suitable tungsten wire or other suitable metal wire having the diameter of the electrode shaft **720** described above and then grinding a distal portion of the wire to a dimension described above for a loop electrode **715** followed by forming the circular shape of the loop electrode **715**.

[0113] In the variation of FIG. **18**, the reduced diameter of the loop electrode **715** reduces the active electrode surface area and thus reduces the power requirements from RF source **130** to ignite a plasma for cutting tissue. In the variation shown in FIG. **18**, the loop electrode **715** extends in 360°. and a weld WW fuses the tail end **744** of the loop with initial section **746** of the loop. It can be seen that in FIG. **18** that the loop electrode **715** has a cylindrical shape CS at least in part and leg portions **748** that extend to axial the portion of the electrode shaft **720**. The circular shape CS extends from 180° to 360° around the loop shape and comprises the active electrode **750**. The leg portions **748** of electrode **715** may be covered with an insulative material such as an epoxy or heat shrink material (not shown) to further reduce the active electrode surface area. In a typical variation, the bare wire portion of loop electrode **715** comprising the active electrode **750** extends at least 180° around the circular shape CS of the loop.

[0114] Referring to FIG. **18**, the central core sleeve **740** of the introducer member **710** comprises an extruded polymeric material such as FEP. The diameter of channel **732** in the wall **752** of the core sleeve **740** is dimensioned to allow rotation and optional axial movement of the electrode shaft **720** therein. The central passageway **755** in the core sleeve **740** communicates with the negative pressure source **135**. In FIGS. **18** and **19**, it can be understood that the combination of small diameter electrode shaft **720** and extruded core sleeve **740** allows for an increased cutting depth when the loop electrode **715** is rotated 180° out of its default inward position of FIG. **17**.

[0115] Referring again to FIG. **18**, the extruded core sleeve **740** is disposed within a thin metal outer sleeve **760**, such as stainless steel, that provides stiffness for the assembly comprising the elongated introducer member **710**. In this variation, the introducer member **710** is configured as a rigid assembly and is not adapted for articulation as in some previous variations. The metal outer sleeve **760** can comprise a stainless steel tube with a wall thickness of less than 0.006" or less than 0.005" to provide a suitable stiffness to the introducer in a variation where the introducer has an outer diameter of less than 6 mm or less than 5 mm. In the variation of FIGS. **17** to **19**, the outer sleeve **760** comprises a return electrode **765**. In an assembled variation shown in FIG. **19**, the outer sleeve **760** has a distal end **768** that is spaced apart from the distal end **770** of the core sleeve **740** to provide an insulative material between the loop electrode **715** and the return electrode **765** during use. As can be seen in FIGS. **17**, **19**, and **22**, an insulative circumferential band **772** is provided around the distal end **770** of the core sleeve **740**, which can comprise a heat shrink material, epoxy, or the like. The axial length of the insulative circumferential band **772** is at least 1.0 mm or at least 2.0 mm and often greater than 4.0 mm.

[0116] FIG. **20** illustrates a variation of loop electrode **715'** wherein the tail end **744'** of the loop is not welded to the initial loop section **746'** as in the variation of FIG. **18**. In FIG. **20**, the tail end **744'** and initial section **746'** are bonded together with an epoxy material **780** molded around a portion of electrode **715'** to provide an insulative layer and to connect the tail end **744'** and initial section **746'** of the loop electrode. In this variation, the electrode shaft **720** is also shown encased in a heat shrink member **778** to add to the insulative properties of the electrode shaft **720**.

[0117] Now, turning to FIGS. **19**, **21**, and **22**, another aspect of the working end **712'** of a resecting device is shown. In this variation, the working end **712'** includes a loop electrode **715** configured for axial extension and retraction in the central passageway **755** of the working end, wherein the outer surface **785** of the circular shape CS of loop electrode **715** is closely matched in dimension to the surfaces **786** of passageway **755** so that when the loop electrode **715** is retracted into the passageway **755**, any eschar sticking to the loop electrode **715** will be scraped away by surface **786**. FIG. **22** shows the radial distance D**1** between the loop electrode **715** and surface **786** is minimal and is often less than 0.5 mm. Similarly, as can be seen in FIGS. **21** and **22**, when the loop electrode **715** is extended outwardly from the passageway **755**, rotation of the loop electrode from any deployed position to the default, inward position will scrape eschar from the proximal surface **788** of the loop electrode **715**. FIG. **22** shows the axial distance D**2** between the loop electrode **715** and distal end **770** of the core sleeve **740** is minimal and is often less than 0.5 mm. As can be seen in FIGS. **19** and **22**, the distal end **790** of channel **732** carrying the electrode shaft **720** is recessed in the core sleeve **740** to allow retraction of the loop electrode **715** into the passageway **755**.

[0118] Referring back to FIG. **17**, it can be seen that the handle **724** carries a second motor drive **792** that is adapted for causing axial movement of the loop electrode **715** as shown in FIGS. **19** and **22**. Thus, in a variation, the handle **724** carries the first motor drive **728** for rotational deployment of the loop electrode **715**, and the second motor drive **792** is configured for the axial extension and retraction of loop electrode **715** from the passageway **755**. In other variations, a single motor can have mechanisms adapted for performing both rotational and axial movements.

[0119] In a variation, the motor drives **728** and **792** comprise encoder motors, which send signals to the controller **140** as to the degree of rotation of the motor shaft, which in turn can be used to determine the dimension of axial deployment and outward deployment of the loop electrode **715** which in turn determines the cutting depth. In the variation shown in FIG. **17**, the controller **140** is also coupled to a touch screen display **795** where the physician can select operating parameters of the systems, for example, the selected cutting depth. In this variation, the actuator button **796** in the handle **724** is adapted only for activating the loop electrode **715** while the touch screen display **795** is used for selecting other operational parameters.

[0120] In the cut-away view of FIG. **22**, the dimensions of components of the working end **716'** are shown that provide for maximizing the cutting depth of the loop electrode **715**. As can be understood, referring to FIG. **22**, the objective is to position the rotational axis **726** of the electrode shaft **720** as close as possible to the outer surface of the introducer member **710** that defines introducer envelope **722** indicated at D**3**, which is less than 0.010" or less than 0.050". However, the outer sleeve **760** comprises return electrode **765**, so that suitable insulative components must separate the electrode shaft **720** from the outer sleeve **760** to prevent electrical coupling within the wall of the introducer member **710**. In a variation, the dialectic material in FIG. **22** has a dimension D**4** of at least 0.003" or at least 0.005" extending through the introducer member **710** that comprises the wall thickness of the core sleeve **740** around the channel **732** and optionally the thickness of a heat shrink member **778** encasing the electrode shaft **720** (see FIG. **20**). The resection devices described above can be used in various surgical fields such as urology, gynecology, arthroscopy, and other fields where resecting procedures are performed in a saline-immersed working space, such as in FIGS. **7**A-**7**D and **13**A-**13**D. For example, the RF devices and methods described above can be used in a BPH procedure to resect tissue to reduce the volume of a patient's prostate. In such a procedure, an articulating working end may not be needed, and a straight, rigid introducer may be used. Small-diameter RF devices, as described above, can be used in the field of arthroscopy, for example, to resect tissue in a patient's shoulder, hip, or knee again without an articulating working end.

[0121] In the variations described above, the negative pressure source **135** (FIGS. **1** and **8**) communicates with a passageway in the introducer wherein the fluid inflow port is either at the distal end of the introducer or in a slot in the introducer from which the RF loop electrode is extended. It should be appreciated that the controller **140**, or a fluid management system, typically will be used to control fluid pressure in the working space. Thus, the openings or ports in the working end of the introducer can be dimensioned to accommodate the required fluid flows, and additional ports may be disposed on any side of the working end to provide for adequate fluid outflows, wherein fluid inflows typically flow an inflow channel in the endoscope FIG. **7**A).

[0122] FIGS. **23**A, **23**B, and **24** illustrate another variation of a working end **800** of an electrosurgical resecting device that is similar to devices **650** and **700** of FIGS. **16** and **17**, respectively. In the variation of FIGS. **23**A and **23**B, the RF loop electrode **815** is configured for axial movement to ablate or core a cylindrical path in targeted tissue wherein substantially all tissue in the path is vaporized, thus leaving very small tissue remnants or no tissue remnants at all. The vaporization of targeted tissue is possible (ii) when the diameter of the loop electrode **815** is small in relation to the electrode wire diameter, (ii) when the power delivered to the RF loop electrode is suitably high, and (iii) when the rate of axial movement of the electrode **815** in targeted tissue is at a suitable selected rate.

[0123] As can be seen in FIG. **23**A, the RF loop electrode **815** again comprises a wire loop at the distal end of an axially-extending electrode shaft **816** that extends through bore **818** in an introducer assembly **820** that comprises an outer introducer sleeve **822** and a movable electrode-carrying inner sleeve **825** that carries the loop electrode **815**. In a variation, FIG. **23**A illustrates the loop electrode **815** having a wire diameter WD ranging from 0.020" (0.50 mm) to 0.10" (2.54 mm) and a mean inner loop diameter LD ranging from 2.5 mm to 5.0 mm. The loop electrode **815** is typically round but also may be oval or have angled regions, as in the variation of FIG. **24** below, where an angled portion **826** transitions to the axial-extending electrode shaft. For this reason, the inner loop diameter LD is defined as the mean dimension across the loop. Similarly, the wire forming the loop electrode **815** can be round, oval, rectangular, polygonal, or star-shaped in cross-section, and the wire diameter WD is defined as the mean dimension of a cross-section of the wire. In a variation, the ratio of the mean inner loop diameter LD to the wire diameter WD is 20:1 or less. In other variations, the ratio of the inner loop diameter LD to the wire diameter WD is 10:1 or less. In other variations, the ratio of the inner loop diameter LD to the wire diameter WD is 8:1 or less. In other variations, the ratio of the inner loop diameter LD to the wire diameter WD is 6:1 or less. The outer diameter of the loop electrode **815** is no larger than the outer diameter of the outer introducer sleeve **822** to allow introducer assembly to be introduced through a working channel of an endoscope as described in previous embodiments. Optionally, the outer diameter of the loop electrode **815** can be dimensioned for retraction into the lumen **828** of the outer sleeve **822** or retraction into the passageway **830** in the inner sleeve **825**.

[0124] FIGS. **23**B and **24** schematically illustrate the cylindrical hole or core C**1** that the loop electrode **815** will bore into tissue about central axis **832**. The end view of FIG. **24** further illustrates the dimensions of tissue ablation or vaporization around the loop electrode **815**. It can be seen schematically that the tissue vaporization dimensions will result in a cylindrical hole for core C**1** in targeted tissue as the loop electrode **815** is moved axially into tissue, as shown in FIG. **23**B.

[0125] In a method of use, the loop electrode of FIGS. **23**A, **23**B, and **24** can be moved or advanced into targeted tissue in one of several modes of operation. First, as shown in FIG. **23**B, the electrode shaft **816** and loop electrode **815** can be extended outwardly from bore **818** in the inner sleeve **825** either manually or by a motor drive to bore into targeted tissue. Second, the inner sleeve **825** carrying the loop electrode **815** can be extended outwardly from passageway **830** in the outer sleeve **822** either manually or by a motor drive to bore into targeted tissue. Third, the entire introducer assembly **820** can be moved and extended outwardly from a working channel of an endoscope, which would typically be a manual mode of operation. In any mode of operation, the negative pressure source **135** (FIG. **17**) in communication with lumen **824** in the inner sleeve **825** will assist in removing any vaporized tissue or tissue remnants from the treatment site. Bore **818** can extend axially through inner sleeve **825**.

[0126] Now, turning to FIG. **25**, another variation of a working end **850** of a resecting device is shown, which is similar to the variation of FIGS. **23**A and **23**B, except that an additional motor drive is provided to move the loop electrode **855** to vaporize a larger core or cylindrical hole in targeted tissue. In the variation of FIG. **25**, the RF loop electrode **855** again comprises a wire loop at the distal end of an axially-extending electrode shaft **856** that extends through bore **858** in an introducer assembly **860** that comprises an outer introducer sleeve **862** and a movable inner sleeve **865** that carries the loop electrode **855**. In this variation, the loop electrode **855** is optionally configured with the wire dimensions and loop dimensions of FIGS. **23**A-**23**B to vaporize substantially all tissue. Alternatively, the loop electrode dimensions can be configured for cutting a path in tissue that leaves tissue chips or remnants that are extracted through the passageway **868** in the inner sleeve **865** by a negative pressure source (not shown). As can be seen in FIG. **25**, the loop electrode **855** and its shaft **856** can be rotated outwardly from the introducer envelope, as defined above and locked in a selected position. The rotation of electrode shaft **856** is typically a manual operation, but motor-driven rotation is possible. In this variation, the outward rotation of the loop electrode **855** is limited to a degree of rotation, for example, up to approximately 90°, wherein a leading edge **870**A of the loop electrode **855** is radially outward from the introducer envelope and an opposing trailing edge **870**B the loop electrode **855** is inward from, or in alignment with, the central axis **875** of the inner sleeve **865**. FIG. **25** then shows that at least one motor drive (cf. FIGS. **16** and **17**) is used to (i) rotate the inner sleeve **865** within the outer sleeve **862** and (ii) contemporaneously move the entire assembly of inner sleeve **865** and RF loop electrode **855** axially in the distal direction to cut or vaporize a hole in tissue indicated dimensionally as core C**2** in FIG. **25**. Thus, the motor-driven variation of FIG. **25** will cut or vaporize tissue in a diameter substantially larger than the introducer envelope, whereas the variation of FIGS. **23**A and **23**B only vaporized a core C**1** (see FIG. **23**B), approximating the diameter of the introducer envelope.

[0127] In FIG. **25**, it can be understood that rotation and the axial movement of loop electrode **855** will cut a spiral path in the tissue, leaving thin tissue strips that can be extracted through the passageway in the inner sleeve **865** by a negative pressure source. The rate of axial movement of the inner sleeve **865** will determine the dimension or thickness of the tissue strips which can be substantially small to be extracted through the interior aspiration passageway **868** in the inner sleeve **865**. In another variation, a controller can operate the movement of the inner sleeve **865** to alternatively rotate the inner sleeve with and without axial movement to further facilitate cutting small tissue chips. In another variation, a motor drive, or manual actuator, can be used to rotate the electrode shaft **856** and loop electrode **855** inwardly and outwardly during rotation and axial movement to further facilitate cutting tissue chips of a small dimension for extraction through the aspiration passageway **868** in the inner sleeve **865**. While at least one motor drive is described in the methods above, it should be appreciated that a single motor drive can be used to rotate the inner sleeve **865**, and manual actuation can be used for advancing and retracting the inner sleeve **865** while cutting tissue.

[0128] In viewing FIG. **25**, it can be understood that if the loop electrode **855** and shaft **856** were rotated outwardly at an angle greater than approximately 90° so that the trailing edge **870**B of the loop electrode **855** was outward of the central axis **875**, then contemporaneous rotation and axial movement of the inner sleeve **865** carrying a loop electrode

855 would not ablate, vaporize or resect tissue around the central axis **875** but instead create a donut-shaped hole in tissue.

[0129] Referring now to FIGS. **26**A-**26**C, another variation of a working end **900** of a resecting device is shown that is similar to that of FIG. **25**, except that the active electrode arrangement comprises a moveable loop electrode **905**A as described above and a secondary fixed electrode **905**B that when operating together allow for ablating larger diameter cores in tissue. This variation again comprises an RF wire loop electrode **905**A at the distal end of an axially-extending electrode shaft **906** that extends through bore **908** in an introducer assembly **910** that comprises an outer introducer sleeve **912** and a movable electrode-carrying inner sleeve **915** that carries the loop electrode **905**A. As can be seen in FIG. **26**A, the loop electrode **905**A is similar to the variation of FIG. **25**, except that the loop can be rotated further outward relative to the inner sleeve, for example, 180°, so that both the leading edge **918**A and the trailing edge **918**B of the electrode **905**A are outward of the introducer envelope. No portion of the loop electrode is close to central axis **920** of the inner sleeve assembly. However, the secondary electrode **905**B is fixed to the inner sleeve **915** and extends across the central axis **920**. Therefore, rotation of the inner sleeve assembly will always cut tissue across the central axis **920** with the secondary fixed electrode **905**B. At the same time, the loop electrode **905**A can be rotated outside the introducer envelope, as shown in FIGS. **26**B and **26**C to cut a substantially larger path in tissue, as indicated by cores C**3** and C**4** in FIGS. **26**B and **26**C, respectively.

[0130] FIG. **27** illustrates another variation of a working end **950** of a resecting device that is similar to the variation of FIGS. **26**A-**26**C, except that the rotatable electrode **955**A has an arc-shape instead of a loop shape. The rotatable electrode **955**A has an axially-extending electrode shaft **956** that extends through bore **958** in an inner sleeve **960** of an introducer assembly **962**. The outer introducer sleeve **965** is similar to previous variations. The secondary fixed electrode **955**B also has an arc shape that extends across the central axis **970**, but it should be appreciated that the fixed electrode can have any shape, such as an elbow or "L" shape, that extends to or across the central axis **970**. As can be seen in FIG. **27**, a core C**5** can be cut with the electrode **955**A fully rotated outwardly.

[0131] FIG. **28** illustrates another variation of a working end **980** that is similar to the variation of FIG. **27** except that the rotatable electrode **985**A and fixed electrode **985**B extend from opposing sides of the inner sleeve **986**, with each electrode having an arc shape that extends to the central axis **990**. This variation of working end **980** will resect tissue in the outline of core C**6** with the rotatable electrode **985**A rotated 180° outward, followed by rotation and axial movement of the inner sleeve **986** carrying electrode **985**A.

[0132] FIG. **29** illustrates another variation of a working end **1000** with an arc-shaped electrode **1005** that is motor-driven to rotate in 360° within bore **1006** in a wall **1008** of the inner sleeve **1010**. FIG. **29** illustrates that core C**7** would be resected by electrode **1005** when rotated in bore **1006** together with axial movement of the inner sleeve **1010**. It can be understood that if the inner sleeve **1010** was also rotated around its central axis **1015** as indicated by arrow AA, then the resected core would be far larger and similar to the core C**6** of FIG. **28**. In a method of use, the rate of rotation of the electrode **1005**, the rate of rotation of the inner sleeve **1010**, and the rate of axial movement of the inner sleeve **1010** can vary or be intermittent to achieve suitable rates of tissue resection.

[0133] FIGS. **30** and **31**A-**31**D illustrate another variation of a working end **1100** of a resecting device **1105**, which is similar to previous variations. In the variation of FIG. **30**, the RF loop electrode **1110** again comprises a wire loop at the distal end of an axially-extending electrode shaft **1112** that extends through an off-center bore **1114** in a cutting sleeve **1115** that is moveable in a bore **1118** in an outer introducer member or sleeve **1120**. The introducer assembly **1125** comprises the introducer sleeve **1120** and the cutting sleeve **1115** that extend about central axis **1122** from a handle **1124** (see FIG. **32**). FIG. **30** shows the introducer sleeve **1120** and cutting sleeve **1115** de-mated from one another. In FIG. **30**, it can be seen that the outer diameter DD**1** of the loop electrode **1110** approximates outer diameter of the cutting sleeve **1115** and the diameter DD**2** of bore **1118** in the introducer sleeve **1120** so that the loop electrode can be fully retracted into the bore **1118** as shown in FIG. **31**A. Thus, the outer diameter of DD**1** of the loop electrode **1110** is as large as possible to maximize cutting depth when the loop electrode **1110** is rotationally deployed. The loop electrode **1110** is an active electrode, and a distal exterior surface of cutting sleeve **1115** is configured with a return electrode **1126** as described previously. In this variation, the outer diameter of the introducer sleeve **1120** is from 2.5 mm to 10 mm, and often 5 mm is diameter or less. The RF loop electrode **1110** comprises a wire having a diameter ranging from 0.015" to 0.025.

[0134] FIG. **31**A shows the introducer sleeve assembly **1125** with inner cutting sleeve **1115** retracted within the bore **1118** of introducer sleeve **1120** in a first position or default position for introducing the working end **1100** through a working channel of an endoscope as described previously. It can be seen that the introducer sleeve **1120** has an outer diameter extending distally that defines an introducer envelope DD3 as described above. FIG. **31**B illustrates another position of the cutting sleeve **1115** and loop electrode **1110** wherein the loop electrode is extended distally from the bore **1118** of introducer sleeve **1120** a short distance X so that the loop electrode **1110** is distal from the distal end **1127** of the introducer sleeve **1120**. From the position shown in FIG. **31**B, it can be understood that the loop electrode **1110** can be rotated by an actuator **128** in the handle **1124** (FIG. **32**) to position the loop electrode **1110** outwardly from the introducer envelope DD**3**. In a variation, the loop electrode **1110** can be rotated outward and locked in a plurality of selected positions, for example, 60°, 90°, and 180°. FIG. **31**C shows the loop electrode **1110** after being rotated outwardly 180° from the cutting sleeve **1115** to provide a maximum cutting depth. With the loop electrode **1110** in the position shown in FIG. **31**C, the physician can then manually move the working with the RF source **1130** providing current in a coagulation mode for coagulating tissue or in a cutting mode for cutting tissue.

[0135] FIG. **31**D shows the working end **1100** in an automated cutting mode wherein the inner cutting sleeve **1115** and loop electrode **1110** are motor-driven to extend and retract from the introducer sleeve **1120** in a spiral path SP. In other words, at least one motor drive is actuated to contemporaneously rotate and reciprocate the cutting sleeve **1115** which results in cutting the spiral path SP in tissue. In the variation of FIG. **31**D, it can be seen that the spiral path

SP includes 3 revolutions of 360° of the energized RF loop electrode **1110**, which then cuts a cylindrical envelope indicated at CC. The motor-driven system can be adapted to rotate the cutting sleeve **1115** from 1 revolution to 10 revolutions or more which then defines a stroke ST having an axial length of from 5 mm to 20 mm (FIG. **31**C). In some variations, the spiral path SP can comprise between two to eight revolutions of 360° of the energized RF loop electrode **1110**.

[0136] In a variation, the motor-driven system can rotate the cutting sleeve **1115** and RF loop electrode **1110** in a first rotational direction when being extended and in an opposing rotational direction when being retracted. In another variation, the cutting sleeve **1115** and loop electrode **1110** can be rotated in a single rotational direction when being extended and when being retracted.

[0137] In another variation, a first motor drive can be adapted to reciprocate the cutting sleeve **1115** and loop electrode **1110** at a selected speed, and a second motor drive can be adapted to rotate the cutting sleeve **1115** at an independent selected speed. In such a variation, the pitch of the spiral path SP, along with the rate of extension and retraction, can be selected to optimize the spiral movement of the RF loop electrode **1110** for cutting tissue.

[0138] Now, turning to FIG. **32**, a schematic view of a handle **1124** of the resecting device **1105** of FIGS. **30-31**D is shown together with a diagram of the RF source **1130**, electrical source **1132**, controller **1135**, and negative pressure source **1138** coupled to the resection device **1105**. A touch screen **139** is also shown, which can be used to select different modes of operation. In this variation, a single electrical motor drive **1140** is coupled to electrical source **1132** and is adapted to rotate the motor shaft **1142**, which is coupled to drive shaft **1144** of a rotating cylindrical cam member **1145**. A continuous advancing and reversing spiral groove **1148** is provided in the cam surface as is known in the art for reciprocating an adjacent member. In this variation, a cooperating reciprocating sleeve **1150** is adapted to move axially in channel **1152** in handle housing **1154**, wherein the sleeve **1150** carries an elliptically-shaped slider **1155** that slides within the spiral groove **1148** of the cam member **1145** so that the elliptically-shaped slider **1155** caused reciprocating axial motion of the slider and sleeve **1150** in response to rotation of the cylindrical cam member **1145**.

[0139] The reciprocating sleeve **1150** also carries a key **1160** that slides in slot **1162** in housing **1154** so that the sleeve moves back and forth in channel **1152** without rotating (see arrow Y in FIG. **32**).

[0140] In the variation of FIG. **32**, the elliptically-shaped slider **1155** is carried in a thin-wall collar **1165** that is keyed with pin **1166** to axially slide around reciprocating sleeve **1150**. The assembly of the collar **1165** and pin **1166** and springs **1168**_a_ and **1168**_b_ on opposing sides of the collar **1165** allow slight axial movement of the collar as a shock-absorbing mechanism. This shock-absorbing mechanism is optional and can be useful when cutting tissue that may be too hard to penetrate.

[0141] In the variation of FIG. **32**, it can be seen that a distal portion **1170** of the cutting sleeve **1115** rotates and reciprocates in the introducer sleeve **1120** that is fixed in the handle housing **1154**. The proximal portion **1172** of the cutting sleeve **1115** extends through the handle **1124** and, more particularly, through the bore **1175** of the reciprocating sleeve **1150**. The negative pressure source **1138** communicates with the interior passageway **1176** in the cutting sleeve **1115**, as described previously. As can be seen in FIG. **32**, the cutting sleeve **1115** has an annular projecting ring **1180** that rotates in an annular groove in the bore **1175** of the reciprocating sleeve **1150** so that reciprocation of the reciprocating sleeve **1150** also reciprocates the cutting sleeve **1115**.

[0142] Rotation of the cutting sleeve **1115** is provided by the motor drive **1140** that rotates a gear first gear **1185** on the cam drive shaft **1144** that in turn engages a second gear **1186** fixed on a proximal portion **1172** of the cutting sleeve **1115**. Thus, the spiral cam member **1145** and the gears **1185 1186** impart both reciprocating motion and rotational motion to the cutting sleeve **1115**. In this variation, the rotational speed of the cutting sleeve **1115** is in a fixed relationship with the rate of reciprocation due to the fixed gearing. In another variation, a first motor drive can be used in the reciprocation mechanism and a second motor drive can rotate the cutting sleeve, which would allow for a variable relationship between reciprocation and rotation, thus allowing for varied pitches of the spiral path of the loop electrode **1110**.

[0143] In FIG. **32**, the electrode shaft **1112** is shown extending through the handle **1124** to a grip **1188** that can be manually operated to move the loop electrode **1110** from its default position of FIG. **31**A to the extended position FIG. **31**B and then to any rotated position as shown in FIG. **31**C. The grip **1188** is also adapted for locking the loop electrode **1110** in a selected deployed position. FIG. **32** also schematically shows the RF source **1130** coupled to the electrode shaft **1112** in the handle **1124**. In this variation, there also is a contact switch (not shown) in the handle that prevents RF source **1130** from delivering current to the electrode **1110** in the default position of FIG. **31**A.

[0144] In another variation, the controller **1135** is configured to fully control movement of the loop electrode **1110** from the default position of FIG. **31**A through the spiral cutting mode, as shown in FIG. **31**D. In such a variation, a contact switch in the handle or an encoder on the motor shaft prevents the RF source **1130** from delivering current to the loop electrode **1110** in the default position. After the device **1105** is actuated by a switch in the handle **1124** or a foot switch, the controller **1135** then operates the motor drive **1140** to move the loop electrode **1110** axially and then to a selected outward position as in FIG. **31**D, and then move the electrode in a spiral path back and forth in a selected stroke to electrosurgically resect tissue. In this variation, the controller **1135** always returns the loop electrode **1110** to default or beginning position, wherein the RF loop electrode **1110** is within the introducer envelope DD**3** to allow its withdrawal through the working channel of an endoscope. In this variation, the touch screen **1139** can be configured to allow for touch screen selection of all the various operating parameters of the resection device, which can include (i) the rate of axial movement of the loop electrode **1110**, (ii) the rotational speed of the loop electrode **1110**, (iii) the stroke of the loop electrode **1110**, and (iv) the outer diameter of the cylindrical envelope CC (FIG. **31**D) cut by the loop electrode **1110** as shown in FIG. **31**D.

[0145] Although particular variations of the present invention have been described above in detail, it will be understood that this description is merely for purposes of illustration, and the above description of the invention is not exhaustive. The variations above are shown with a motor drive for moving a cutting sleeve helically and rotationally, but manually operated mechanisms are also possible for either or both such helical and rotational movements. Specific features of the invention are shown in some drawings and not in others, and this is for convenience only, and any feature may be combined with another in accordance with the invention. A number of variations and alternatives will be apparent to one having ordinary skills in the art. Such alternatives and variations are intended to be included within the scope of the claims. Particular features that are presented in dependent claims can be combined and fall within the scope of the invention. The invention also encompasses embodiments as if dependent claims were alternatively written in a multiple dependent claim format with reference to other independent claims.

[0146] Various changes may be made to the invention described, and equivalents (whether recited herein or not included for the sake of some brevity) may be substituted without departing from the true spirit and scope of the invention. Also, any optional feature of the inventive variations may be set forth and claimed independently, or in combination with any one or more of the features described herein. Accordingly, the invention contemplates combinations of various aspects of the embodiments or combinations of the embodiments themselves, where possible. Reference to a singular item includes the possibility that there are plural of the same items present. More specifically, as used herein and in the appended claims, the singular forms "a," "and," "said," and "the" include plural references unless the context clearly dictates otherwise.

[0147] It is important to note that where possible, aspects of the various described embodiments, or the embodiments themselves can be combined. Where such combinations are intended to be within the scope of this disclosure.

What is claimed is:

1. An electrosurgical device, comprising:

a handle coupled to an elongated introducer member extending about a central axis to a working end, wherein the elongated introducer member has an outer surface that defines an introducer envelope;

an RF loop electrode carried at a distal end of a cutting sleeve extending through a bore in the elongated introducer member to the handle;

an actuator in the handle adapted for moving the RF loop electrode between a first position within the introducer envelope and at least one second position radially outward from the introducer envelope; and

a motor-driven mechanism in the handle configured for extension and retraction of the cutting sleeve in a spiral path from a distal end of the bore of the elongated introducer member.

2. The electrosurgical device of claim **1**, wherein the spiral path includes at least one 360° rotation of the cutting sleeve and RF loop electrode.

3. The electrosurgical device of claim **1**, wherein the spiral path comprises from two to eight 360° rotations of the cutting sleeve and RF loop electrode.

4. The electrosurgical device of claim **1**, wherein the spiral path defines a stroke having an axial length that ranges from 5 mm to 20 mm.

5. The electrosurgical device of claim **1**, wherein the motor-driven mechanism provides a fixed pitch of the spiral path.

6. The electrosurgical device of claim **1**, wherein the motor-driven mechanism allows for selection of pitch of the spiral path.

7. The electrosurgical device of claim **1**, wherein the motor-driven mechanism comprises a first motor drive for rotating the cutting sleeve and a second motor drive for reciprocating the cutting sleeve.

8. The electrosurgical device of claim **1**, wherein the motor-driven mechanism rotates the cutting sleeve in a first rotational direction in the extension of the cutting sleeve and an opposing rotational direction in the retraction of the cutting sleeve.

9. The electrosurgical device of claim **1**, wherein the motor-driven mechanism rotates the cutting sleeve in the same rotational direction in the extension of the cutting sleeve and in the retraction of the cutting sleeve.

10. The electrosurgical device of claim **1**, wherein the actuator is adapted to move the RF loop electrode to a plurality of selected positions radially outward from the introducer envelope.

11. The electrosurgical device of claim **1**, wherein the actuator in the handle is manually operated.

12. The electrosurgical device of claim **1**, wherein the RF loop electrode in the first position is retracted into the bore of the elongated introducer member.

13. The electrosurgical device of claim **1**, wherein an outer diameter of the elongated introducer member is 5 mm or less.

14. The electrosurgical device of claim **1**, wherein an outer diameter of the elongated introducer member is from 2.5 mm to 10 mm.

15. The electrosurgical device of claim **1**, wherein the RF loop electrode comprises a wire having a diameter 0.015" to 0.025".

16. An electrosurgical device, comprising:

an introducer member extending about a central axis to a working end, wherein the introducer member has an outer surface that defines an introducer envelope;

an RF loop electrode with a carried at the working end;

wherein the RF loop electrode comprises a wire formed into a loop with a mean loop diameter across an interior of a loop of the RF loop electrode; and

wherein a ratio of the mean loop diameter to a diameter of the wire is 20:1 or less.

17. The electrosurgical device of claim **16**, wherein the ratio of the mean loop diameter to the diameter of the wire is 10:1 or less.

18. An electrosurgical device, comprising:

a handle coupled to an elongated introducer assembly extending about a central axis to a working end, wherein the elongated introducer assembly has an outer surface that defines an introducer envelope;

a bi-polar RF electrode arrangement carried at the working end including an RF electrode at a distal end of an electrode shaft extending through an axial bore in a wall of the elongated introducer assembly; and

an actuator in the handle configured to rotate the electrode shaft to deploy the RF electrode from a non-deployed position within the introducer envelope to a deployed position wherein a portion of the RF electrode is radially outward from the introducer envelope.

19. The electrosurgical device of claim **18**, wherein a portion of the RF electrode in the deployed position is inward of the central axis.

20. The electrosurgical device of claim **18**, wherein the RF electrode has a shape selected from group of loop shapes, curved shapes, angled shapes and linear shapes.

21. The electrosurgical device of claim **18**, further comprising a motor drive adapted to rotate the elongated introducer assembly.

22. The electrosurgical device of claim **18**, further comprising a motor drive adapted to move the elongated introducer assembly axially.

23. The electrosurgical device of claim **18**, further comprising a motor drive adapted to rotate the electrode shaft.

24. The electrosurgical device of claim **18**, further comprising a negative pressure source in communication with a passageway in the elongated introducer assembly.

25. An electrosurgical tissue resection method, comprising:

providing a device comprising a handle coupled to an elongated introducer having an outer surface that defines an introducer envelope, an RF loop electrode carried at a working end of the elongated introducer, and an actuator in the handle adapted for rotating a shaft of the RF loop electrode;

introducing the working end into a working space;

actuating the actuator to deploy the RF loop electrode from a non-deployed position within the introducer envelope to a deployed radially outward from the introducer envelope; and

energizing the RF loop electrode and moving the RF loop electrode to thereby resect tissue in the working space.

26. The electrosurgical tissue resection method of claim **25**, wherein the RF loop electrode is moved axially to resect tissue.

27. The electrosurgical tissue resection method of claim **25**, wherein the RF loop electrode is moved axially by at least one of manually and by a motor drive.

28. The electrosurgical tissue resection method of claim **25**, wherein the RF loop electrode is moved rotationally to resect tissue.

29. The electrosurgical tissue resection method of claim **25**, wherein the RF loop electrode is moved rotationally by at least one of manually and by a motor drive.

30. The electrosurgical tissue resection method of claim **25**, further comprising extracting resected tissue through a lumen in the elongated introducer responsive to negative pressure in the lumen provided by a negative pressure source coupled thereto.

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