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(54) **OPEN IRRIGATED-MAPPING LINEAR ABLATION CATHETER**

(71) Applicant: **Boston Scientific Scimed Inc.**, Maple Grove, MN (US)

(72) Inventor: **Robert F. Bencini**, Sunnyvale, CA (US)

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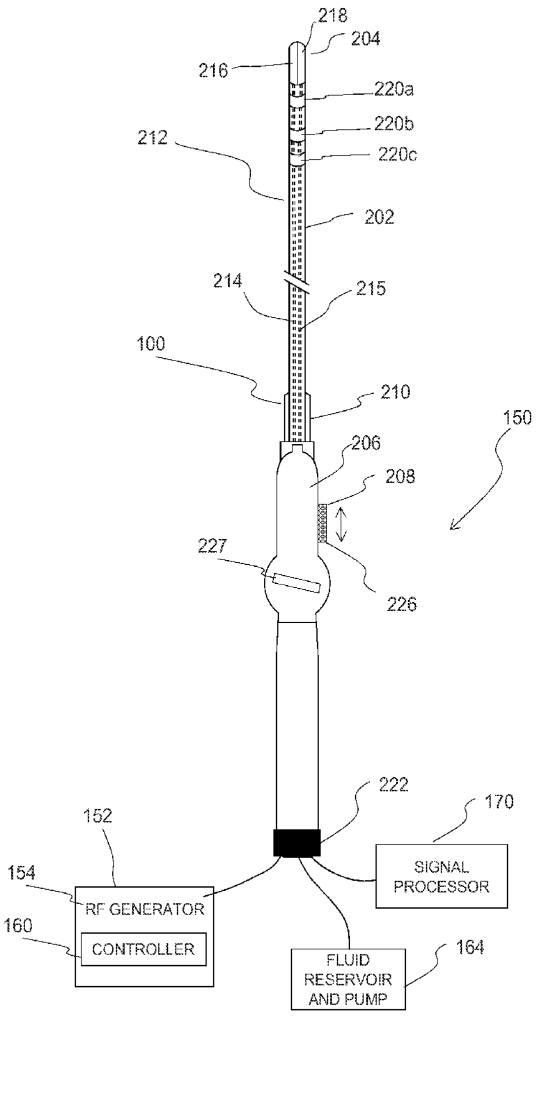
(57) **ABSTRACT**

A catheter device for use in ablating heart tissues includes an elongate body having a proximal end and an opposite distal end, and a tip section positioned at the distal end of the elongate body. The tip section includes a first jaw member and a second jaw member each including a proximal portion, a distal portion, an outer surface, and an inner surface. The jaw members are pivotally joined to one another at the proximal portions thereof, and the tip section is configured to transition between a closed configuration in which the inner surfaces are at least partially in contact with one another, and an open configuration in which the distal portions of the jaw members are deflected away from one another. The tip section is operable as ablation electrode for selectively ablating the heart tissues.



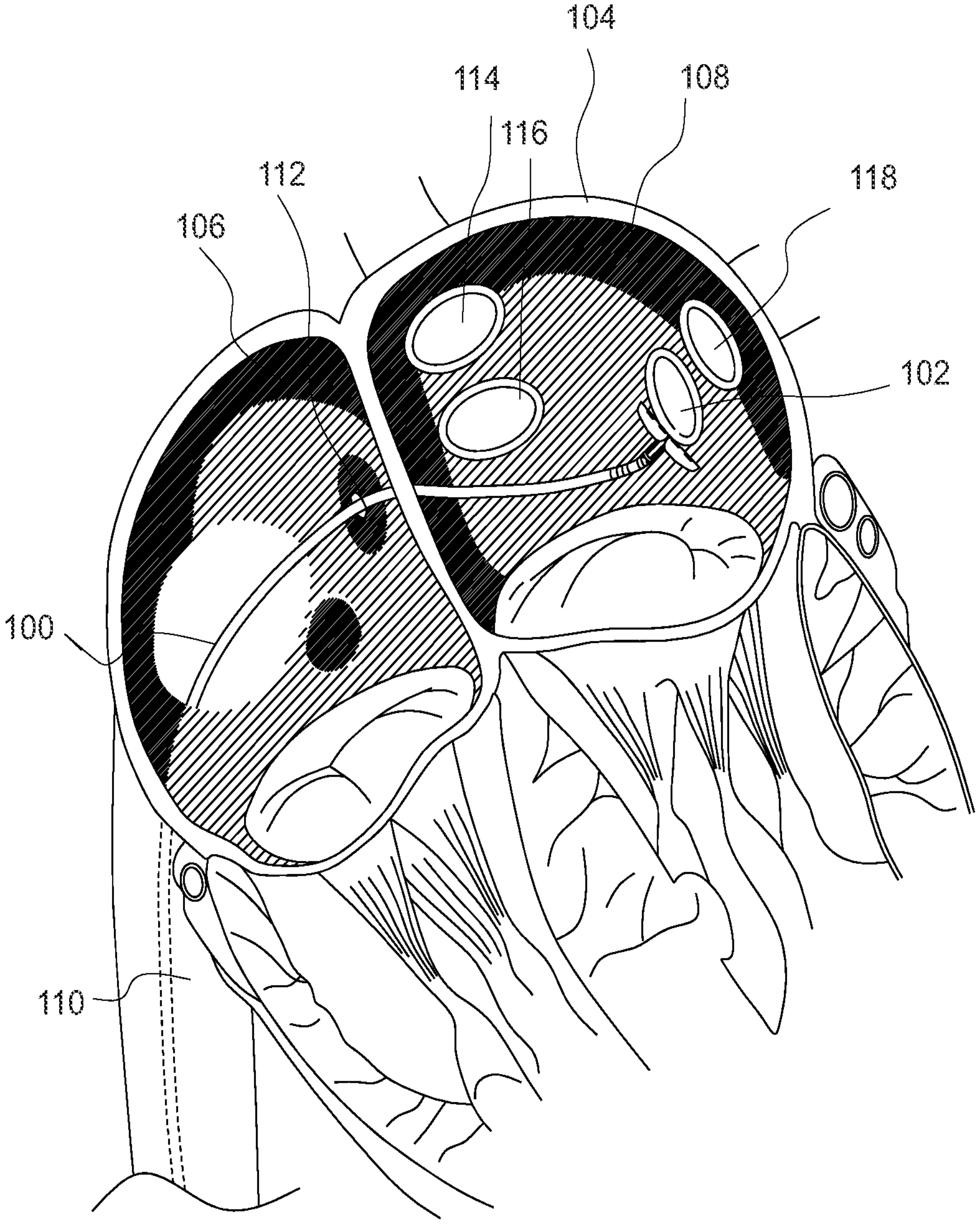


Fig. 1

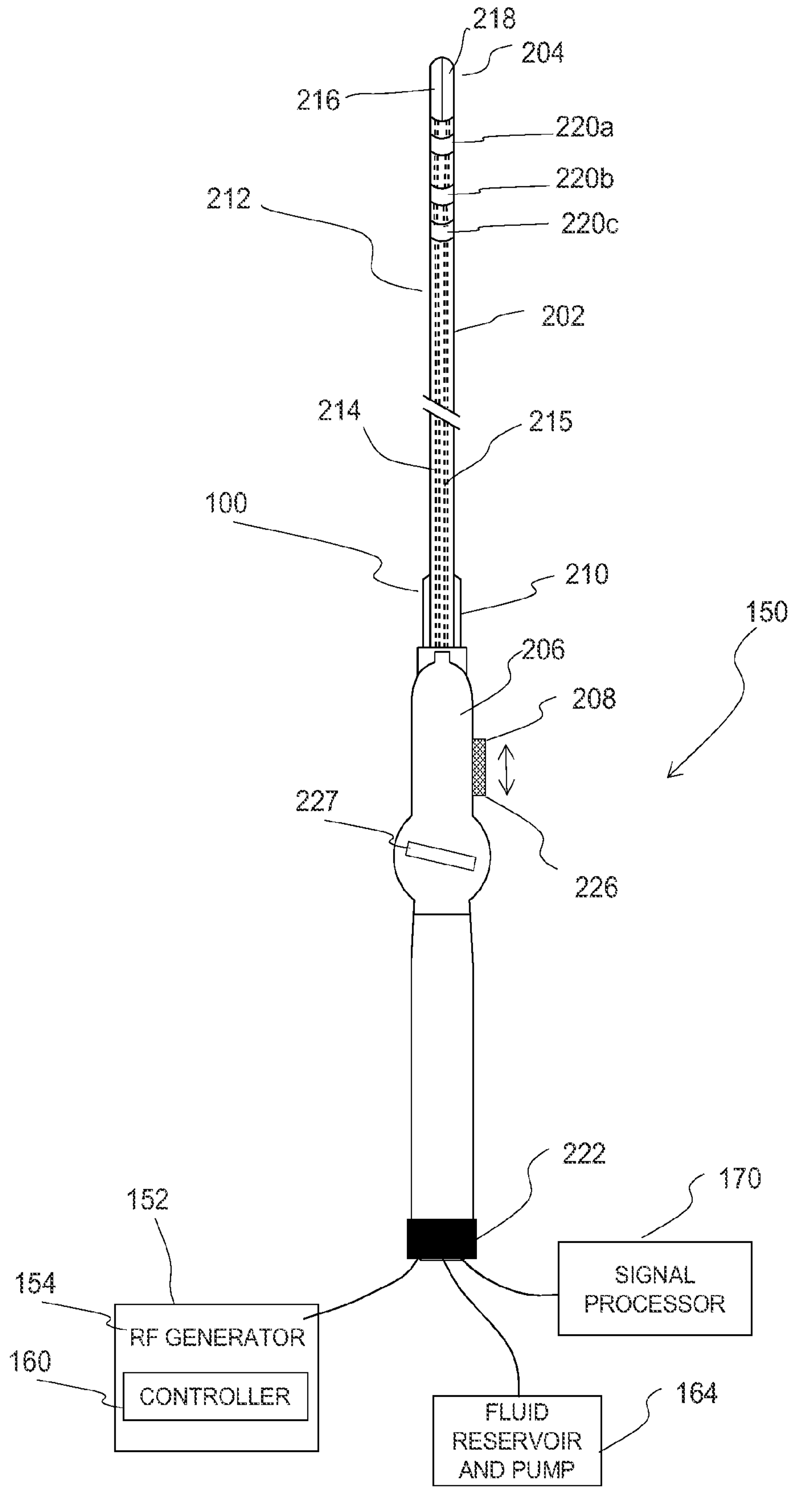
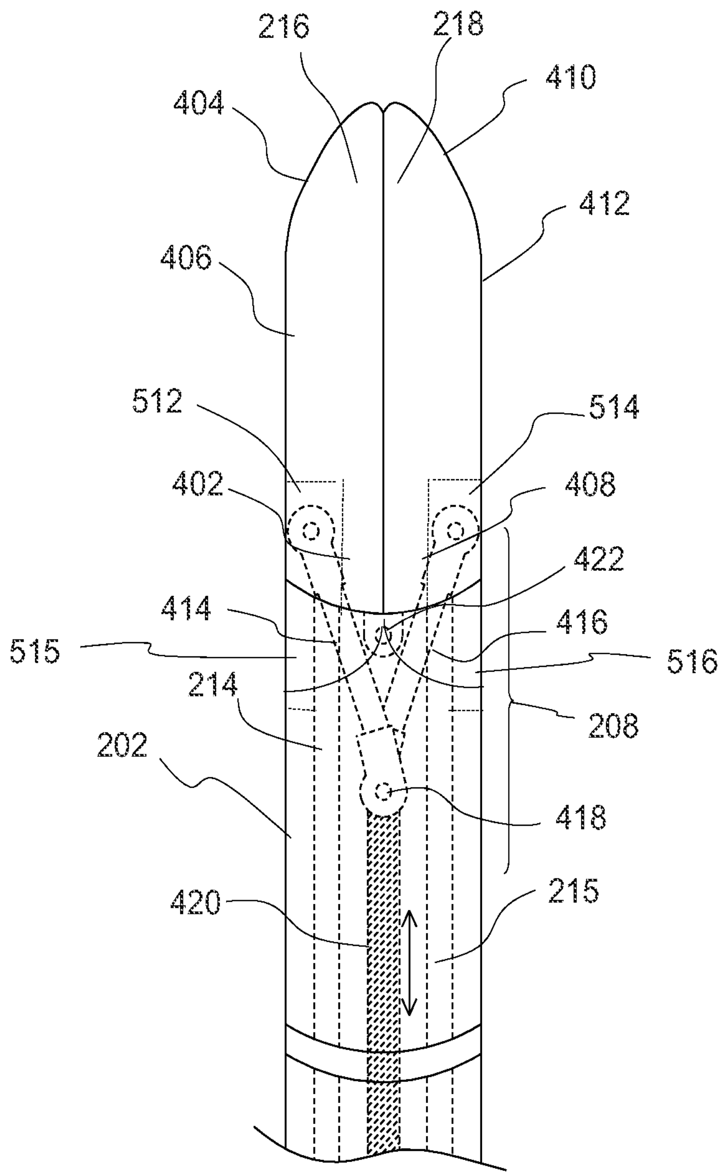

218
204
216
220a
220b
212
220c
202
214
215
100
210
150
206
208
227
226
222
170
152
154
SIGNAL PROCESSOR
RF GENERATOR
160
CONTROLLER
164
FLUID RESERVOIR AND PUMP

Fig. 2


216
218
410
404
412
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515
516
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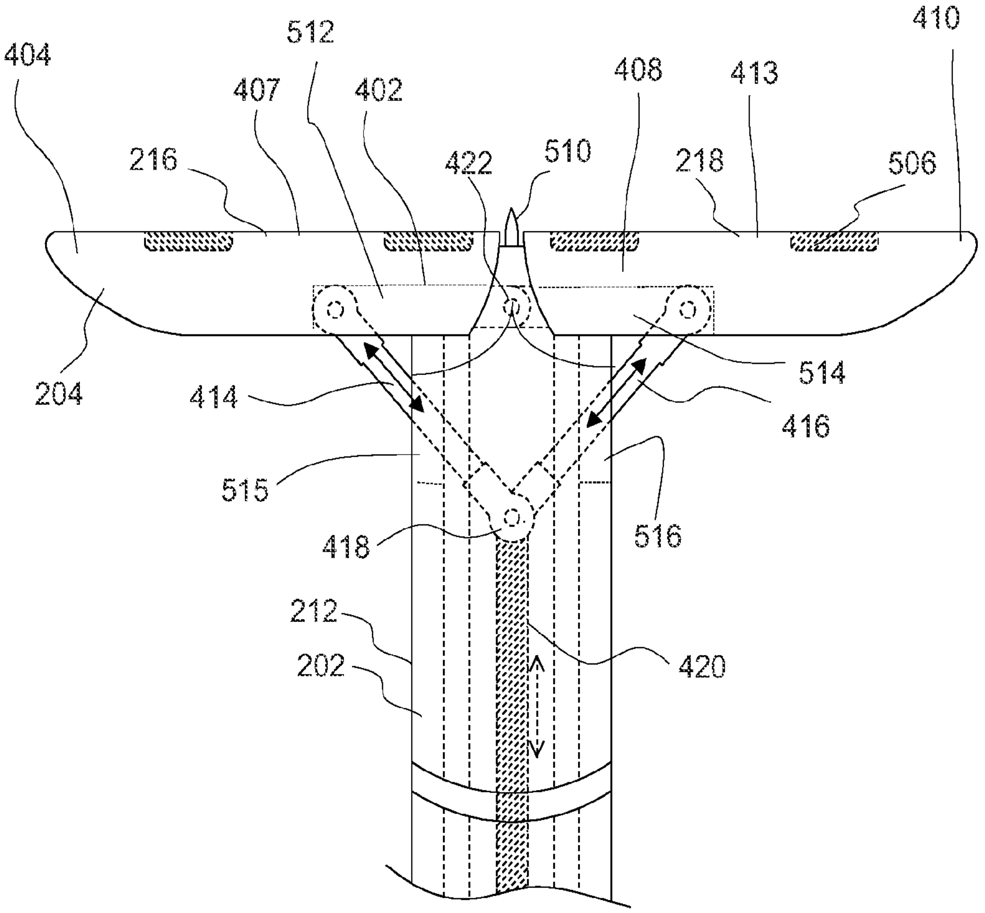
208
202
418
420
215

Fig. 3A


404
512
407
402
408
413
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216
422
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414
514
416
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212
202
420

Fig. 3B

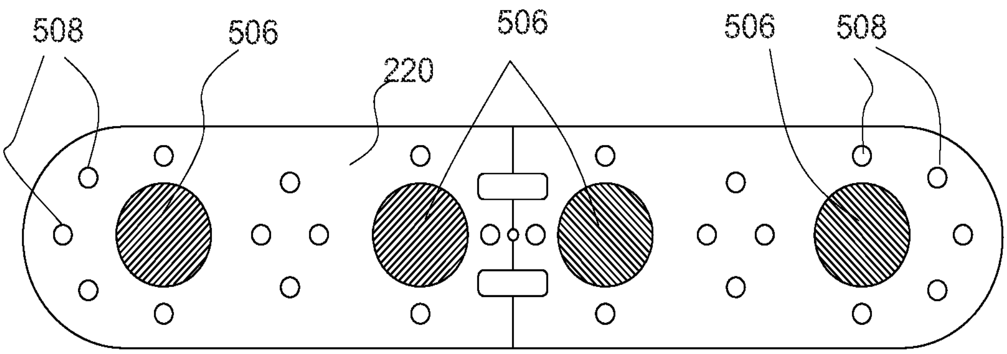

Fig. 4

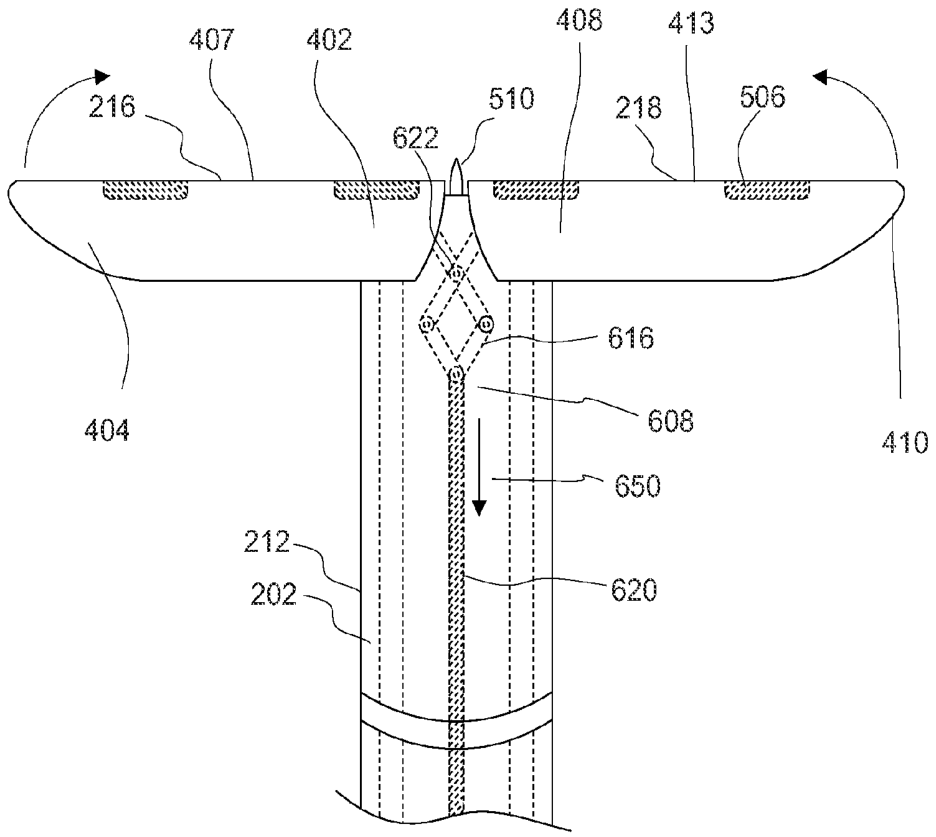
407
402
408
413
216
510
218
506
622
616
404
608
410
650
212
620
202

Fig. 5

OPEN IRRIGATED-MAPPING LINEAR ABLATION CATHETER

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Provisional Application No. 61/700,235, filed Sep. 12, 2012, which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure generally relates to systems and methods for providing a therapy to a patient. More particularly, the present disclosure relates to a catheter for mapping and ablating tissue within the heart of the patient.

BACKGROUND

[0003] Various catheters have been developed for use in ablating cardiac tissue proximate the pulmonary vein ostia in the left atrium in an effort to treat atrial fibrillation. Such catheters include capabilities for mapping bioelectrical signals arising proximate these ostia. There remains a continuing need for improvements in the foregoing catheters.

SUMMARY

[0004] In Example 1, a catheter device for use in ablating heart tissues. The catheter device comprises an elongate body and a tip section. The elongate body has a proximal end and an opposite distal end. The tip section is positioned at the distal end of the elongate body, and includes a first jaw member and a second jaw member. Each of the jaw members includes a proximal portion, a distal portion, an outer surface, and an inner surface, the jaw members pivotally joined to one another at the proximal portions thereof. The tip section is configured to transition between a closed configuration in which the inner surfaces are at least partially in contact with one another, and an open configuration in which the distal portions of the jaw members are deflected away from one another. In addition, the tip section is operable in both the open and closed configurations as an ablation electrode for selectively ablating the heart tissues.

[0005] In Example 2, the catheter device of Example 1, wherein the proximal portions of the first jaw member and the second jaw member are coupled together by a hinge element to allow splitting of the tip section by allowing the distal portions of the first jaw member and the second jaw member to deflect away from one another.

[0006] In Example 3, the catheter device of Examples 1 or 2, wherein the catheter is an irrigated catheter configured to deliver irrigation fluid through the tip section during an ablation procedure.

[0007] In Example 4, the catheter device of any of Examples 1-3, wherein the tip section is configured to map electrical activity of the heart.

[0008] In Example 5, the catheter device of any of Examples 1-4, wherein the first jaw member and the second jaw member are substantially perpendicular with respect to the elongate body in the open configuration.

[0009] In Example 6, the catheter device of any of Examples 1-5, wherein the first jaw member and the second jaw member configured to lie linearly in the open configuration.

[0010] In Example 7, the catheter device of any of Examples 1-6, wherein the inner surfaces of the first and second jaw members are generally flat.

[0011] In Examples 8, the catheter device of any of Examples 1-7, further comprising a control mechanism coupled to the tip section for manipulating the tip section between its closed and open configurations.

[0012] In Example 9, the catheter device of Example 8, wherein the control mechanism includes first and second control members connected, respectively, to the first and second jaw members and slideably disposed within the elongate body.

[0013] In Example 10, the catheter device of Examples 8 or 9, further comprising a handle coupled to the proximal end of the body, wherein the control mechanism includes a control element on the handle, and wherein the first and second control members extend at least partially within the elongate body from the tip section to the handle and are coupled to the control element, and wherein manipulation of the control element causes the control members to move relative to the elongate body so as to cause the tip section to transition between its open and closed configuration.

[0014] In Example 11, the catheter device of any of Examples 8-10, wherein the control mechanism is configured such that proximal movement of the first and second control members relative to the elongate body causes the distal portions of the first and second jaw members to deflect away from one another thereby causing the tip section to assume its open configuration.

[0015] In Example 12, the catheter device of any of Example 8-11, wherein the control mechanism includes a locking element to releasably retain the tip section in its open configuration at the target location within the patient.

[0016] In Example 13, a catheter device for use in ablating heart tissues. The catheter device comprises an elongate body and a tip section. The elongate body has a proximal end and an opposite distal end, and an inner fluid lumen extending from the proximal end through the distal end of the body. The tip section includes a first jaw member, a second jaw member, a plurality of microelectrodes, and a plurality of irrigation ports. The tip section is positioned at the distal end of the elongate body. Each of the jaw members includes a proximal portion, a distal portion, an outer surface, and an inner surface, the jaw members pivotally joined to one another at the proximal portions thereof. The tip section is configured to transition between a closed configuration in which the inner surfaces are at least partially in contact with one another, and an open configuration in which the distal portions of the jaw members are deflected away from one another, wherein the tip section is operable as an ablation electrode for selectively ablating the heart tissues. The microelectrodes are positioned on the inner surface of each of the jaw members for sensing electrical signals originating from the heart tissues. The irrigation ports provided on the inner surface of each of the jaw members and in fluid communication with the fluid lumen.

[0017] In Example 14, the catheter device of Example 13, wherein, the first jaw member and the second jaw member are substantially perpendicular with respect to the elongate body in the open configuration.

[0018] In Example 15, the catheter device of Example 13 or 14, wherein the first jaw member and the second jaw member configured to lie linearly in the open configuration.

[0019] In Example 16, the catheter device of any of Examples 13-15, wherein the inner surfaces of the first and second jaw members are generally flat.

[0020] In Example 17, the catheter device of any of Examples 13-16, further comprising a control mechanism coupled to the tip section for manipulating the tip section between its closed and open configurations, and further wherein the tip section is biased to its closed configuration, and wherein manipulation of the control mechanism causes the tip section to assume its open configuration.

[0021] In Example 18, a tissue ablation method comprising first advancing a portion of a catheter device to a location proximate target tissue within a patient's heart. The catheter device includes a tip section positioned at a distal end of an elongate body of the catheter device, the tip section including a first jaw member and a second jaw member, each of the jaw members including a proximal portion, a distal portion, an outer surface, and an inner surface. The jaw members are pivotally joined to one another at the proximal portions thereof. The advancing step is performed with the tip section in a closed configuration in which the inner surfaces are at least partially in contact with one another. The method further comprises manipulating a control mechanism on the catheter device to cause the distal portions of the jaw members to deflect and rotate away from one another such that the tip section assumes an open configuration wherein the inner surfaces of the jaw members are exposed to and positioned proximate the target tissue. The method further comprises positioning the inner surfaces of the jaw members in contact with the target tissue, and causing RF ablation energy to be supplied to the jaw members to effectuate RF ablation of the target tissue in contact with the inner surfaces of the jaw members.

[0022] In Example 19, the method of Example 18, further comprising, after manipulating the control mechanism to cause the tip section to assume its open configuration, mapping cardiac electrical activity proximate the target tissue using microelectrodes positioned on the inner surfaces of the jaw members.

[0023] In Example 20, the method of Example 18 or 19, further comprising causing irrigation fluid to be supplied to the target tissue while supplying the RF ablation energy via irrigation ports disposed in the inner surfaces of the jaw members.

[0024] While multiple embodiments are disclosed, still other embodiments of the present invention will become apparent to those skilled in the art from the following detailed description, which shows and describes illustrative embodiments of the invention. Accordingly, the drawings and detailed description are to be regarded as illustrative in nature and not restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. **1** is a schematic diagram illustrating an example of a catheter device positioned in a pulmonary vein of a heart.

[0026] FIG. **2** is a schematic elevation view of the catheter device of FIG. **1**, in accordance with an embodiment.

[0027] FIGS. **3**A-**3**B are schematic elevation views of a portion of the catheter device of FIG. **2**, showing a tip section of the catheter in closed and open configurations, respectively, according to an embodiment.

[0028] FIG. **4** is an end view of the catheter of FIG. **2** with the tip section in the open configuration shown in FIG. **3**B.

[0029] FIG. **5** is a schematic elevation view of a portion of an alternative embodiment of the catheter device of FIG. **2**, showing the tip section of the catheter in the open configurations.

[0030] While the invention is amenable to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and are described in detail below. The intention, however, is not to limit the invention to the particular embodiments described. On the contrary, the invention is intended to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

[0031] Various modifications and additions can be made to the exemplary embodiments discussed without departing from the scope of the present invention. For example, while the embodiments described above refer to particular features, the scope of this invention also includes embodiments having different combinations of features and embodiments that do not include all of the described features. Accordingly, the scope of the present invention is intended to embrace all such alternatives, modifications, and variations as falling within the scope of the claims, together with all equivalents thereof.

[0032] FIG. **1** is a schematic diagram illustrating a portion of a catheter device **100** positioned proximate a pulmonary vein **102** of a heart **104**. As is known, the heart **104** includes a right atrium (RA) **106**, a left atrium (LA) **108**, the pulmonary vein **102**, an inferior vena cava **110** and an intra-atrial septum **112**. In various embodiments, the catheter device **100** is configured for use in ablating heart tissues to treat cardiac arrhythmias. In one embodiment, the catheter device **100** is configured for treating atrial fibrillation by ablating tissue surrounding the ostia of pulmonary veins **102** of the heart **104** and ensuring an electrical isolation of the pulmonary vein **102**.

[0033] In the embodiment shown in FIG. **1**, to position the catheter device **100** at a target tissue location in the pulmonary vein **102**, the catheter device **100** can be inserted through a transseptal puncture. The transseptal puncture permits a direct route from the RA **106** to the LA **108** via an intra-atrial septum **112** (by puncturing the septum **112** proximate or at the fossa ovalis). Once, the catheter device **100** reaches the target tissue location in the pulmonary vein **102** in the LA **108** of the heart **104**, the catheter device **100** is directed towards the pulmonary vein **102**. The catheter device **100** can then be used to deliver radiofrequency (RF) energy to ablate the target tissues thereby isolating the pulmonary vein **102** from the rest of the heart **104** and preventing any pulses from the vein from getting into the heart **104**. As shown, the LA **108** of the heart **104** includes three additional pulmonary veins **114**, **116**, and **118** that can be ablated as per the requirements in a manner similar to the ablation of the pulmonary veins **102**.

[0034] FIG. **2** is a schematic elevation view of an ablation system **150** including the catheter device **100**, in an embodiment of the present invention. As shown in FIG. **2**, in addition to the catheter device **100**, the system **150** includes additional hardware and equipment including, in the particular embodiment shown, an ablation control system **152** including a radiofrequency generator **154** coupled to a controller **160**, a fluid delivery system **164** including, among other things, a fluid reservoir and pump, and a signal processor **170**. In various embodiments, for example, a system incorporating a non-irrigated catheter device **100**, the fluid delivery system

164 can be omitted. In various embodiments, the ablation control system **152** is configured to provide a controlled amount of RF energy to the catheter device **100** as needed for the particular ablation procedure being performed. The RF controller **160** controls the timing and the level of the RF energy delivered through the catheter device **100**. In the various embodiments, the signal processor **170** is configured, at least in part, to receive and process cardiac signals obtained by the catheter device **100** for interpretation and use by the clinician during the ablation procedure. The signal processor **170** can be configured to detect, process, and record electrical signals within the heart **104**. Based on the detected electrical signals, the signal processor **170** outputs electrocardiograms (ECGs) to a display (not shown), which can be analyzed by the operator to determine the existence and/or location of arrhythmia substrates within the heart **104** and/or determine the location of the catheter device **100** within the heart **104**. In an embodiment, the signal processor **170** generates and outputs an isochronal map of the detected electrical activity to the display for analysis by the operator. Although the ablation control system **152**, the fluid delivery system **164**, and the signal processor **170** are shown as discrete components, they can alternatively be incorporated into a single integrated device.

[0035] It is emphasized that the particular configuration and presence of the ablation control system **152**, the fluid delivery system **164** and the signal processor **170** are not critical to the various embodiments. Thus, when present, any such systems and hardware, whether currently known or later developed, can be utilized within the system **150**.

[0036] As further shown in FIG. **2**, the catheter device **100** includes an elongate body **202**, a tip section **204**, a handle **206**, and a control mechanism **208**. Additionally, the elongate body **202** includes a proximal end **210**, an opposite distal end **212**, and a pair of inner fluid lumens **214**, **215**. As shown, the inner fluid lumens **214**, **215** extend from the proximal end **210** through the distal end **212** of the elongate body **202**. In various embodiments, the elongate body **202** is generally tubular and houses additional components including, without limitation, electrical conductors and, as will be discussed in greater detail below, components for manipulating the catheter device **100**, including the tip section **204**, during the ablation procedures.

[0037] In the illustrated embodiment, the tip section **204** of the catheter device **100** includes a first jaw member **216** and a second jaw member **218**. In addition, in the particular embodiment shown, the distal portion of the catheter device **100** includes a plurality of ring electrodes **220***a*, **220***b*, **220***c* along the distal end **212** of the body **202** that can be used to gather electrocardiogram data before, during and after the particular ablation procedure. Additionally, as will be explained in further detail, a portion of the control mechanism **208** extends to and is operatively coupled to the jaw members **216**, **218** to facilitate manipulation thereof during the procedure.

[0038] As further shown, the handle **206** is coupled to the proximal end **210** of the elongate body **202**, and includes a connection port **222**, and a portion of the control mechanism **208** (in the illustrated embodiment, a control element **226**). The connection port **222** is operable to allow external devices and hardware, e.g., the ablation control system **152**, the fluid delivery system **164** and/or the signal processor **170**, to be operably coupled to the catheter device **100**. In addition, the handle **206** further includes a plurality of conduits, conductors, and wires (not shown) to facilitate control of the catheter device **100**. In the illustrated embodiment, the handle **206** also includes a control knob **227** operably to be manipulated by the clinician to deflect the distal end **212** of the elongate body **202**. As such, the control knob **227** is mechanically and operably coupled to additional components (e.g., one or more control wires) extending along the elongate body **202**. It is emphasized, however, that the particular technique for controlling deflection and steerability of the catheter device **100** is not critical to the various embodiments of the present invention. In addition, in various embodiments, the catheter device **100** is a fixed-shape catheter (i.e., is not steerable) and thus the control knob **227** and associated components can be omitted in such embodiments.

[0039] The tip section **204** is formed from an electrically conductive material. For example, some embodiments may use a platinum-iridium alloy. Some embodiments may use an alloy with approximately 90% platinum and 10% iridium.

[0040] The elongate body **202** can, in various embodiments, range from about 1.67 millimeters to about 3 millimeters in diameter, and between about 800 millimeters and 1500 millimeters in length. The foregoing dimensions, however, are exemplary only, and can vary depending on the particular clinical needs for the catheter device **100**.

[0041] In various embodiments, the elongate body **202** can have a circular cross-sectional geometry. However, other cross-sectional shapes, such as elliptical, rectangular, triangular, and various other shapes, can be provided. In some embodiments, the elongate body **202** can be preformed of an inert, resilient polymeric material that retains its shape and does not soften significantly at body temperature; for example, polyether block amides, polyurethane, polyester, and the like. The elongate body **202** can be flexible so that it is capable of winding through a tortuous path that leads to a target site. In some embodiments, the elongate body **202** can be semi-rigid, i.e., by being made of a stiff material, or by being reinforced with a coating, braid, coil, or similar structure, to control the flexibility of the elongate body **202**.

[0042] The handle **206** is used to be comfortably held by an operator during a treatment procedure involving ablation. The handle **206** is composed of a durable and generally rigid material, such as medical grade plastic, and ergonomically molded to allow the practitioner to easily manipulate the catheter device **100**.

[0043] In various embodiments, the jaw members **216**, **218** are configured to be operable as RF ablation electrodes to deliver RF energy to target cardiac tissue in an RF ablation procedure. As shown, the tip section **204** is positioned at the distal end **212** of the elongate body **202** and the handle **206** is positioned at the proximal end **210** of the elongate body **202**. As will be explained in further detail herein, a portion of the control mechanism **208** is placed at the tip section **204** and a portion of the control mechanism **208** is placed at the handle **206** of the catheter device **100**. The control mechanism **208** is configured to manipulate the tip section **204** between a closed and an open configuration. In the closed configuration, the jaw members **216** and **218** are generally parallel to the elongate body **202**. In an embodiment, in the open configuration, the jaw members **216** and **218** can be configured to lie substantially perpendicular to the elongate body **202**. In the various embodiments, the tip section **204** can be operable as an RF ablation electrode in both the open and closed configurations.

[0044] FIGS. 3A and 3B are schematic partial elevation views of the distal portion of the catheter device **100** showing the tip section **204** in the closed and open configurations, respectively. In addition, FIG. **4** is a schematic end view of the tip section **204** in its open configuration. As shown in FIG. 3B, the first jaw member **216** includes a first proximal portion **402**, a first distal portion **404**, a first outer surface **406**, and a first inner surface **407**. As further shown, the second jaw member **218** includes a second proximal portion **408**, a second distal portion **410**, a second outer surface **412**, and a second inner surface **413**.

[0045] In the illustrated embodiment, the control mechanism **208** includes a first control member **414** and a second control member **416**. In some embodiments, the control mechanism **208** can include additional elements to facilitate manipulation and actuation of the jaw members **216**, **218**, such as one or more pivot pins **418**, a control wire **420** and the like. As shown, the first and second proximal portions **402**, **408** of the jaw members **216**, **218** are pivotally connected to one another via a hinge element **422**. In addition, the first and second control members **414**, **416** extend partially within the elongate body **202** and are also connected to the first and second proximal portions **402**, **408** of the first and second jaw members **216** and **218**, and also to the control element **226** (e.g., via the control wire **420** and the pivot pin **418**).

[0046] The control wire **420** can be made of any polymeric or metallic material having sufficient flexibility and mechanical strength to transfer forces between the control element **226** and the tip section **204**. The diameter and the constituent material of the control wire **420** are selected to ensure that the control wire **420** has sufficient axial stiffness to support the axial load necessary to open the jaws. Exemplary materials include, without limitation, nickel titanium (nitinol) alloys, stainless steels, and the like. In one embodiment, the control wire **420** can be made of nitinol and can have a diameter of about 0.018-0.019 inch. The control wire **420** operably connects the jaw members **216** and **218** with the control element **226**. In various embodiments, the control element **226** can be a knob, or a push button or any other similar element.

[0047] As shown, in the open configuration of the tip section **204**, the inner surfaces **407**, **413** lie substantially in the same plane and the jaw members **216**, **218** are oriented generally orthogonal to the elongate body **202**. In the various embodiments, the inner surfaces **407**, **413** are operable as RF ablation electrodes for forming linear ablation lesions in or on the target cardiac tissue. In an embodiment, the inner surfaces **407**, **413** of the first and second jaw members **216** and **218** are generally flat.

[0048] As can be further seen in FIGS. 3B and **4**, in the illustrated embodiment, the tip section **204** includes a plurality of microelectrodes **506**, a plurality of irrigation ports **508**, and a locking element **510**. As shown, the micro-electrodes **506** and the irrigation ports **508** are disposed along the inner surfaces **407**, **413** of the jaw members **216**, **218**, respectively, with at least one microelectrode **506** and at least one irrigation port **508** in each of the jaw members **216**, **218**. As can be seen in FIGS. 3B and **4**, when the tip section is in its open configuration, the microelectrodes **506** and the irrigation ports **508** will be exposed to the environment.

[0049] In addition, the jaw member **216** includes a first slot **512** and the jaw member **218** includes a second slot **514**. As further shown, the distal end **212** of the body includes slots **515**, **516** aligned, respectively, with the first slot **512** and the second slot **514**.

[0050] In an embodiment, the slots **512**, **515** are configured to receive the first control member **414**, and the slots **514**, **516** are configured to receive the second control member **416**. This arrangement allows the control members **414**, **416** to translate and rotate relative to the elongate body **202** to facilitate transitioning the tip section **204** between its closed and open configurations.

[0051] In use, the operator can manipulate the catheter device **100** so as to direct and position the catheter tip section **204** at the target tissue location (see, e.g., FIG. **1**). Upon reaching the target tissue location (i.e. a location proximate the pulmonary vein to be isolated), the catheter device **100** can be used in a generally conventional manner to map and/or ablate cardiac tissue. For example, in the illustrated embodiment, the ring electrode **220***a* and the tip section **204**, in the closed configuration, can be used as a pair of mapping electrodes. Similarly, tissue can also be mapped between the electrode pair **220***b*, **220***c*. Additionally, the tip section **204** can be used as either a point ablation source (i.e., by positioning the tip section **204** to lie generally perpendicular to the tissue to be ablated), or as a linear ablation electrode (i.e., by manipulating the catheter device **100** so that the outer surface of the tip section **204** lies along the tissue to be ablated.

[0052] Subsequently, the clinician can manipulate the control element **226** to cause the control members **414** and **416** to move relative to the elongate body **202** so as to cause the tip section **204** to transition from its closed configuration to its open configuration. In the closed configuration, the inner surfaces **407**, **413** are at least partially in contact with one another.

[0053] In order to transition the tip section **204** from the closed configuration to the open configuration, a force is applied on the control element **226**. Upon application of the force on the control element **226**, the pulling of the control wire **420** causes deflection of the first and second control members **414** and **416**. Upon application of the force, the hinge element **422** facilitates transition of the tip section **204** from the closed configuration to the open configuration. The hinge element **422** facilitates splitting of the tip section **204** by allowing the distal portions **404** and **410** of the first jaw member **216** and the second jaw member **218** to rotate and deflect away from one another. In various other embodiments, the hinge element **422** also includes linkages to allow the first and second proximal portions **402**, **408** to deflect laterally away from one another as the tip section **204** opens, to further facilitate transition to the open configuration.

[0054] In some embodiments, the tip section **204** can be returned to its closed configuration by further manipulation of the control mechanism **208**. In various embodiments, the jaw member **216**, **218** are biased (e.g., by a spring or similar element, not shown, in the control mechanism **208**) toward the closed configuration. In such embodiments, upon removal of the force, the jaw members **216** and **218** can automatically transition back to the closed configuration.

[0055] In various embodiments, the locking element **510** is operable to retain the tip section **204** in the desired position relative to the target cardiac tissue. In the illustrated embodiment, the locking element **510** can be a pin or similar structure configured to engage the tissue to inhibit unintended movement of the tip section **204** during formation of the ablation lesion. The first and the second jaw members **216** and **218** are configured to revolve on the locking element **510**, which is exposed when the tip section **204** assumes its open configuration.

[0056] In the open configuration, the inner surfaces **407**, **413** of the first jaw member **216** and the second jaw member **218** are exposed to the target tissue location, and can be operable as RF ablation electrodes to form a generally linear ablation lesion on the targeted cardiac tissue. In addition, the microelectrodes **506** are exposed to the target tissues that allow the operator to map the electrical signals within the heart **104**. The electrical signals are recorded via the microelectrodes **506** of the catheter device **100**. The electrical signals within the heart **104** can be detected, processed, and recorded by the signal processor **170** that is coupled to the microelectrodes **506**. Based on the electrical signals sensed by the microelectrodes **506**, the operator can identify the specific target tissue sites within the heart **104**, and ensure that the arrhythmia causing substrates have been electrically isolated by the ablative treatment. After mapping the electrical signals and upon recognition of the tissues responsive for causing arrhythmia, the operator can then ablate the target tissue, with the inner surfaces **407**, **413** of the jaw members **216**, **218** in contact with the tissue and operable as the RF ablation electrodes using the energy generated from the ablation control system **152**. In various embodiments, the irrigation ports **508** are fluidly coupled to the fluid lumens **214**, **215**. In order to maintain the temperature of the tip section **204** and surrounding tissues during ablation, a cooling fluid, such as a saline fluid, is delivered from the fluid delivery system **164** through the fluid lumens **214**, **215** to the catheter tip section **204**, where the fluid exits through irrigation ports **508** to cool the tip section **204** and surrounding tissue. In an embodiment, the inner fluid lumens **214**, **215** can be formed of a flexible material so as to get articulated during transition between the open configuration and the closed configuration. In the illustrated embodiment, the fluid lumen **214** is fluidly coupled to and supplies cooling fluid to the irrigation ports **508** in the jaw member **216**, while the fluid lumen **215** is fluidly coupled to and supplies cooling fluid to the irrigation ports **508** in the jaw member **218**. This arrangement is illustrative only, however, and so other fluid lumen and irrigation port configurations can be utilized within the scope of the various embodiments. In various embodiments, the microelectrodes **506** and/or the fluid/coolant delivery capabilities are omitted from the system.

[0057] The mechanism shown in the figures is exemplary and modifications may be made for employing a different control mechanism **208** that is capable of causing the jaw members to transition between the open and closed configurations. For example, FIG. **5** is a schematic elevation view of the distal end portion of an alternative embodiment of the catheter device **100** with the tip section **204** in its open configuration. In the particular embodiment shown in FIG. **5**, the catheter device **100** includes an alternative control mechanism **608** including a control linkage **616** and a control wire **620**. As further shown, the control linkage includes an arrangement of linking members pivotally connected to one another, including at a fixed pivot hinge **622**. As further shown, the linkages are connected to the jaw members **216**, **218**. In the illustrated embodiment, the control wire **620** is shown in its distal-most position such that the jaw members **216**, **218** lie relatively orthogonal to the longitudinal axis of the catheter body **202**. As indicated by the arrow **650** in FIG. **5**, proximal motion of the control wire **620** relative to the body **202** (accomplished by, for example, manipulation of the control element **226** shown in FIG. **2**) will cause the distal end portions **404**, **410** of the jaw members **216**, **218** to rotate toward one another about the fixed pivot hinge **622**, thus transitioning the tip section **204** to its closed configuration. Of course, still other actuation mechanisms may be employed to facilitate transitioning the tip section **204** between its open and closed configurations.

[0058] Clinical benefits of the catheter device **100**, in some embodiments, can include, but are not limited to, controlling the temperature and reducing coagulum formation on the tip section **204** of the catheter, preventing impedance rise of tissue in contact with the catheter tip, and maximizing potential energy transfer to the tissue. Additionally, the localized intra cardiac electrical activity can be recorded in real time or near-real time right at the point of energy delivery. The open configuration of the tip section **204** allows the operator to perform the longer ablations by doubling the active length of the ablation electrode as compared to a conventional RF tip electrode. At the same time, the compact profile of the tip section **204** when in the closed configuration facilitates ease of delivery and deployment of the catheter device **100** to the area of interest within the heart **104**.

I claim:

1. A catheter device for use in ablating heart tissues, the catheter device comprising:

an elongate body having a proximal end and an opposite distal end; and

a tip section positioned at the distal end of the elongate body, the tip section including a first jaw member and a second jaw member, each of the jaw members including a proximal portion, a distal portion, an outer surface, and an inner surface, the jaw members pivotally joined to one another at the proximal portions thereof, the tip section configured to transition between a closed configuration in which the inner surfaces are at least partially in contact with one another, and an open configuration in which the distal portions of the jaw members are deflected away from one another,

wherein the tip section is operable in both the open and closed configurations as an ablation electrode for selectively ablating the heart tissues.

2. The catheter device of claim **1**, wherein the proximal portions of the first jaw member and the second jaw member are coupled together by a hinge element to allow splitting of the tip section by allowing the distal portions of the first jaw member and the second jaw member to deflect away from one another.

3. The catheter device of claim **1**, wherein the catheter is an irrigated catheter configured to deliver irrigation fluid through the tip section during an ablation procedure.

4. The catheter device of claim **1**, wherein the tip section is configured to map electrical activity of the heart.

5. The catheter device of claim **1**, wherein the first jaw member and the second jaw member are substantially perpendicular with respect to the elongate body in the open configuration.

6. The catheter device of claim **5**, wherein the first jaw member and the second jaw member configured to lie linearly in the open configuration.

7. The catheter device of claim **1**, wherein the inner surfaces of the first and second jaw members are generally flat.

8. The catheter device of claim **1**, further comprising a control mechanism coupled to the tip section for manipulating the tip section between its closed and open configurations.

9. The catheter device of claim **8**, wherein the control mechanism includes first and second control members connected, respectively, to the first and second jaw members and slideably disposed within the elongate body.

10. The catheter device of claim **8**, further comprising a handle coupled to the proximal end of the body, wherein the control mechanism includes a control element on the handle, and wherein the first and second control members extend at least partially within the elongate body from the tip section to the handle and are coupled to the control element, and wherein manipulation of the control element causes the control members to move relative to the elongate body so as to cause the tip section to transition between its open and closed configuration.

11. The catheter device of claim **10**, wherein the control mechanism is configured such that proximal movement of the first and second control members relative to the elongate body causes the distal portions of the first and second jaw members to deflect away from one another thereby causing the tip section to assume its open configuration.

12. The catheter device of claim **8**, wherein the control mechanism includes a locking element to releasably retain the tip section in its open configuration at the target location within the patient.

13. A catheter device for use in ablating heart tissues, the catheter device comprising:

- an elongate body having a proximal end and an opposite distal end, and an inner fluid lumen extending from the proximal end through the distal end of the body; and
- a tip section positioned at the distal end of the elongate body, the tip section including:
  - a first jaw member and a second jaw member, each of the jaw members including a proximal portion, a distal portion, an outer surface, and an inner surface, the jaw members pivotally joined to one another at the proximal portions thereof, the tip section configured to transition between a closed configuration in which the inner surfaces are at least partially in contact with one another, and an open configuration in which the distal portions of the jaw members are deflected away from one another, wherein the tip section is operable as an ablation electrode for selectively ablating the heart tissues;
  - a plurality of microelectrodes positioned on the inner surface of each of the jaw members for sensing electrical signals originating from the heart tissues; and
  - a plurality of irrigation ports provided on the inner surface of each of the jaw members and in fluid communication with the fluid lumen.

14. The catheter device of claim **13**, wherein, the first jaw member and the second jaw member are substantially perpendicular with respect to the elongate body in the open configuration.

15. The catheter device of claim **14**, wherein the first jaw member and the second jaw member configured to lie linearly in the open configuration.

16. The catheter device of claim **13**, wherein the inner surfaces of the first and second jaw members are generally flat.

17. The catheter device of claim **13**, further comprising a control mechanism coupled to the tip section for manipulating the tip section between its closed and open configurations, and further wherein the tip section is biased to its closed configuration, and wherein manipulation of the control mechanism causes the tip section to assume its open configuration.

18. A tissue ablation method comprising:

- advancing a portion of a catheter device to a location proximate target tissue within a patient's heart, wherein the catheter device includes a tip section positioned at a distal end of an elongate body of the catheter device, the tip section including a first jaw member and a second jaw member, each of the jaw members including a proximal portion, a distal portion, an outer surface, and an inner surface, the jaw members pivotally joined to one another at the proximal portions thereof, wherein the advancing step is performed with the tip section in a closed configuration in which the inner surfaces are at least partially in contact with one another;
- manipulating a control mechanism on the catheter device to cause the distal portions of the jaw members to deflect and rotate away from one another such that the tip section assumes an open configuration wherein the inner surfaces of the jaw members are exposed to and positioned proximate the target tissue;
- positioning the inner surfaces of the jaw members in contact with the target tissue; and
- causing RF ablation energy to be supplied to the jaw members to effectuate RF ablation of the target tissue in contact with the inner surfaces of the jaw members.

19. The method of claim **18**, further comprising, after manipulating the control mechanism to cause the tip section to assume its open configuration, mapping cardiac electrical activity proximate the target tissue using microelectrodes positioned on the inner surfaces of the jaw members.

20. The method of claim **19**, further comprising causing irrigation fluid to be supplied to the target tissue while supplying the RF ablation energy via irrigation ports disposed in the inner surfaces of the jaw members.

* * * * *

patsnap

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申请(专利权)人(译)	BOSTON SCIENTIFIC SCIMED INC.		
当前申请(专利权)人(译)	BOSTON SCIENTIFIC SCIMED INC.		
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摘要(译)

用于消融心脏组织的导管装置包括细长主体和尖端部分，细长主体具有近端和相对的远端，尖端部分定位在细长主体的远端。尖端部分包括第一钳口构件和第二钳口构件，每个包括近端部分，远端部分，外表面和内表面。钳口构件在其近端部分处可枢转地彼此连接，并且尖端部分构造成在内表面至少部分地彼此接触的闭合配置和远端的打开配置之间转换。钳口构件的一部分彼此偏离。尖端部分可用作消融电极，用于选择性地消融心脏组织。