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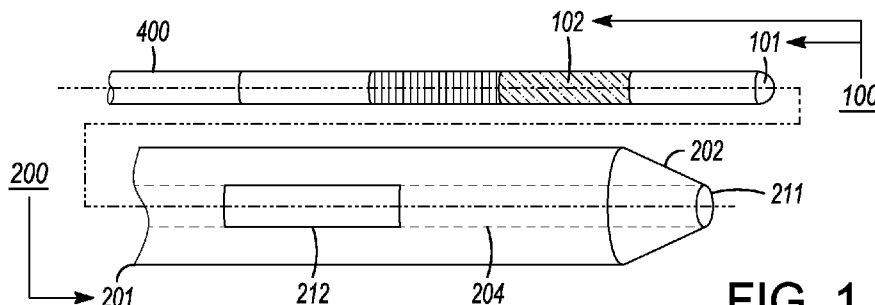


FIG. 1

(57) Abstract: At least one energy-emitting device configured to selectively initially emit and direct energy for the initial formation of a puncture hole through a biological feature. At least one other energy-emitting device configured to further emit and direct energy for subsequent or further enlargement of the puncture hole after the initial formation of the puncture hole by said at least one energy-emitting device.

ENERGY-EMITTING DEVICES FOR ELONGATED MEDICAL ASSEMBLY**TECHNICAL FIELD**

[01] This document relates to the technical field of (and is not limited to) (A) energy-emitting devices for use with an elongated medical assembly (and method therefor), and/or (B) an elongated medical assembly including energy-emitting devices (and method therefor).

BACKGROUND

[02] Known medical devices are configured to facilitate a medical procedure, and help healthcare providers diagnose and/or treat medical conditions of sick patients.

SUMMARY

[03] It will be appreciated that there exists a need to mitigate (at least in part) at least one problem associated with the existing (known) energy-emitting devices (also called the existing technology). After much study of, and experimentation with, the existing (known) energy-emitting devices, an understanding (at least in part) of the problem and its solution have been identified (at least in part) and are articulated (at least in part) as follows:

[04] Various procedures may require the formation of a relatively large bore hole through the inter-atrial septum of the heart (an example of a biological feature). For example, it may be necessary to deliver a relatively larger medical device from the right side to the left side of the heart of the patient. Cryoablations, mitral valve repairs and/or left atrial appendage closures are some of the procedures that may require relatively larger medical devices to access the left atrium of the heart. There are known medical devices (such as the known transseptal dilator) configured for large access. The known procedural workflow, however, may require the use of an energy-emitting needle to form a puncture hole through the septum (of the heart), and prior to using (deploying) the larger medical device, predilation of the puncture hole may be required (by using a dilation device). Utilization of these many medical devices may lead to extended surgical time and/or exposure to unwanted surgical mishaps as a result of the insertion, movement and/or removal of these medical devices (into, and out from, the patient).

[05] In view of the foregoing problems, it may be desirable to reduce the number of medical devices required for the initial formation of the puncture hole and subsequent enlargement of the puncture hole. It may be desirable to provide an apparatus configured to selectively emit (and direct) energy (such as radio-frequency energy) to (A) initially form a puncture hole through a biological feature (such as the inter-atrial septum) of a patient, and (B) further enlarge the puncture hole (after its initial formation). It may be

desirable to provide these functions and/or structures in a single apparatus, in which the apparatus is configured to (A) initially form the puncture hole (through the biological feature), and (B) subsequently dilate the puncture hole. This arrangement may streamline, at least in part, the workflow and/or reduce the number of devices in the sterile field used in a procedure, etc.

[06] It may be desirable to create a large bore hole in the inter-atrial septum by using the apparatus. It may be desirable to provide the apparatus for creating large bore holes in other biological structures including, and not limited to, the inter-ventricular septum and blood vessels, etc.

[07] To mitigate, at least in part, at least one problem associated with the existing technology, there is provided (in accordance with a major aspect) an apparatus. The apparatus includes and is not limited to (comprises) at least one energy-emitting device configured to selectively initially emit and direct energy for the initial formation of a puncture hole through a biological feature. At least one other energy-emitting device is configured to further selectively emit and direct energy for subsequent or further enlargement of the puncture hole after the initial formation of the puncture hole by at least one energy-emitting device. Preferably, at least one energy-emitting device and at least one other energy-emitting device are configured to be mounted proximate to a distal portion of an elongated medical needle. Even more preferably, at least one energy-emitting device, at least one other energy-emitting device and the elongated medical needle are configured to be deployed along an elongated medical assembly.

[08] To mitigate, at least in part, at least one problem associated with the existing technology, there is provided (in accordance with a major aspect) an apparatus. The apparatus is for the formation of (is configured to form) a puncture hole to be extended through (extending through) a biological feature. The apparatus is for use with (configured to be used with or on) an elongated medical assembly. The apparatus includes and is not limited to (comprises) an energy-emitting assembly movable along the elongated medical assembly toward a position proximate to the biological feature.

[09] The energy-emitting assembly is configured to direct, at least in part, the initial emission of energy toward, at least in part, the biological feature for the initial formation of the puncture hole, extending through the biological feature, after the energy-emitting assembly, in use, is moved along the elongated medical assembly and is positioned proximate to the biological feature.

[010] The energy-emitting assembly is also configured to further direct, at least in part, subsequent emission of energy toward, at least in part, the biological feature neighboring (surrounding) the puncture hole for subsequent or further enlargement of the puncture hole after the energy-emitting assembly is further moved along the elongated medical assembly toward the biological feature neighboring (surrounding) the puncture hole.

[011] To mitigate, at least in part, at least one problem associated with the existing technology, there is provided (in accordance with a major aspect) a method. The method is for the formation of a puncture hole through a biological feature by at least one energy-emitting device and at least one other energy-emitting device configured to be mounted proximate to a distal needle tip section of an elongated medical needle. The elongated medical needle is configured to be deployed along an elongated medical assembly. The method includes and is not limited to (comprises) moving a distal tip section of the elongated medical assembly to the biological feature. The method also includes moving at least one energy-emitting device and at least one other energy-emitting device by moving the distal needle tip section of the elongated medical needle along the elongated medical assembly to the biological feature. The method also includes selectively initially emitting and directing energy, via at least one energy-emitting device, for the initial formation of the puncture hole through the biological feature. The method also includes further selectively emitting and directing energy, via at least one other energy-emitting device, for subsequent or further enlargement of the puncture hole after the initial formation of the puncture hole by at least one energy-emitting device.

[012] Other aspects are identified in the claims. Other aspects and features of the non-limiting embodiments may now become apparent to those skilled in the art upon review of the following detailed description of the non-limiting embodiments with the accompanying drawings. This Summary is provided to introduce concepts in simplified form that are further described below in the Detailed Description. This Summary is not intended to identify potentially key features or possible essential features of the disclosed subject matter, and is not intended to describe each disclosed embodiment or every implementation of the disclosed subject matter. Many other novel advantages, features, and relationships will become apparent as this description proceeds. The figures and the description that follow more particularly exemplify illustrative embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[013] The non-limiting embodiments may be more fully appreciated by reference to the following detailed description of the non-limiting embodiments when taken in conjunction with the accompanying drawings, in which:

[014] FIG. 1 to FIG. 4 depict side perspective views of embodiments of an energy-emitting assembly including a first energy-emitting device and a second energy-emitting device; and

[015] FIG. 5 depicts a side view of an embodiment of the energy-emitting assembly of FIG. 1; and

[016] FIG. 6 to FIG. 12 depict side views (FIG. 6 and FIG. 7) and side perspective views (FIG. 8 to FIG. 12) of embodiments of the energy-emitting assembly of FIG. 1; and

[017] FIG. 13 to FIG. 15 depict side views (FIG. 13 and FIG. 14) and a side perspective view (FIG. 15) of embodiments of the energy-emitting assembly of FIG. 1; and

[018] FIG. 16 to FIG. 19 depict side views of embodiments of the energy-emitting assembly of FIG. 1.

[019] The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details unnecessary for an understanding of the embodiments (and/or details that render other details difficult to perceive) may have been omitted. Corresponding reference characters indicate corresponding components throughout the several figures of the drawings. Elements in the several figures are illustrated for simplicity and clarity and have not been drawn to scale. The dimensions of some of the elements in the figures may be emphasized relative to other elements for facilitating an understanding of the various disclosed embodiments. In addition, common, and well-understood, elements that are useful in commercially feasible embodiments are often not depicted to provide a less obstructed view of the embodiments of the present disclosure.

[020] LISTING OF REFERENCE NUMERALS USED IN THE DRAWINGS

energy-emitting assembly 100	three-way stopcock 203
first energy-emitting device 101	lumen 204
one energy-emitting device 101	hemostatic valve 205
elongated medical assembly 200	handle assembly 207
elongated catheter assembly 201	side wall section 208
distal tip section 202	first portal 211

second portal 212	display device 504
medical needle 400	guidewire assembly 600
distal needle tip section 401	biological feature 900
triangle-shaped arrangement 402	puncture hole 902
first wire 411	movement direction 904
second wire 412	distal angle 906
energy source 500	
connector cable 502	

DETAILED DESCRIPTION OF THE NON-LIMITING EMBODIMENT(S)

[021] The following detailed description is merely exemplary and is not intended to limit the described embodiments or the application and uses of the described embodiments. As used, the word “exemplary” or “illustrative” means “serving as an example, instance, or illustration.” Any implementation described as “exemplary” or “illustrative” is not necessarily to be construed as preferred or advantageous over other implementations. All of the implementations described below are exemplary implementations provided to enable persons skilled in the art to make or use the embodiments of the disclosure and are not intended to limit the scope of the disclosure. The scope of the disclosure is defined by the claims. For the description, the terms “upper,” “lower,” “left,” “rear,” “right,” “front,” “vertical,” “horizontal,” and derivatives thereof shall relate to the examples as oriented in the drawings. There is no intention to be bound by any expressed or implied theory in the preceding Technical Field, Background, Summary or the following detailed description. It is also to be understood that the devices and processes illustrated in the attached drawings, and described in the following specification, are exemplary embodiments (examples), aspects and/or concepts defined in the appended claims. Hence, dimensions and other physical characteristics relating to the embodiments disclosed are not to be considered as limiting, unless the claims expressly state otherwise. It is understood that the phrase “at least one” is equivalent to “a”. The aspects (examples, alterations, modifications, options, variations, embodiments and any equivalent thereof) are described regarding the drawings. It should be understood that the disclosure is limited to the subject matter provided by the claims, and that the disclosure is not limited to the particular aspects depicted and described. It will be appreciated that the scope of the meaning of a device configured to be coupled to an item (that is, to be connected to, to interact with the item, etc.) is to be interpreted as the device being configured to be coupled to the item, either directly or

indirectly. Therefore, “configured to” may include the meaning “either directly or indirectly” unless specifically stated otherwise.

[022] FIG. 1 to FIG. 15 are directed to a major embodiment, and FIG. 16 to FIG. 19 are directed to another major embodiment.

[023] FIG. 1 to FIG. 4 depict side perspective views of embodiments of an energy-emitting assembly 100 including a first energy-emitting device 101 and a second energy-emitting device 102.

[024] Referring to the embodiment as depicted in FIG. 1, the energy-emitting assembly 100 is configured to be deployed along an elongated medical assembly 200. The energy-emitting assembly 100 includes a first energy-emitting device 101 and a second energy-emitting device 102 (spaced apart from each other). Preferably, the elongated medical assembly 200 defines an elongated lumen 204 extending from a distal tip section 202 (as depicted in FIG. 1) and a proximal section (as depicted in FIG. 5). The energy-emitting assembly 100 is configured to be inserted into, and deployed along, the lumen 204 of the elongated medical assembly 200. Preferably, the elongated medical assembly 200 forms a first portal 211 and a second portal 212. The first portal 211 is configured to interact with the first energy-emitting device 101. The second portal 212 is configured to interact with the second energy-emitting device 102. It will be appreciated that in accordance with the embodiments as depicted in FIG. 16 to FIG. 19, the second portal 212 is not provided with the elongated medical assembly 200. The elongated medical assembly 200 may include (for example), a catheter assembly 201, a dilator assembly, etc., and any equivalent thereof.

[025] Referring to the embodiment as depicted in FIG. 1, the energy-emitting assembly 100 is (preferably) configured to be mounted to an elongated medical needle 400. The elongated medical needle 400 is configured to be inserted into, and deployed along, the lumen 204 of the elongated medical assembly 200. The elongated medical needle 400 is configured to be inserted into a confined space defined by a living body (the patient). The elongated medical needle 400 includes (preferably) a relatively thin and flexible wire (an elongated flexible shaft) configured to be inserted into a confined or tortuous space (a confined space) defined by the patient. The elongated medical needle 400 is (preferably) impermeable by a bodily fluid of the patient.

[026] Referring to the embodiment as depicted in FIG. 1, the elongated medical needle 400 and the energy-emitting assembly 100 may include (and are not limited to) a radio frequency puncture device configured to emit energy therefrom, such as the BAYLIS

(TRADEMARK) POWERWIRE (REGISTERED TRADEMARK) radio frequency guidewire, manufactured by the BAYLIS MEDICAL COMPANY (headquartered in Canada).

[027] Referring to the embodiment as depicted in FIG. 2, the elongated medical needle 400 is slidably inserted into (received by) the lumen 204 of the elongated medical assembly 200; this is done in such a way that the first energy-emitting device 101 is positionable proximate to the distal tip section 202 of the elongated medical assembly 200. The elongated medical needle 400 includes (preferably) the first energy-emitting device 101 configured to form an initial puncture through a biological wall (not depicted). The first energy-emitting device 101 is movable from within the distal tip section 202 of the elongated medical assembly 200 and out from the first portal 211. The elongated medical needle 400 includes (preferably) the second energy-emitting device 102 configured to further enlarge the puncture that was initially formed by the first energy-emitting device 101 (once the second energy-emitting device 102 is deployed, or positioned, as depicted in FIG. 4). The second energy-emitting device 102 is movable from within the lumen 204 of the distal tip section 202 and out from the second portal 212. The first energy-emitting device 101 is configured to be positioned (by movement of the elongated medical needle 400 along the elongated medical assembly 200) proximate to (or at) the catheter assembly 201 of the elongated medical assembly 200. The second energy-emitting device 102 is configured to be positioned (by movement of the elongated medical needle 400 along the elongated medical assembly 200) proximate to the second portal 212 of the elongated medical assembly 200. The first energy-emitting device 101 is configured to puncture (by forming the puncture hole 902 through) the biological feature 900 (such as a biological wall, tissue, etc.) of the patient (such as, the inter-atrial septum, etc.) while the first energy-emitting device 101 is moved out from the first portal 211 of the elongated medical assembly 200. The second energy-emitting device 102 is configured to further enlarge the puncture hole 902 (after the puncture hole 902 was initially formed by the first energy-emitting device 101) while the second energy-emitting device 102 is moved out from the second portal 212 of the elongated medical assembly 200 and while the elongated medical assembly 200 is further moved toward the puncture hole (so that the second energy-emitting device 102 may be moved toward the puncture hole).

[028] Referring to the embodiment as depicted in FIG. 2, the elongated medical needle 400 is configured to extend toward the distal tip section 202 of the elongated medical assembly 200 (once the elongated medical needle 400 is inserted into the lumen 204 of the elongated

medical assembly 200). As depicted in FIG. 2, the first energy-emitting device 101 is positioned proximate to (or at) the distal tip section 202 (near the first portal 211) of the elongated medical needle 400. The second energy-emitting device 102 is positioned proximate to the distal tip section 202 (near the second portal 212) of the elongated medical needle 400. The energy-emitting devices (101, 102) are configured to be selectively activated to emit energy (to emit energy or to deliver an amount of radio frequency energy) to a biological feature after the energy-emitting devices (101, 102) are positioned proximate to the biological feature. The surgeon (physician) may selectively control (or select) activation of the energy-emitting devices (101, 102) by using suitable equipment, such as depicted in FIG. 5, etc., and any equivalent thereof.

[029] Referring to the embodiments as depicted in FIG. 3 and FIG. 4, the second energy-emitting device 102 is mounted to the elongated medical needle 400, and the elongated medical needle 400 is configured to selectively move (pivot) the second energy-emitting device 102 from within an interior of the elongated medical assembly 200 (as depicted in FIG. 3) to an exterior of the elongated medical assembly 200 (as depicted in FIG. 4), in which case the elongated medical needle 400 includes a memory alloy, etc., and any equivalent thereof. The second energy-emitting device 102 is configured to be moved to a position located outside of the elongated medical assembly 200; this is done in such a way that the second energy-emitting device 102 is extended, at least in part, through the second portal 212. As depicted in FIG. 4, a section of the elongated medical needle 400 surrounding the second energy-emitting device 102 is configured to form a triangle-shaped arrangement 402, etc., once (after) the section of the elongated medical needle 400 is deployed or moved out from an interior of the elongated medical assembly 200.

[030] Referring to the embodiments as depicted in FIG. 1 to FIG. 4, the elongated medical assembly 200 forms the first portal 211 and the second portal 212 (spaced apart from each other). The first portal 211 is configured to interact with the first energy-emitting device 101. The first energy-emitting device 101 is configured to pass through (at least in part) the first portal 211. The second portal 212 is configured to interact with the second energy-emitting device 102. The second energy-emitting device 102 is configured to pass through (at least in part) the second portal 212. The elongated medical assembly 200 includes the distal tip section 202, and the distal tip section 202 forms the first portal 211. The elongated medical assembly 200 includes a side wall section 208, and the side wall section 208 forms the second portal 212. The elongated medical needle 400 is configured to be selectively moved so that the first energy-emitting device 101 is moved from within the

elongated medical assembly 200 to externally of the elongated medical assembly 200 via the first portal 211 (and may be selectively activated by the user as needed, etc.). The elongated medical needle 400 is configured to be selectively shaped or formed to move the second energy-emitting device 102 from within the elongated medical assembly 200 to externally of the elongated medical assembly 200 via the second portal 212. The second energy-emitting device 102 is configured to be moved from within the elongated medical assembly 200 and positioned outside of the elongated medical assembly 200 (by the user), and then to be selectively activated (by the user) as needed, etc. When the second energy-emitting device 102 is positioned (outside of the elongated medical assembly 200), the second energy-emitting device 102 may be selectively activated. The second energy-emitting device 102 is moved (extended) through the second portal 212 of the side wall section 208. After (or once) the energy-emitting device 102 is positioned outside of the elongated medical assembly 200, the energy-emitting device 102 (and/or a portion of the elongated medical needle 400) forms the triangle-shaped arrangement 402.

[031] Referring to the embodiments as depicted in FIG. 1 to FIG. 4, the elongated medical assembly 200 may have various outer diameters, lengths and/or curves. The elongated medical assembly 200 may be made of a high-density polyethylene (HDPE) core, braiding pattern or formation, and/or a low-density polyethylene (LDPE) outer layer. The elongated medical assembly 200 has a tapered tip, similar to a dilator, and should have a slit located at the distal end. The elongated medical assembly 200 may include a steer mechanism (known and not depicted) positioned (preferably) in and along components of the elongated medical assembly 200 (such as, in between a high-density polyethylene (HDPE) core and a braiding formation. The steer mechanism is configured to steer or control movement of the elongated medical needle 400, etc., as required during the procedure. The elongated medical assembly 200 may be configured to be radiopaque (e.g. have a platinum/iridium band, etc.) and/or echogenic, etc., and any equivalent thereof.

[032] Referring to the embodiments as depicted in FIG. 1 to FIG. 4, the elongated medical assembly 200 may be adapted to include a steerable catheter, etc., and any equivalent thereof. The elongated medical assembly 200 may be made of a medical grade thermoplastic elastomer material (such as the PEBAX (TRADEMARK) material manufactured by the ARKEMA Company). The elongated medical assembly 200 may be made of Nylon 12; Nylon is a generic designation for a family of synthetic polymers, based on aliphatic or semi-aromatic polyamides. Nylon is a thermoplastic silky material

that can be melt-processed into fibers, films, or shapes. It is made of repeating units linked by amide links similar to the peptide bonds in proteins.

[033] Referring to the embodiments as depicted in FIG. 1 to FIG. 4, the elongated medical assembly 200 may have side lumens, pull rings and/or pull wires (known and not depicted), etc. The elongated medical assembly 200 may have small, medium or large curves, etc. The elongated medical assembly 200 may be bi-directional, with either symmetrical or asymmetrical curves, or unidirectional, etc. Movement of the elongated medical assembly 200 may be controlled via a handle.

[034] Referring to the embodiments as depicted in FIG. 1 to FIG. 4, the elongated medical needle 400 may have various outer diameters, such as about 0.035 inches, and/or an elongated length of about 180 centimeters. The elongated medical needle 400 may have a lever that is located distally to the second electrode and may have a pivot on each end. The elongated medical needle 400 may have a steer mechanism (known and not depicted), etc. The elongated medical needle 400 may have positional markers to confirm the position of the first energy-emitting device 101 and/or the second energy-emitting device 102. The elongated medical needle 400 is configured to form an angle between the elongated medical assembly 200 and the elongated medical needle 400 higher than 90 degrees, facilitating the cut of the tissue (reference is made to FIG. 12). The elongated medical needle 400 may be radiopaque and echogenic, etc., and any equivalent thereof.

[035] Referring to the embodiments as depicted in FIG. 1 to FIG. 4, the elongated medical needle 400 may include a shape-memory material configured to be manipulated and/or deformed followed by a return to the original shape that the shape-memory material was set in (prior to a predetermined manipulation). Shape-memory materials (SMMs) are known and not further described in detail. Shape-memory materials are configured to recover their original shape from a significant and seemingly plastic deformation in response to a particular stimulus applied to the shape-memory material. This is known as the shape memory effect (SME). Superelasticity (in alloys) may be observed once the shape-memory material is deformed under the presence (an application) of a stimulus force.

[036] Referring to the embodiment as depicted in FIG. 4, when the second energy-emitting device 102 is deployed (pivoted), the second energy-emitting device 102 and a portion of the elongated medical needle 400 may be extended through the second portal 212 of the elongated medical assembly 200 to form a predetermined shape (such as a triangle shape,

etc.) configured to position the second energy-emitting device 102 for further enlargement of the puncture hole that was initially formed by the first energy-emitting device 101.

[037] FIG. 5 depicts a side view of an embodiment of the energy-emitting assembly 100 of FIG. 1.

[038] Referring to the embodiment as depicted in FIG. 5, the medical assembly 200 includes (for instance) a catheter assembly 201. The catheter assembly 201 includes, for instance, a three-way stopcock 203, a hemostatic valve 205 and a handle assembly 207, etc., and other components (known and not described in any specific details). The elongated medical needle 400 includes a first electrical wire and a second electrical wire (embodiments of which are depicted in FIG. 16). The first wire and the second wire are configured to electrically connect the first energy-emitting device 101 and the second energy-emitting device 102 (respectively) to an energy source 500 through (via) at least one connector cable 502, etc. The energy source 500 may include a radio-frequency generator, etc., and any equivalent thereof. The energy source 500 is configured to generate energy, which is conveyed to the energy-emitting devices (101, 102) via the connector cable 502 and the first and second wires of the elongated medical needle 400. The energy-emitting devices (101, 102) emit (broadcast, direct) the energy to the neighboring tissue of the patient after the energy-emitting devices (101, 102) are positioned accordingly. The energy source 500 may include a display device 504 configured to display parameters (such as voltages, etc.) associated with the first energy-emitting device 101 and/or the second energy-emitting device 102, etc. The energy-emitting devices (101, 102) may include electrodes, etc., and any equivalents thereof. The surgeon (physician) may control which of the energy-emitting devices (101, 102) is activated to deliver or emit energy (such as, radio-frequency energy, etc.), and any equivalent thereof.

[039] Referring to the embodiment as depicted in FIG. 5, the energy-emitting assembly 100, the elongated medical assembly 200 and the elongated medical needle 400 include bio-compatible material properties suitable for sufficient performance (such as, dielectric strength, thermal performance, insulation, corrosion, water and/or heat resistance) in compliance with industrial and regulatory safety standards (or compatible for medical usage), etc. Reference is made to the following publication for consideration in the selection of a suitable material: *Plastics in Medical Devices: Properties, Requirements, and Applications*; 2nd Edition; author: Vinny R. Sastri; hardcover ISBN: 9781455732012;

published: 21 November 2013; publisher: Amsterdam [Pays-Bas]: Elsevier/William Andrew, [2014].

[040] FIG. 6 to FIG. 12 depict side views (FIG. 6 and FIG. 7) and side perspective views (FIG. 8 to FIG. 12) of embodiments of the energy-emitting assembly 100 of FIG. 1 (and a workflow manner or method for use thereof).

[041] Referring to the embodiment as depicted in FIG. 6, the method includes the step of advancing an elongated guidewire assembly 600 toward a biological feature 900 (such as, into the superior vena cava of the heart of the patient).

[042] Referring to the embodiment as depicted in FIG. 7, the method further includes the step of advancing the elongated medical assembly 200 over the elongated guidewire assembly 600 into the superior vena cava. The method further includes the step of removing the elongated guidewire assembly 600 once the elongated medical assembly 200 is positioned as desired (for the purposes of the procedure).

[043] Referring to the embodiment as depicted in FIG. 8, the method further includes the step of moving and/or rotating (clocking) the elongated medical assembly 200 (such as from the 3 o'clock position to the 6 o'clock position).

[044] Referring to the embodiment as depicted in FIG. 9, the method further includes the step of moving the elongated medical assembly 200 (along the movement direction 904) to the biological feature 900 (such as, the fossa ovalis of the heart), and tenting the biological feature 900.

[045] Referring to the embodiments as depicted in FIG. 9 and FIG. 10, the method further includes the step of providing energy (such as, radio-frequency energy) to the first energy-emitting device 101 (after the biological feature 900 is tented), so that the first energy-emitting device 101 initially forms the puncture hole 902 extending through the biological feature 900.

[046] Referring to the embodiment as depicted in FIG. 10, the method further includes the step of confirming access to the biological feature 900 (such as left atrium access, etc.).

[047] Referring to the embodiment as depicted in FIG. 11, the method further includes the step of deploying the second energy-emitting device 102 (extending or pivoting the second energy-emitting device 102 from an interior of the elongated medical assembly 200 to an exterior of the elongated medical assembly 200 via the second portal 212). Preferably, the second energy-emitting device 102 is positioned (once deployed) closer to the puncture hole 902. A section of the elongated medical needle 400 selectively forms a lever

formation that extends through the second portal 212 to form a deployment shape (such as a triangle, etc.).

[048] Referring to the embodiment as depicted in FIG. 12, the method further includes the step of applying energy to the second energy-emitting device 102 and advancing the second energy-emitting device 102 toward the puncture hole 902 (toward the tissue neighboring the puncture hole 902); this is done in such a way that the second energy-emitting device 102 may cross the biological feature 900 (the inter-atrial septum). The method further includes the step of continuing with any remaining aspects of the procedure (e.g. cryoablation, mitral valve repair and left atrial appendage closure, etc.).

[049] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, the first energy-emitting device 101 is configured to puncture, and form, the puncture hole 902 through the biological feature 900 (such as a biological wall, tissue, etc.) of the patient (such as, the inter-atrial septum, etc.) while the first energy-emitting device 101 is moved out from the first portal 211 of the elongated medical assembly 200. The second energy-emitting device 102 is configured to further enlarge the puncture hole 902 (after the puncture hole 902 was initially formed by the first energy-emitting device 101) while the second energy-emitting device 102 is moved out from the second portal 212 of the elongated medical assembly 200 and while the elongated medical assembly 200 is further moved toward the puncture hole (so that the second energy-emitting device 102 may be moved toward the puncture hole).

[050] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, at least one energy-emitting device 101 is configured to selectively initially emit and direct energy for the initial formation of a puncture hole 902 through a biological feature 900. At least one other energy-emitting device 102 is configured to further selectively emit and direct energy for subsequent or further enlargement of the puncture hole 902 after initial formation of the puncture hole 902 by said at least one energy-emitting device (such as the energy-emitting device 101). Preferably, at least one energy-emitting device 101 and at least one other energy-emitting device 102 are configured to be mounted proximate to a distal portion of the elongated medical needle 400. At least one energy-emitting device 101, at least one other energy-emitting device 102 and the elongated medical needle 400 are configured to be deployed along (an interior of) the elongated medical assembly 200.

[051] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, a method is depicted for formation of the puncture hole 902 through the biological feature 900 by at least one energy-emitting device 101 and at least one other energy-emitting device 102

configured to be mounted proximate to the distal needle tip section 401 of the elongated medical needle 400. The elongated medical needle 400 is configured to be deployed along an elongated medical assembly 200. The method includes moving the distal tip section 202 of the elongated medical assembly 200 to the biological feature 900. The method also includes moving at least one energy-emitting device 101 and at least one other energy-emitting device 102 by moving the distal needle tip section 401 of the elongated medical needle 400 along the elongated medical assembly 200 to the biological feature 900. The method also includes selectively initially emitting and directing energy, via at least one energy-emitting device 101, for the initial formation of the puncture hole 902 through the biological feature 900. The method also includes further selectively emitting and directing energy, via at least one other energy-emitting device 102, for subsequent or further enlargement of the puncture hole 902 after initial formation of the puncture hole 902 by said at least one energy-emitting device 101.

[052] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, the elongated medical assembly 200 includes a distal tip section 202 configured to be positioned proximate to the biological feature 900. The first energy-emitting device 101 (such as a radio-frequency energy emitter) is movable toward the distal tip section 202. The first energy-emitting device 101 is configured to selectively initially emit and direct energy for the initial formation of a puncture hole 902 through the biological feature 900 (such as, the inter-atrial septum) after the first energy-emitting device 101, in use, is moved proximate to the biological feature 900. The second energy-emitting device 102 (such as a radio-frequency energy emitter) is movable toward the distal tip section 202. The second energy-emitting device 102 is configured to further emit and direct energy for subsequent or further enlargement of the puncture hole 902 (after the first energy-emitting device 101, in use, initially forms the puncture hole 902, and the second energy-emitting device 102, in use, is moved proximate to the puncture hole 902).

[053] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, the first energy-emitting device 101 is movable toward the distal tip section 202 of the elongated medical assembly 200. The first energy-emitting device 101 is configured to selectively initially emit and direct energy for the initial formation of a puncture hole 902 through the biological feature 900 (such as, the inter-atrial septum) after the first energy-emitting device 101, in use, is moved proximate to the biological feature 900. The second energy-emitting device 102 is movable toward the distal tip section 202. The second energy-emitting device 102 is configured to further emit and direct energy for subsequent or

further enlargement of the puncture hole 902 (after the first energy-emitting device 101, in use, initially forms the puncture hole 902, and the second energy-emitting device 102, in use, is moved proximate to the puncture hole 902).

[054] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, the energy-emitting assembly 100 is movable along the elongated medical assembly 200 toward a position proximate to the biological feature 900. The energy-emitting assembly 100 is configured to direct, at least in part, the initial emission of energy toward, at least in part, the biological feature 900 for the initial formation of the puncture hole 902 extending through the biological feature 900 (after the energy-emitting assembly 100, in use, is moved along the elongated medical assembly 200 and is positioned proximate to the biological feature 900). The energy-emitting assembly 100 is also configured to further direct, at least in part, subsequent emission of energy toward, at least in part, the biological feature 900 neighboring (surrounding) the puncture hole 902 for subsequent or further enlargement of the puncture hole 902 (after the energy-emitting assembly 100 is further moved along the elongated medical assembly 200 toward the biological feature 900 neighboring (surrounding) the puncture hole 902).

[055] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, the energy-emitting assembly 100 is movable along the elongated medical assembly 200 toward a position proximate to the biological feature 900. The energy-emitting assembly 100 is configured to direct, at least in part, the initial emission of energy toward, at least in part, the biological feature 900 for the initial formation of the puncture hole 902, extending through the biological feature 900 (after the energy-emitting assembly 100, in use, is moved along the elongated medical assembly 200 and is positioned proximate to the biological feature 900). The energy-emitting assembly 100 is also configured to further direct, at least in part, subsequent emission of energy toward, at least in part, the biological feature 900 neighboring (surrounding) the puncture hole 902 for subsequent or further enlargement of the puncture hole 902 (after the energy-emitting assembly 100 is further moved along the elongated medical assembly 200 toward the biological feature 900 neighboring (surrounding) the puncture hole 902).

[056] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, the energy-emitting assembly 100 is movable along the elongated medical assembly 200 toward a position proximate to the biological feature 900. The energy-emitting assembly 100 is configured to direct, at least in part, the initial emission of energy toward, at least in part, the biological feature 900 for the initial formation of the puncture hole 902, extending

through the biological feature 900 (after the energy-emitting assembly 100, in use, is moved along the elongated medical assembly 200 and is positioned proximate to the biological feature 900). The energy-emitting assembly 100 is also configured to further direct, at least in part, subsequent emission of energy toward, at least in part, the biological feature 900 neighboring (surrounding) the puncture hole 902 for subsequent or further enlargement of the puncture hole 902 after the energy-emitting assembly 100 is further moved along the elongated medical assembly 200 toward the biological feature 900 neighboring (surrounding) the puncture hole 902. Preferably, the energy-emitting assembly 100 includes a first energy-emitting device 101 movable along the elongated medical assembly 200. The first energy-emitting device 101 is configured to selectively direct, at least in part, the initial emission of energy toward, at least in part, the biological feature 900 for the initial formation of the puncture hole 902 through the biological feature 900 after the distal tip section 202 and the first energy-emitting device 101, in use, are positioned proximate to the biological feature 900. Preferably, the energy-emitting assembly 100 also includes a second energy-emitting device 102 movable along the elongated medical assembly 200. The second energy-emitting device 102 is configured to selectively direct, at least in part, subsequent emission of energy toward the biological feature 900 neighboring (surrounding) the puncture hole 902 for further or subsequent enlargement of the puncture hole 902 after the second energy-emitting device 102, in use, is further moved toward the biological feature 900 neighboring (surrounding) the puncture hole 902.

[057] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, a method is provided for operating the elongated medical assembly 200 including a distal tip section 202 configured to be moved and positioned proximate to a biological feature 900. An energy-emitting assembly 100 is configured to be moved and positioned proximate to the distal tip section 202. The method includes moving and positioning the distal tip section 202 of the elongated medical assembly 200 proximate to the biological feature 900. The method also includes moving and positioning the energy-emitting assembly 100 proximate to the distal tip section 202 after the distal tip section 202 is moved and positioned proximate to the biological feature 900. The method also includes activating the energy-emitting assembly 100, after the distal tip section 202 is moved and positioned proximate to the biological feature 900, and the energy-emitting assembly 100 is moved and positioned proximate to the distal tip section 202, in such a way that the energy-emitting assembly 100, once activated, directs, at least in part, the emission of energy toward, at

least in part, the biological feature 900, with the emission of energy forming a puncture hole 902 extending through the biological feature 900. The method also includes moving the distal tip section 202 further (more so) toward the puncture hole 902 formed through the biological feature 900 after the puncture hole 902 is formed and extends through the biological feature 900. The method also includes activating the energy-emitting assembly 100, after the distal tip section 202 is further moved toward the puncture hole 902, in such a way that the energy-emitting assembly 100, once activated, directs, at least in part, further emission of energy toward, at least in part, the biological feature 900 surrounding, and positioned proximate to, the puncture hole 902, with the further emission of energy further enlarging the puncture hole 902 as (while) the distal tip section 202 moves further (more so) toward the puncture hole 902. The method may also include activating a first energy-emitting device 101 of the energy-emitting assembly 100 to form the puncture hole 902 through the biological feature 900 after the distal tip section 202 and the first energy-emitting device 101, in use, are placed proximate to the biological feature 900, and the first energy-emitting device 101, in use, is activated to direct, at least in part, the emission of energy toward, at least in part, the biological feature 900 for forming the puncture hole 902. The method may also include activating a second energy-emitting device 102 of the energy-emitting assembly 100 to further enlarge the puncture hole 902 after the puncture hole 902 is formed by the first energy-emitting device 101, and the second energy-emitting device 102 is activated to direct, at least in part, further emission of energy toward the biological feature 900 surrounding, and positioned proximate to, the puncture hole 902 for further enlargement of the puncture hole 902.

[058] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, an apparatus is provided for formation of the puncture hole 902 to be extended through the biological feature 900. The apparatus is for use with an elongated medical assembly 200 including a distal tip section 202 configured to be moved and positioned proximate to the biological feature 900. The apparatus includes an energy-emitting assembly 100 movable along the elongated medical assembly 200, and positionable proximate to the distal tip section 202. The energy-emitting assembly 100 is configured to direct, at least in part, the initial emission of energy toward, at least in part, the biological feature 900 for the initial formation of the puncture hole 902 through the biological feature 900 after the distal tip section 202 and the energy-emitting assembly 100, in use, are moved and positioned proximate to the biological feature 900. The energy-emitting assembly 100 is also configured to further direct, at least in part, further emission of energy from the energy-

emitting assembly 100 toward, at least in part, the biological feature 900 neighboring (surrounding) the puncture hole 902 for further enlargement of the puncture hole 902 after the distal tip section 202 and the energy-emitting assembly 100, in use, are moved further (more so) toward (closer) to the puncture hole 902.

[059] Referring to the embodiments as depicted in FIG. 10 and FIG. 12, an apparatus is for formation of the puncture hole 902 to be extended through the biological feature 900. The apparatus is for use with an elongated medical assembly 200 including a distal tip section 202 movable and positionable proximate to the biological feature 900. The apparatus includes an energy-emitting assembly 100 movable along the elongated medical assembly 200, and positionable proximate to the distal tip section 202. The energy-emitting assembly 100 is configured to be activated after the distal tip section 202 is moved and positioned proximate to the biological feature 900. The energy-emitting assembly 100 is moved and positioned proximate to the distal tip section 202 in such a way that the energy-emitting assembly 100, once activated, directs, at least in part, the emission of energy toward, at least in part, the biological feature 900, with the emission of energy forming the puncture hole 902 extending through the biological feature 900. The energy-emitting assembly 100 is also configured to be activated after the distal tip section 202 is further moved toward the puncture hole 902 in such a way that the energy-emitting assembly 100, once activated, directs, at least in part, further emission of energy toward, at least in part, the biological feature 900 surrounding, and positioned proximate to, the puncture hole 902, with the further emission of energy further enlarging the puncture hole 902 as (while) the distal tip section 202 moves further (more so) toward the puncture hole 902.

[060] FIG. 13 to FIG. 15 depict side views (FIG. 13 and FIG. 14) and a side perspective view (FIG. 15) of embodiments of the energy-emitting assembly 100 of FIG. 1.

[061] Referring to the embodiments as depicted in FIG. 13 and FIG. 14, the elongated medical needle 400 may include any type of tips, such as a J-tip (as depicted in FIG. 14) or a pigtail (as depicted in FIG. 13), so as to secure access after puncturing and enlarging the septum, etc.

[062] Referring to the embodiment as depicted in FIG. 15, the surgeon may pull (along the movement direction 904), rather than push, the elongated medical needle 400 to enlarge the puncture hole 902. In this configuration, the formation of the section of the elongated medical needle 400 (that pivots outwardly from an interior of the elongated medical assembly 200) may be located between the first energy-emitting device 101 and the second energy-emitting device 102. It will be appreciated that a mechanism (not depicted) may be

provided for the surgeon to decide how large to make the puncture hole 902 (e.g. a small hole versus a large hole). A distal angle 906 is formed between the elongated medical needle 400 (the radiofrequency wire) and the elongated medical assembly 200 when (once or after) the second energy-emitting device 102 is deployed from the interior of the elongated medical assembly 200. The size of the distal angle 906 may be optimized to facilitate cutting of tissue by utilization of (emission of) energy from the second energy-emitting device 102, such as radiofrequency energy, etc. The size of the distal angle 906 may be (preferably) greater than 90 degrees.

[063] FIG. 16 to FIG. 19 depict side views of embodiments of the energy-emitting assembly 100 of FIG. 1.

[064] Referring to the embodiment as depicted in FIG. 16, the first energy-emitting device 101 and the second energy-emitting device 102 are coaxially aligned with each other. The first energy-emitting device 101 and the second energy-emitting device 102 remain coaxially aligned with each other once, or when, they are activated as in FIG. 18 or FIG. 19, or while they remain inactivated as in FIG. 17. The front ends of the first energy-emitting device 101 and the second energy-emitting device 102 provide (preferably) a sloped frontal surface (blunt surface) for smoother formation of a puncture hole, and subsequent enlargement thereof.

[065] Referring to the embodiment as depicted in FIG. 16, it will be appreciated that the outer diameter of the elongated medical needle 400 may be the same diameter on both sides of the second energy-emitting device 102 (if desired).

[066] Referring to the embodiment as depicted in FIG. 17, the first energy-emitting device 101 and the second energy-emitting device 102 are inactivated as in FIG. 17 while the distal tip portion of the elongated medical needle 400 is moved toward the biological feature 900 (along the movement direction 904).

[067] Referring to the embodiment as depicted in FIG. 18, the second energy-emitting device 102 is deactivated, and the first energy-emitting device 101 is activated to initially form (create) the puncture hole 902 through the biological feature 900 (while the elongated medical needle 400 is moved along the movement direction 904 so that the first energy-emitting device 101 contacts the surface of the biological feature 900).

[068] Referring to the embodiment as depicted in FIG. 19, the first energy-emitting device 101 is deactivated (after formation of the puncture hole 902), and the second energy-emitting device 102 is further moved toward the puncture hole 902 (the neighboring tissue surrounding the puncture hole 902), and the second energy-emitting device 102 is

activated for subsequent enlargement of the puncture hole 902 through the biological feature 900 (after the puncture hole 902 was formed by the first energy-emitting device 101, as depicted in FIG. 18, and while the elongated medical needle 400 is moved along the movement direction 904 and through the puncture hole 902).

[069] Referring to the embodiments as depicted in FIG. 18 and FIG. 19, at least one energy-emitting device 101 is configured to selectively initially emit and direct energy for the initial formation of a puncture hole 902 through a biological feature 900. At least one other energy-emitting device 102 is configured to further emit and direct energy for subsequent further enlargement of the puncture hole 902 after initial formation of the puncture hole 902 by said at least one energy-emitting device 101.

[070] Referring to the embodiments as depicted in FIG. 18 and FIG. 19, the energy-emitting assembly 100 is (preferably) mounted to the elongated medical needle 400. The first energy-emitting device 101 is mounted, at least in part, to a distal tip section of the elongated medical needle 400. The second energy-emitting device 102 is mounted to, at least in part, a circumference of the elongated medical needle 400. The first wire 411 extends, at least in part, along the elongated medical needle 400. The first wire 411 is electrically connected to the first energy-emitting device 101. The second wire 412 extends, at least in part, along the elongated medical needle 400. The second wire 412 is electrically connected to the second energy-emitting device 102. The first wire 411 and the second wire 412 are configured to be electrically connected to at least one or more energy sources 500. The first energy-emitting device 101 and the second energy-emitting device 102 (preferably) are movable from an interior of the elongated medical assembly 200 via the first portal 211 of the elongated medical assembly 200.

[071] The following is offered as further description of the embodiments, in which any one or more of any technical feature (described in the detailed description, the summary and the claims) may be combinable with any other one or more of any technical feature (described in the detailed description, the summary and the claims). It is understood that each claim in the claims section is an open ended claim unless stated otherwise. Unless otherwise specified, relational terms used in these specifications should be construed to include certain tolerances that the person skilled in the art would recognize as providing equivalent functionality. By way of example, the term perpendicular is not necessarily limited to 90.0 degrees, and may include a variation thereof that the person skilled in the art would recognize as providing equivalent functionality for the purposes described for the relevant member or element. Terms such as “about” and “substantially”, in the context

of configuration, relate generally to disposition, location, or configuration that are either exact or sufficiently close to the location, disposition, or configuration of the relevant element to preserve operability of the element within the disclosure which does not materially modify the disclosure. Similarly, unless specifically made clear from its context, numerical values should be construed to include certain tolerances that the person skilled in the art would recognize as having negligible importance as they do not materially change the operability of the disclosure. It will be appreciated that the description and/or drawings identify and describe embodiments of the apparatus (either explicitly or inherently). The apparatus may include any suitable combination and/or permutation of the technical features as identified in the detailed description, as may be required and/or desired to suit a particular technical purpose and/or technical function. It will be appreciated that, where possible and suitable, any one or more of the technical features of the apparatus may be combined with any other one or more of the technical features of the apparatus (in any combination and/or permutation). It will be appreciated that persons skilled in the art would know that the technical features of each embodiment may be deployed (where possible) in other embodiments even if not expressly stated as such above. It will be appreciated that persons skilled in the art would know that other options may be possible for the configuration of the components of the apparatus to adjust to manufacturing requirements and still remain within the scope as described in at least one or more of the claims. This written description provides embodiments, including the best mode, and also enables the person skilled in the art to make and use the embodiments. The patentable scope may be defined by the claims. The written description and/or drawings may help to understand the scope of the claims. It is believed that all the crucial aspects of the disclosed subject matter have been provided in this document. It is understood, for this document, that the word “includes” is equivalent to the word “comprising” in that both words are used to signify an open-ended listing of assemblies, components, parts, etc. The term “comprising”, which is synonymous with the terms “including,” “containing,” or “characterized by,” is inclusive or open-ended and does not exclude additional, unrecited elements or method steps. Comprising (comprised of) is an “open” phrase and allows coverage of technologies that employ additional, unrecited elements. When used in a claim, the word “comprising” is the transitory verb (transitional term) that separates the preamble of the claim from the technical features of the disclosure. The foregoing has outlined the non-limiting embodiments (examples). The description is made for particular

non-limiting embodiments (examples). It is understood that the non-limiting embodiments are merely illustrative as examples.

CLAIMS

WHAT IS CLAIMED IS:

1. An apparatus, comprising:

at least one energy-emitting device configured to selectively initially emit and direct energy for initial formation of a puncture hole through a biological feature; and

at least one other energy-emitting device configured to further selectively emit and direct energy for subsequent enlargement of the puncture hole after initial formation of the puncture hole by said at least one energy-emitting device.

2. The apparatus of claim 1, wherein:

said at least one energy-emitting device and said at least one other energy-emitting device configured to be mounted proximate to a distal portion of an elongated medical needle; and

said at least one energy-emitting device, said at least one other energy-emitting device and said elongated medical needle configured to be deployed along an elongated medical assembly.

3. An apparatus for formation of a puncture hole to be extended through a biological feature, and for use with an elongated medical assembly, and the apparatus comprising:

an energy-emitting assembly movable along the elongated medical assembly toward a position proximate to the biological feature; and

the energy-emitting assembly configured to direct, at least in part, initial emission of energy toward, at least in part, the biological feature for initial formation of the puncture hole, extending through the biological feature, after the energy-emitting assembly, in use, is moved along the elongated medical assembly and is positioned proximate to the biological feature; and

the energy-emitting assembly also configured to further direct, at least in part, subsequent emission of energy toward, at least in part, the biological feature neighboring the puncture hole for subsequent enlargement of the puncture hole after the energy-emitting assembly is further moved along the elongated medical assembly toward the biological feature neighboring the puncture hole.

4. The apparatus of claim 3, wherein:

the energy-emitting assembly includes:

a first energy-emitting device movable along the elongated medical assembly;

and

the first energy-emitting device configured to selectively direct, at least in part, initial emission of energy toward, at least in part, the biological feature for initial formation of the puncture hole through the biological feature after the first energy-emitting device, in use, is positioned proximate to the biological feature; and

a second energy-emitting device movable along the elongated medical assembly; and

the second energy-emitting device configured to selectively direct, at least in part, subsequent emission of energy toward the biological feature neighboring the puncture hole for further subsequent enlargement of the puncture hole after the second energy-emitting device, in use, is further moved toward the biological feature neighboring the puncture hole.

5. The apparatus of claim 4, wherein:

the energy-emitting assembly is mounted to an elongated medical needle; and

the first energy-emitting device is mounted, at least in part, to a distal tip section of the elongated medical needle; and

the second energy-emitting device is mounted to, at least in part, a circumference of the elongated medical needle; and

a first wire extends, at least in part, along the elongated medical needle, and the first wire is electrically connected to the first energy-emitting device; and

a second wire extends, at least in part, along the elongated medical needle, and the second wire is electrically connected to the second energy-emitting device; and

the first wire and the second wire are configured to be electrically connected to an energy source.

6. The apparatus of claim 5, wherein:

the second energy-emitting device is configured to be mounted to the elongated medical needle; and

the elongated medical needle is configured to selectively move the second energy-emitting device from within an interior of the elongated medical assembly to an exterior of the elongated medical assembly via a second portal of the elongated medical assembly.

7. The apparatus of claim 5, wherein:

the elongated medical assembly forms a first portal and a second portal that are spaced apart from each other.

8. The apparatus of claim 7, wherein:

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the first portal is configured to interact with the first energy-emitting device;
and

the first energy-emitting device is configured to pass through, at least in part,
the first portal.

9. The apparatus of claim 7, wherein:

the second portal is configured to interact with the second energy-emitting
device; and

the second energy-emitting device is configured to pass through, at least in part,
the second portal.

10. The apparatus of claim 7, wherein:

the elongated medical assembly includes the distal tip section, and the distal tip
section forms the first portal.

11. The apparatus of claim 7, wherein:

the elongated medical assembly includes a side wall section, and the side wall
section forms the second portal.

12. The apparatus of claim 7, wherein:

the elongated medical needle is configured to be selectively moved so that the
first energy-emitting device is moved from within the elongated medical assembly to
externally of the elongated medical assembly via the first portal.

13. The apparatus of claim 12, wherein:

the elongated medical needle is configured to be selectively shaped to move the
second energy-emitting device from within the elongated medical assembly to
externally of the elongated medical assembly via the second portal.

14. The apparatus of claim 13, wherein:

the second energy-emitting device is configured to be moved from within the
elongated medical assembly and positioned outside of the elongated medical assembly.

15. The apparatus of claim 5, wherein:

the elongated medical needle includes a shape-memory material.

16. The apparatus of claim 3, wherein:

the elongated medical assembly includes a catheter assembly.

17. The apparatus of claim 3, wherein:

the energy-emitting assembly includes a first energy-emitting device and a
second energy-emitting device; and

the first energy-emitting device and the second energy-emitting device are movable from an interior of the elongated medical assembly via a first portal of the elongated medical assembly.

18. A method for formation of a puncture hole through a biological feature by at least one energy-emitting device and at least one other energy-emitting device configured to be mounted proximate to a distal needle tip section of an elongated medical needle configured to be deployed along an elongated medical assembly, the method comprising:

moving a distal tip section of the elongated medical assembly to the biological feature; and

moving said at least one energy-emitting device and said at least one other energy-emitting device by moving the distal needle tip section of the elongated medical needle along the elongated medical assembly to the biological feature; and

selectively initially emitting and directing energy, via said at least one energy-emitting device, for initial formation of the puncture hole through the biological feature; and

further selectively emitting and directing energy, via said at least one other energy-emitting device, for subsequent enlargement of the puncture hole after initial formation of the puncture hole by said at least one energy-emitting device.

19. A method of operating an elongated medical assembly including a distal tip section configured to be moved, and positioned, proximate to a biological feature, and an energy-emitting assembly configured to be moved and positioned proximate to the distal tip section, and the method comprising:

moving and positioning the distal tip section, of the elongated medical assembly, proximate to the biological feature; and

moving and positioning the energy-emitting assembly to a location being proximate to the distal tip section after the distal tip section is moved and positioned proximate to the biological feature; and

activating the energy-emitting assembly, after the distal tip section is moved and positioned proximate to the biological feature, and the energy-emitting assembly is moved and positioned proximate to the distal tip section, in such a way that the energy-emitting assembly, once activated, directs, at least in part, emission of energy toward, at least in part, the biological feature, with emission of energy forming a puncture hole extending through the biological feature; and

moving the distal tip section further toward the puncture hole formed through the biological feature after the puncture hole is formed and extends through the biological feature; and

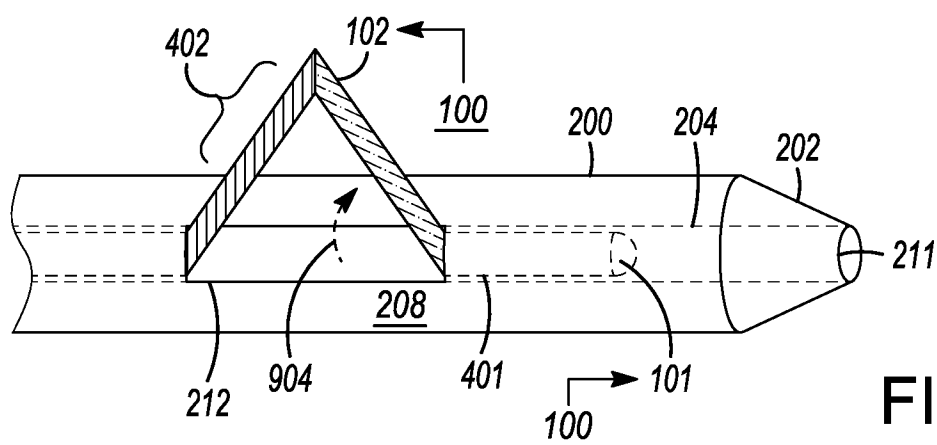
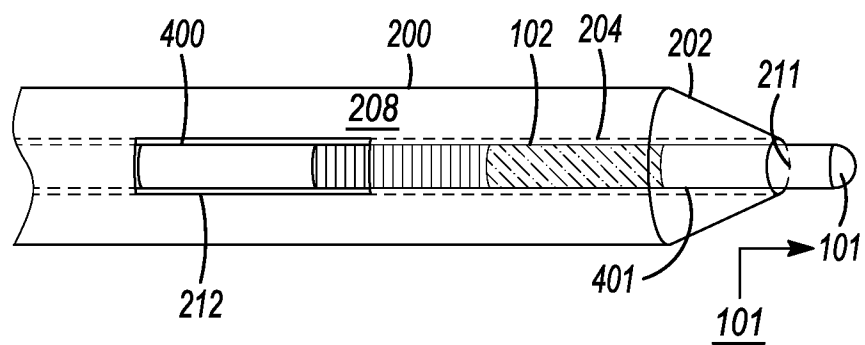
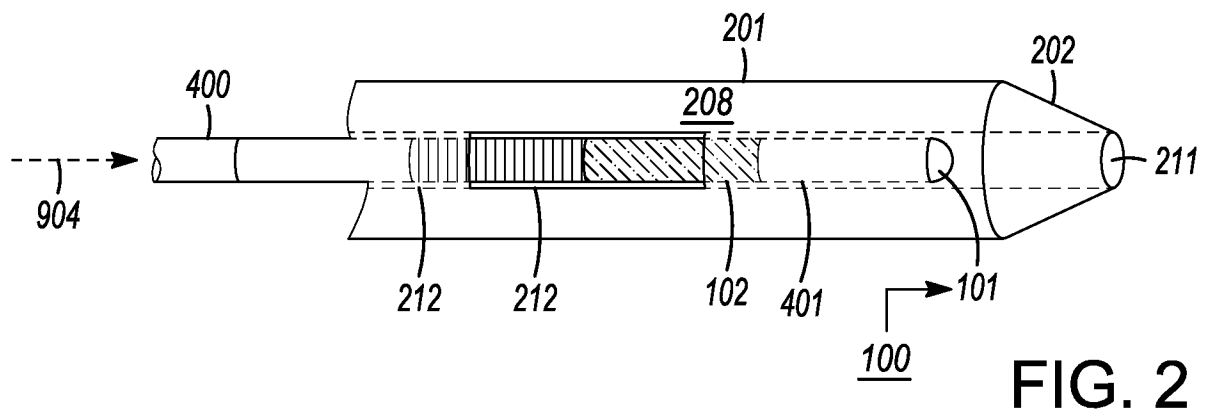
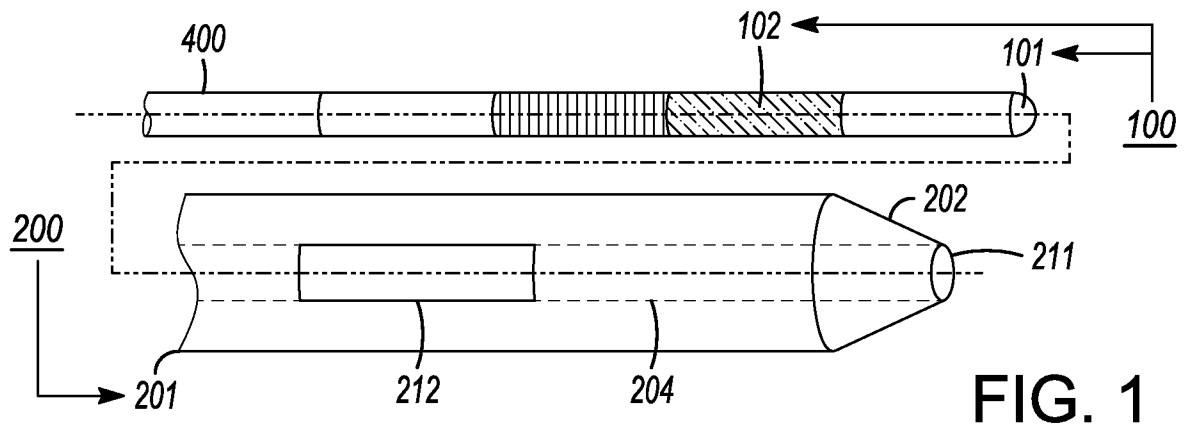
activating the energy-emitting assembly, after the distal tip section is further moved toward the puncture hole, in such a way that the energy-emitting assembly, once activated, directs, at least in part, further emission of energy toward, at least in part, the biological feature surrounding, and positioned proximate to, the puncture hole, with further emission of energy further enlarging the puncture hole while the distal tip section moves further toward the puncture hole.

20. The method of claim 19, further comprising:

activating a first energy-emitting device of the energy-emitting assembly to form the puncture hole through the biological feature after the distal tip section and the first energy-emitting device, in use, are placed proximate to the biological feature, and the first energy-emitting device, in use, is activated to direct, at least in part, emission of energy toward, at least in part, the biological feature for forming the puncture hole; and

activating a second energy-emitting device of the energy-emitting assembly to further enlarge the puncture hole after the puncture hole is formed by the first energy-emitting device, and the second energy-emitting device is activated to direct, at least in part, further emission of energy toward the biological feature surrounding, and positioned proximate to, the puncture hole for further enlargement of the puncture hole.

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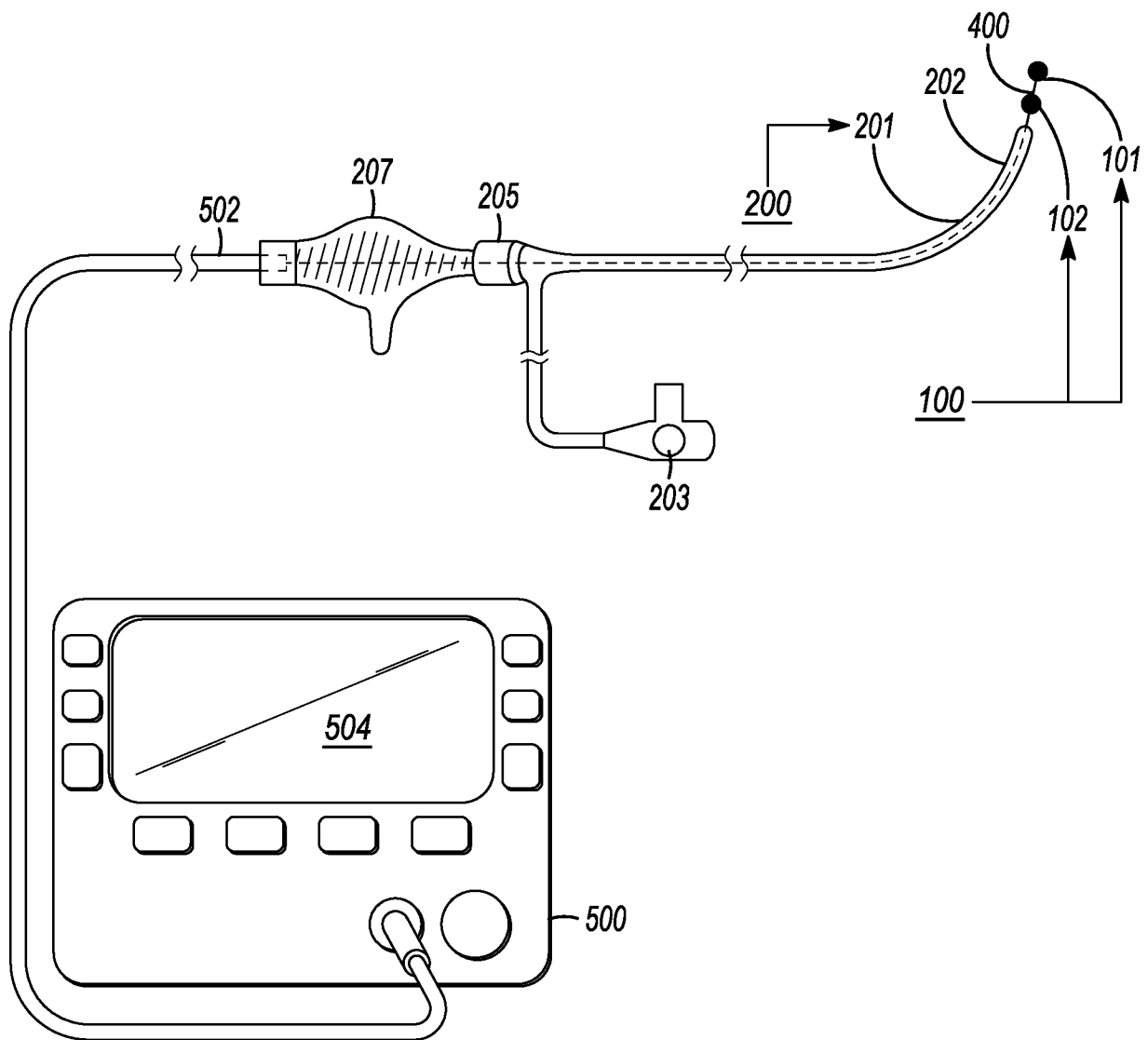


FIG. 5

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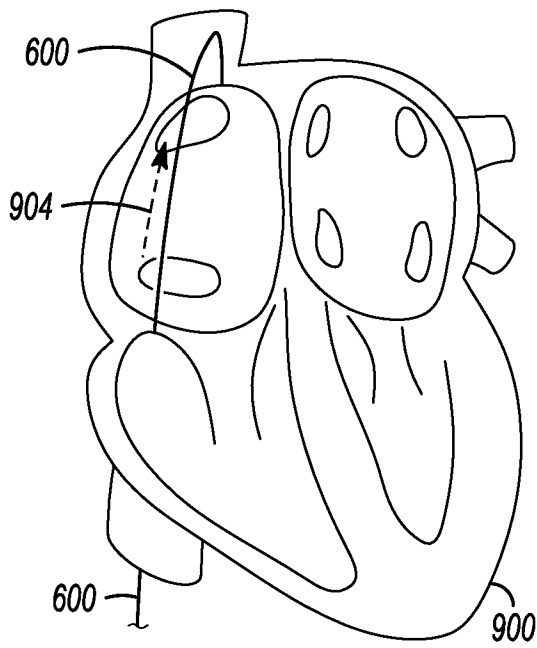


FIG. 6

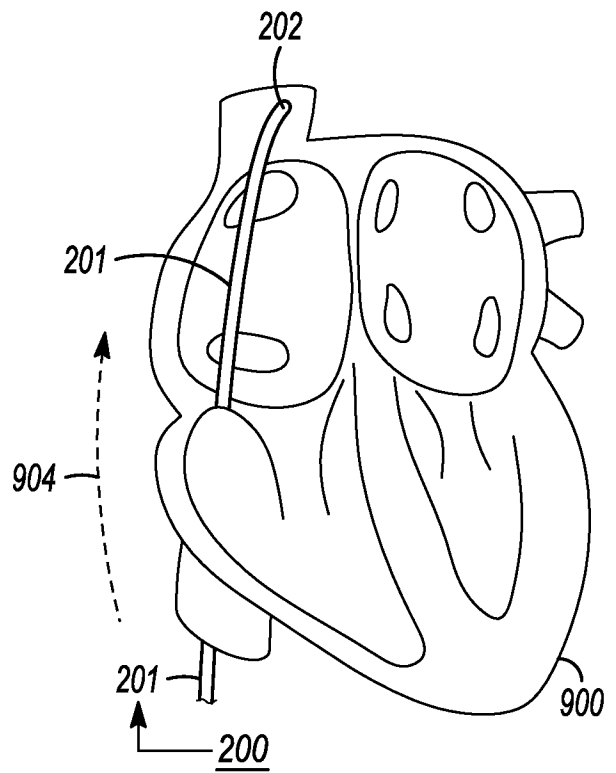


FIG. 7

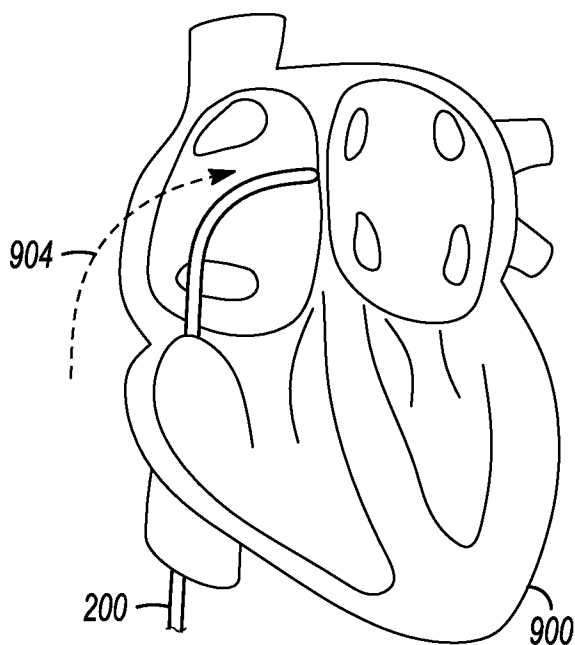


FIG. 8

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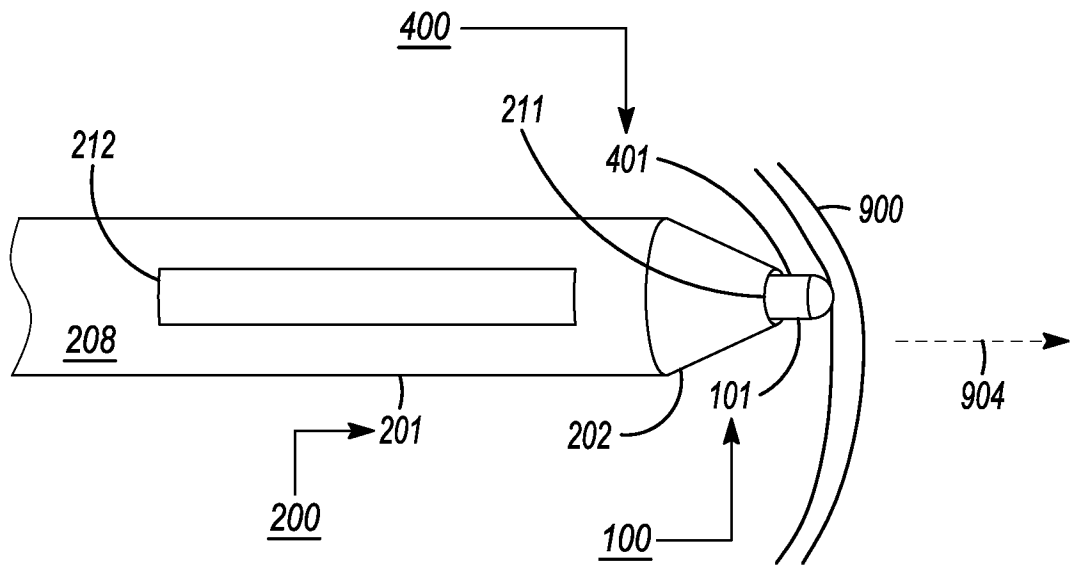


FIG. 9

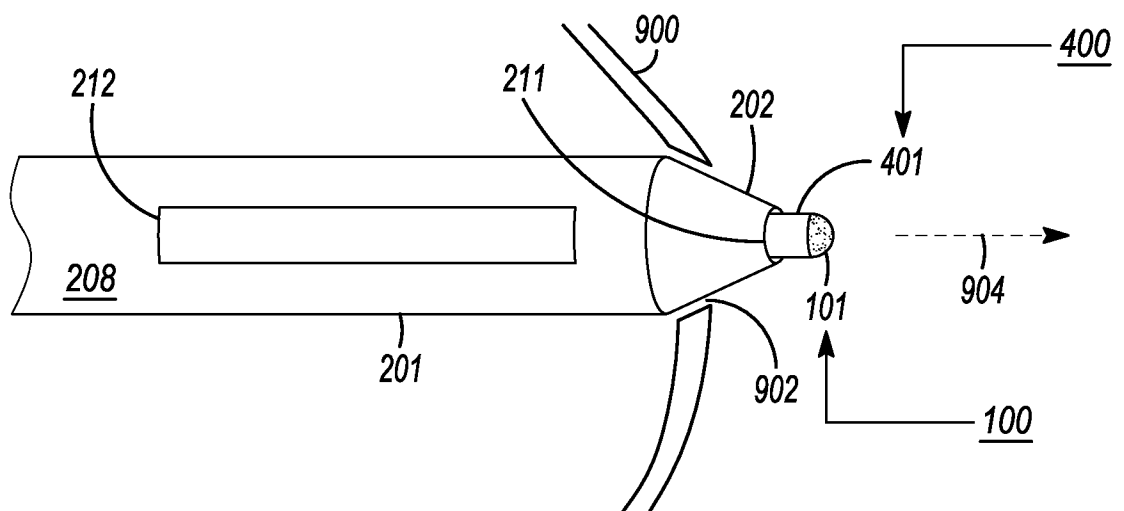


FIG. 10

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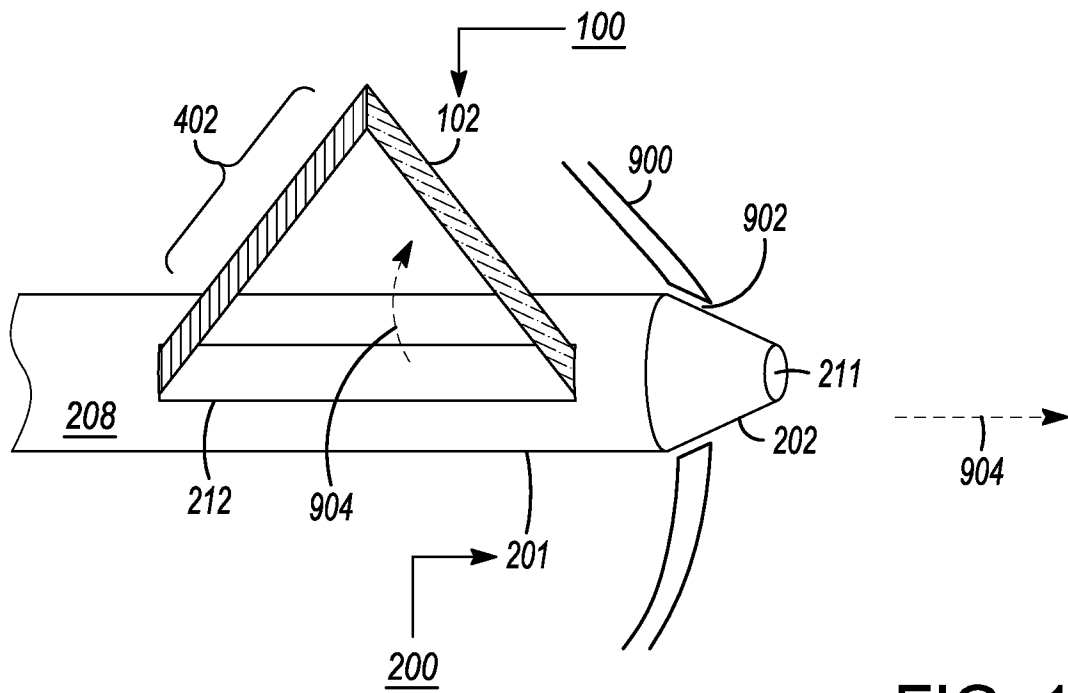


FIG. 11

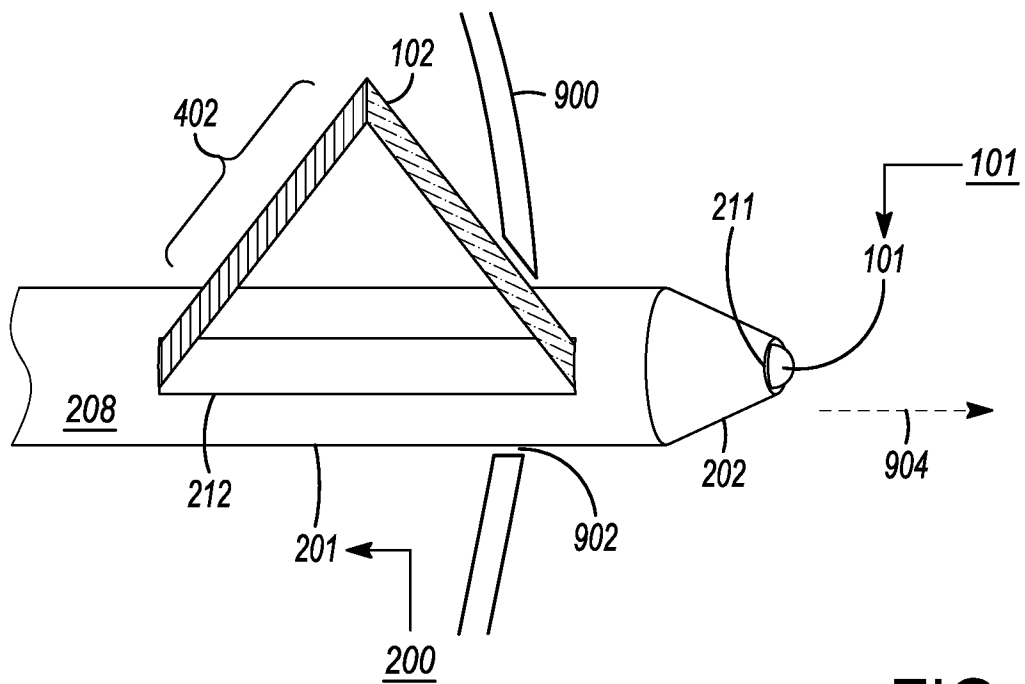


FIG. 12

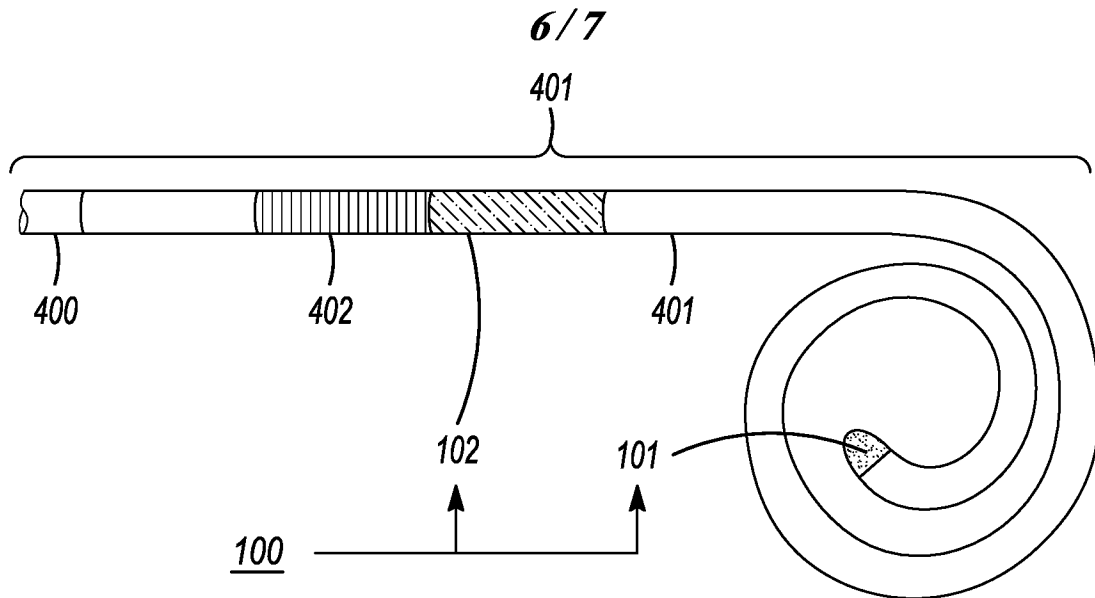


FIG. 13

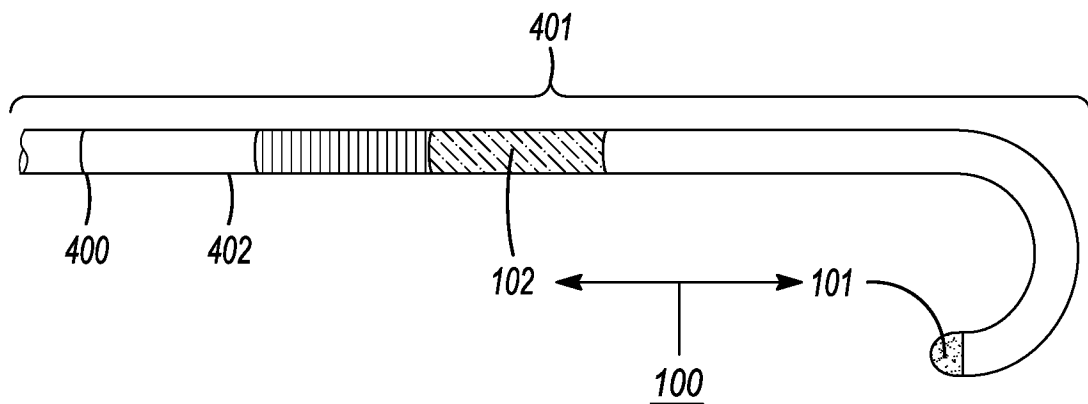


FIG. 14

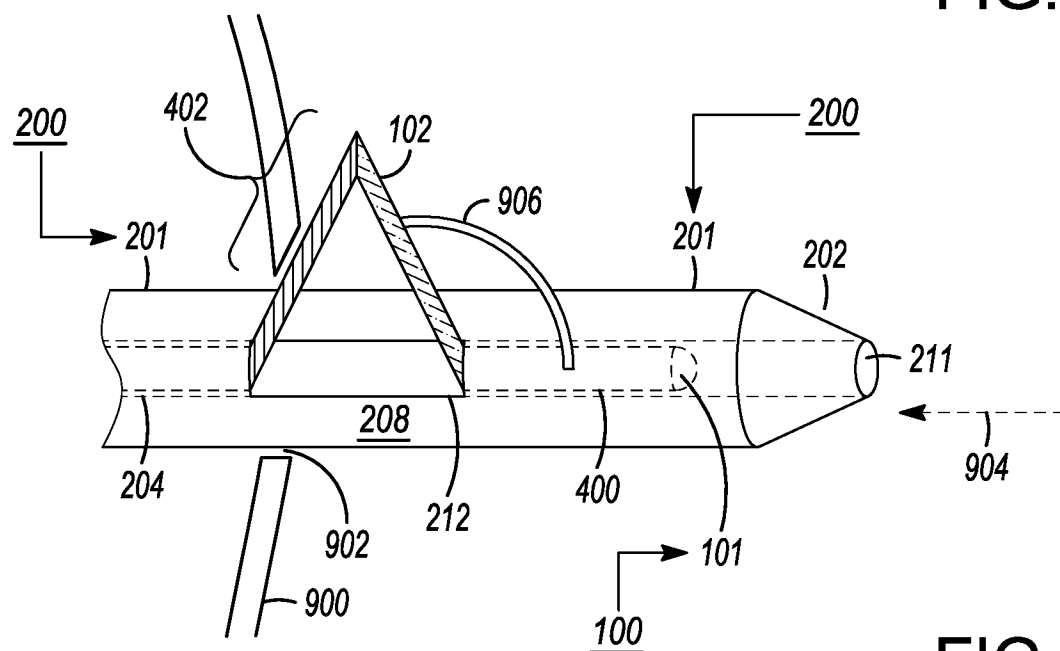


FIG. 15

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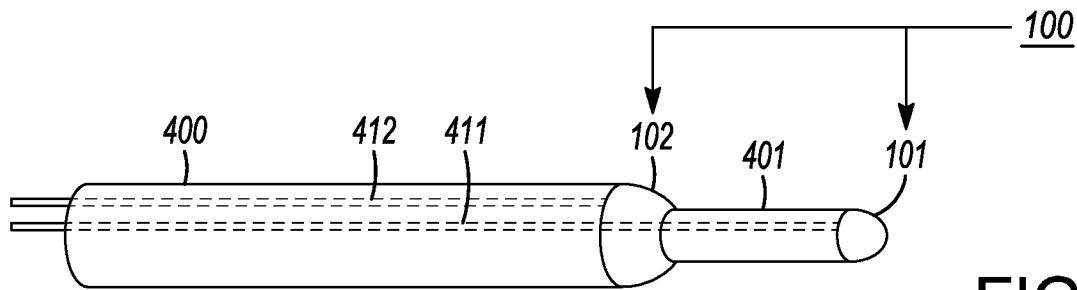


FIG. 16

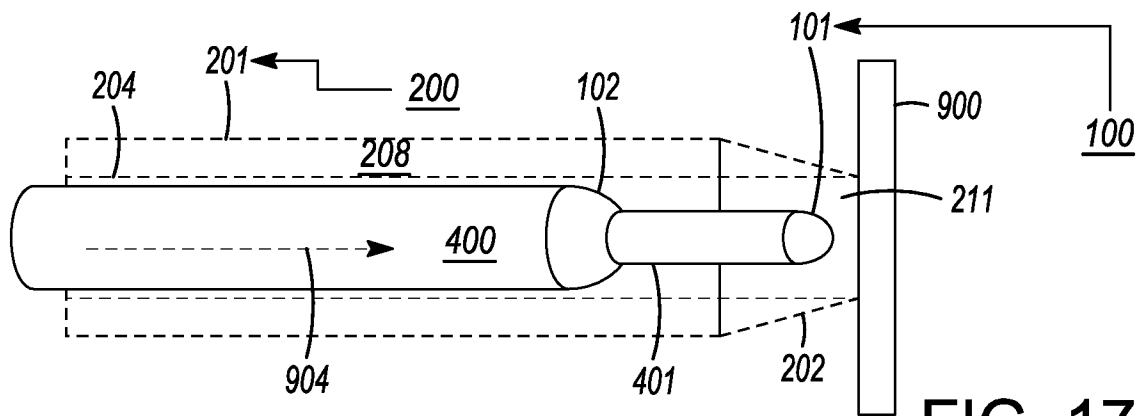


FIG. 17

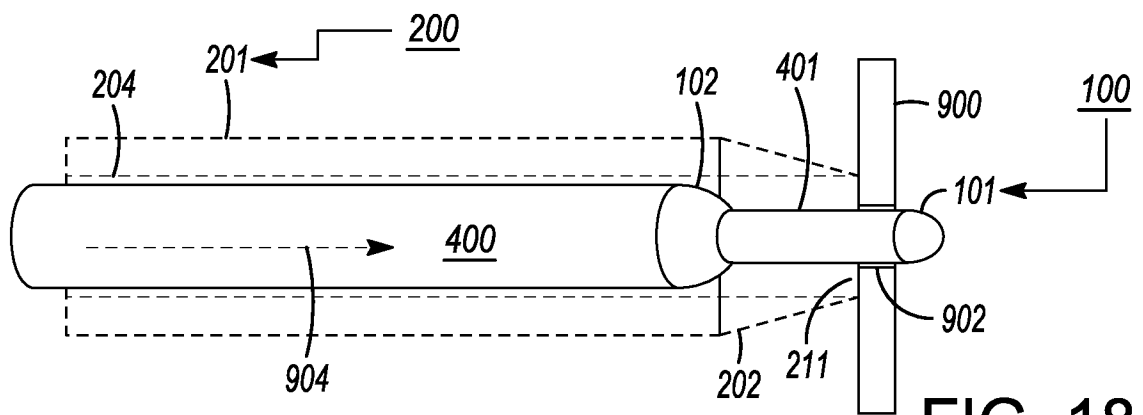


FIG. 18

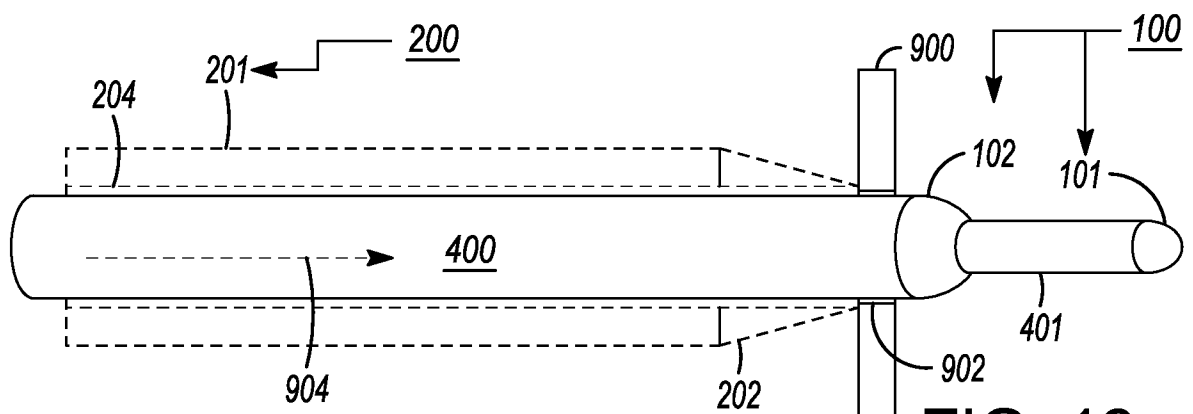


FIG. 19

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2021/055273

A. CLASSIFICATION OF SUBJECT MATTER A61B 18/14(2006.01)i; A61B 18/18(2006.01)i; A61B 17/34(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A61B 18/14(2006.01); A61B 10/04(2006.01); A61B 10/06(2006.01); A61B 17/02(2006.01); A61B 17/3205(2006.01); A61B 17/34(2006.01); A61B 18/02(2006.01) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models Japanese utility models and applications for utility models Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS(KIPO internal) & Keywords: energy-emitting device, puncture hole, elongated medical assembly, biological feature, enlargement		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2019-181611 A1 (TERUMO KABUSHIKI KAISHA et al.) 26 September 2019 (2019-09-26) See paragraphs [0009]-[0047]; and figs. 2, 3, 6.	1-5,15-20
A		6-14
Y	WO 2019-188916 A1 (TERUMO KABUSHIKI KAISHA et al.) 03 October 2019 (2019-10-03) See paragraphs [0013]-[0041]; and figs. 3, 9, 10	1-5,15-20
A	US 2013-0046305 A1 (BAYLIS MEDICAL COMPANY) 21 February 2013 (2013-02-21) See paragraphs [0042]-[0066]; and figs. 2A-2F.	1-20
A	US 2018-0140289 A1 (BOSTON SCIENTIFIC SCIMED, INC.) 24 May 2018 (2018-05-24) See paragraphs [0030]-[0043]; and figs. 1-8.	1-20
A	US 2020-0060710 A1 (BAYLIS MEDICAL COMPANY INC.) 27 February 2020 (2020-02-27) See paragraphs [0066]-[0097]; and figs. 3B, 3C.	1-20
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 16 September 2021		Date of mailing of the international search report 16 September 2021
Name and mailing address of the ISA/KR Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon 35208, Republic of Korea Facsimile No. +82-42-481-8578		Authorized officer PARK, Hye Lyun Telephone No. +82-42-481-3463

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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