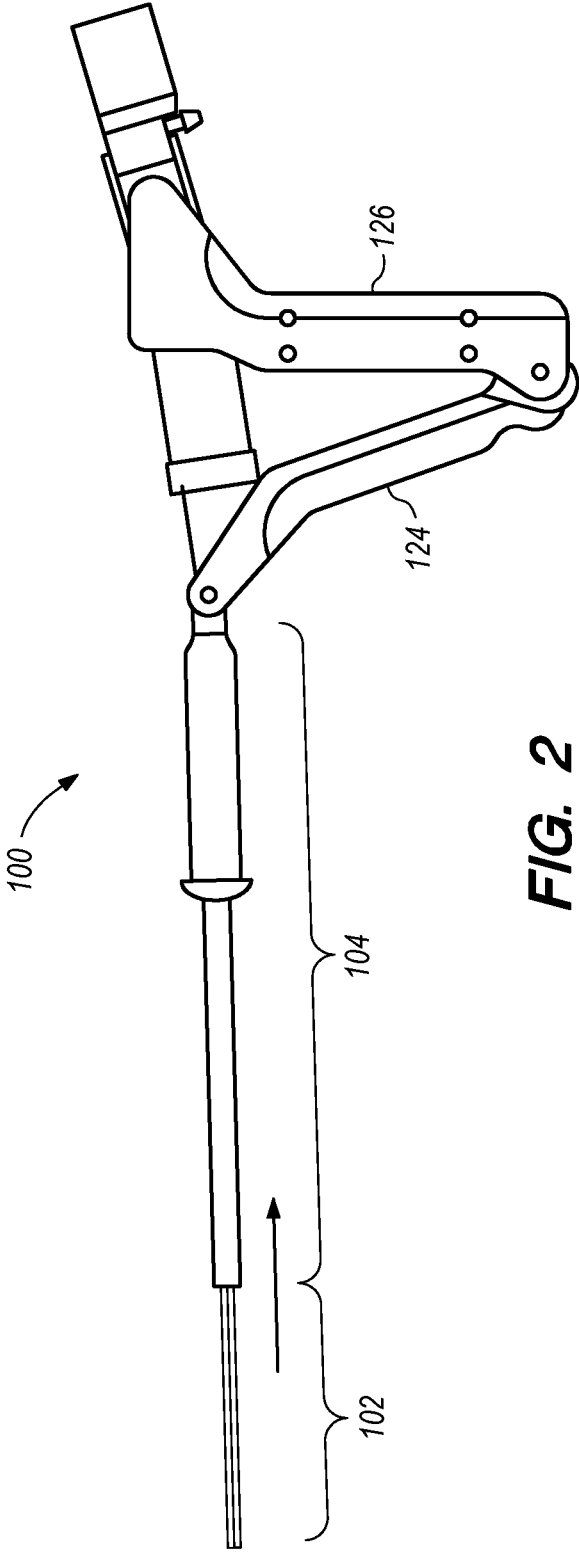


FIG. 1



**FIG. 2**

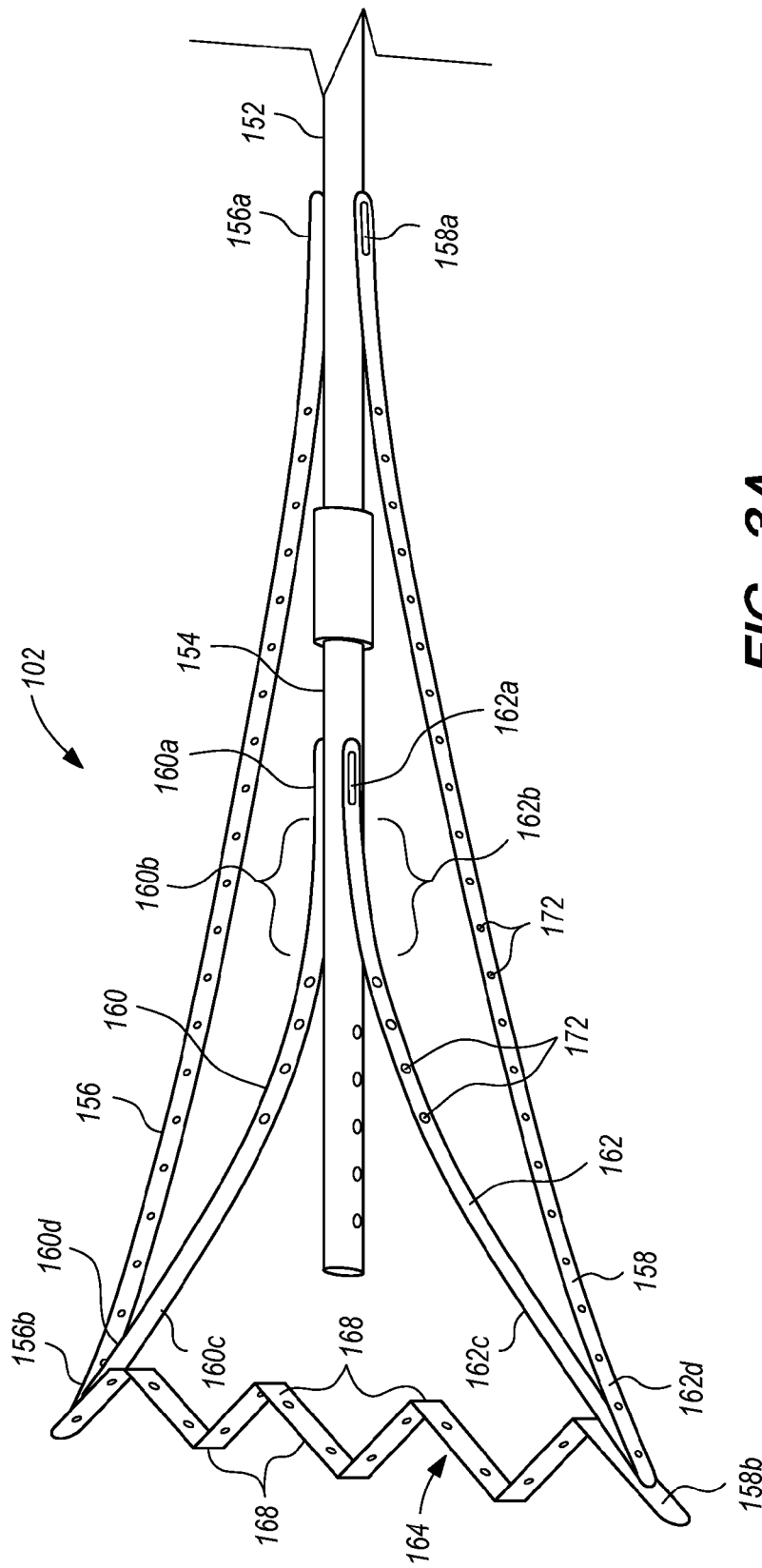
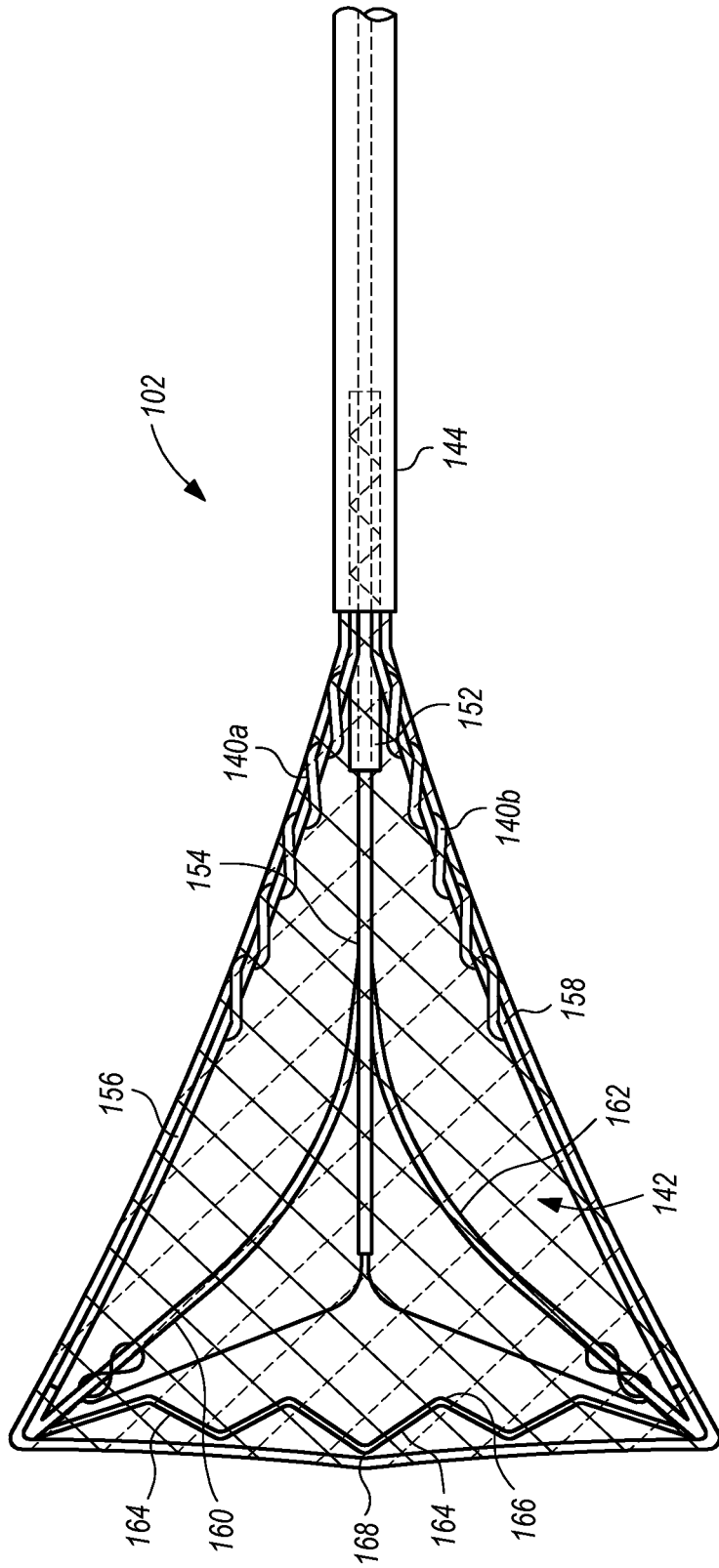
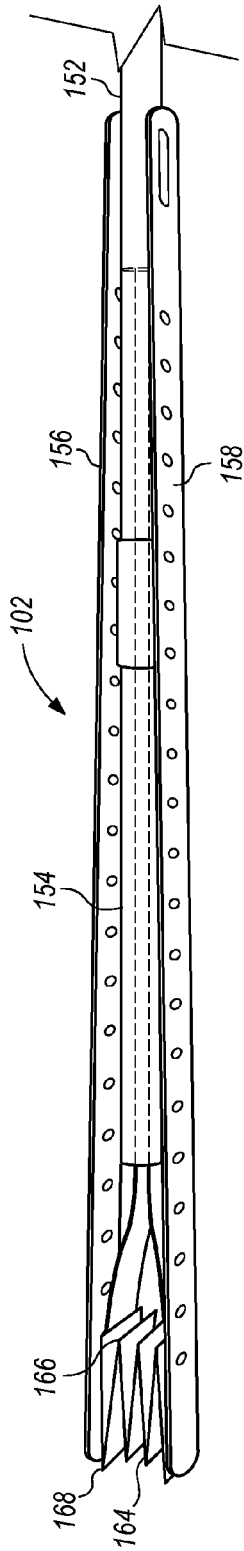


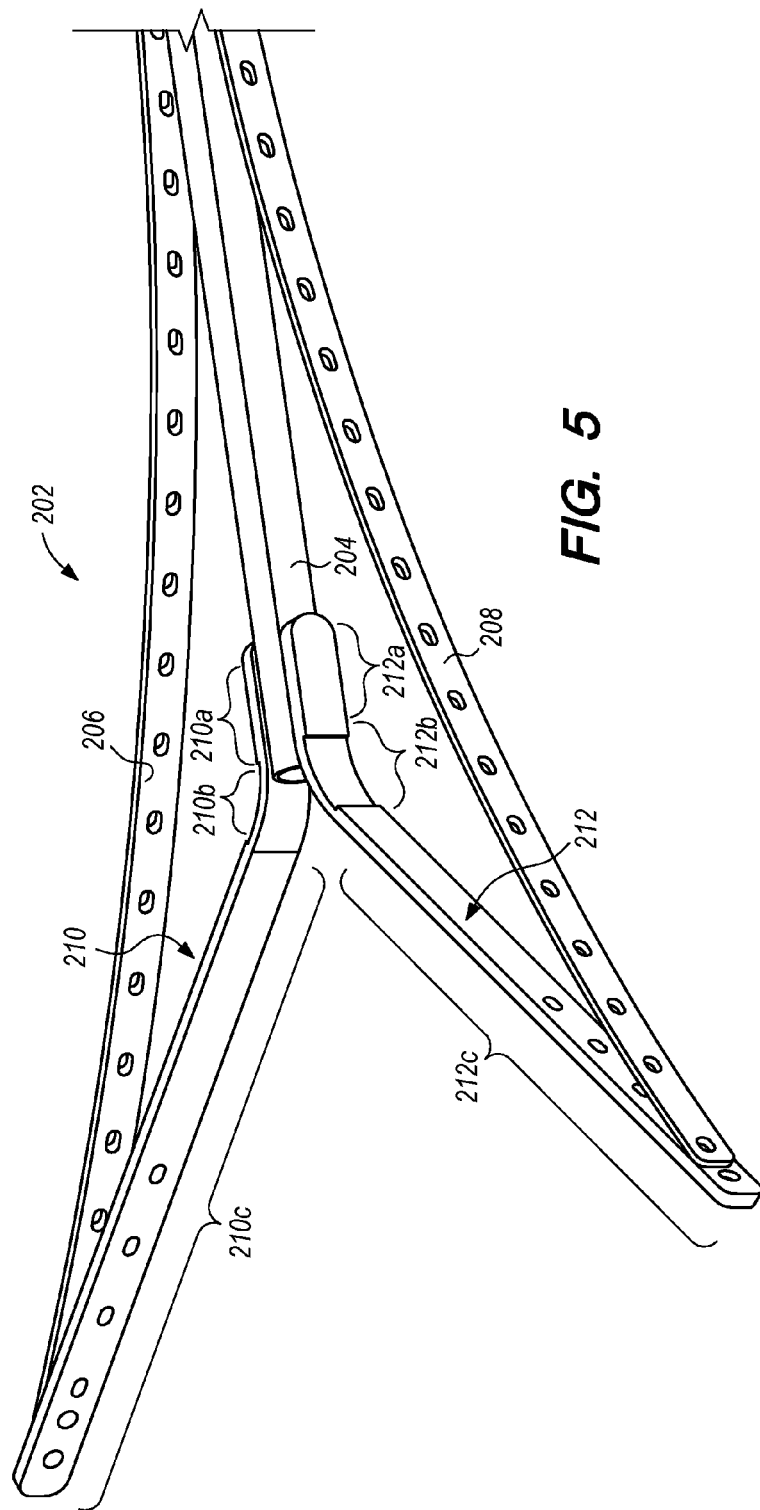
FIG. 3A



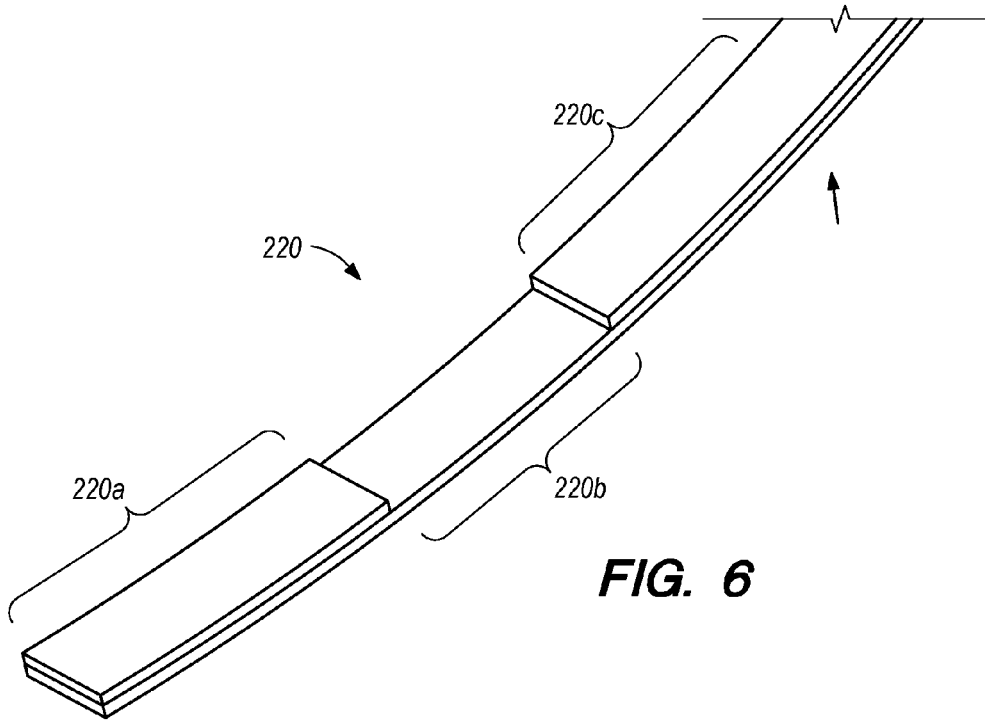
**FIG. 3B**



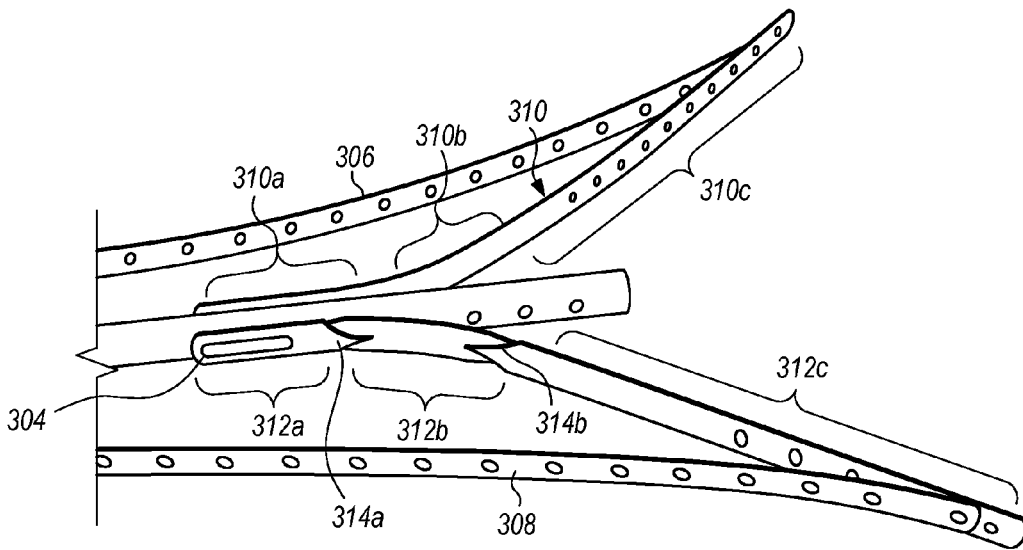
**FIG. 4**



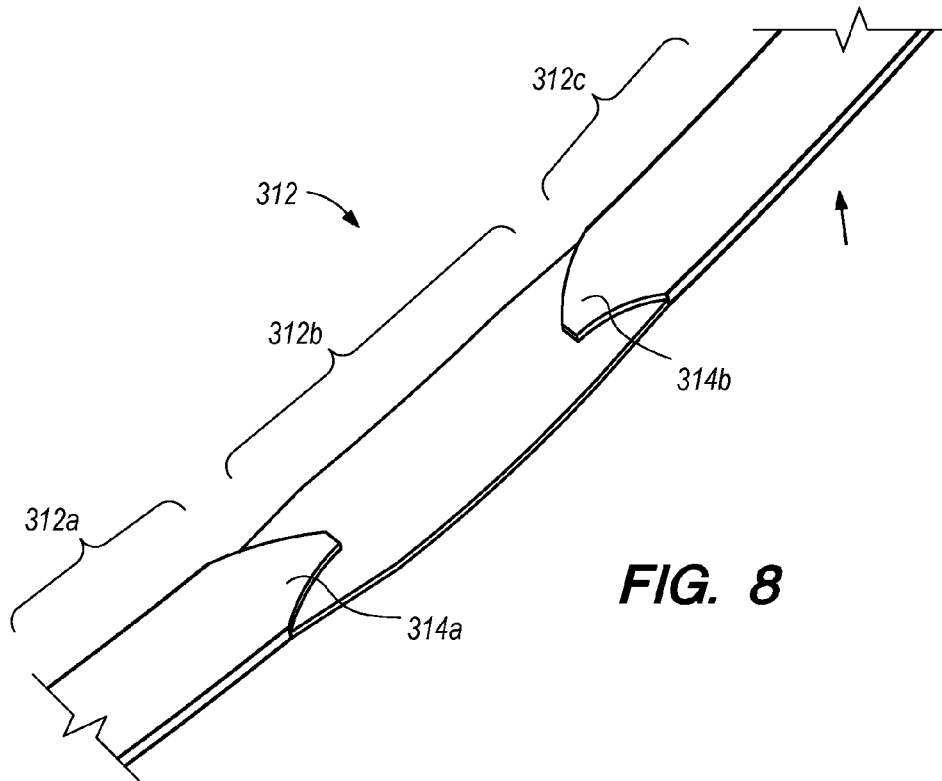
**FIG. 5**



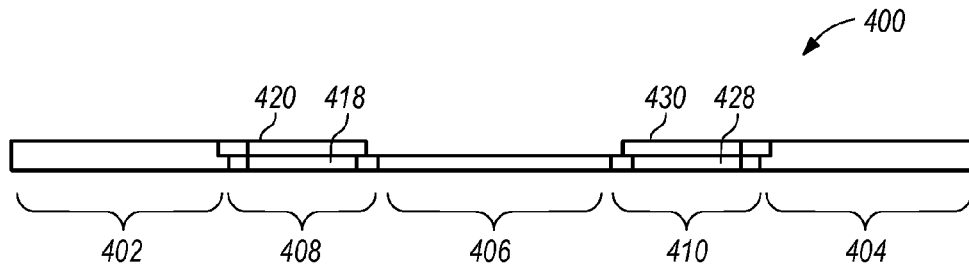
**FIG. 6**



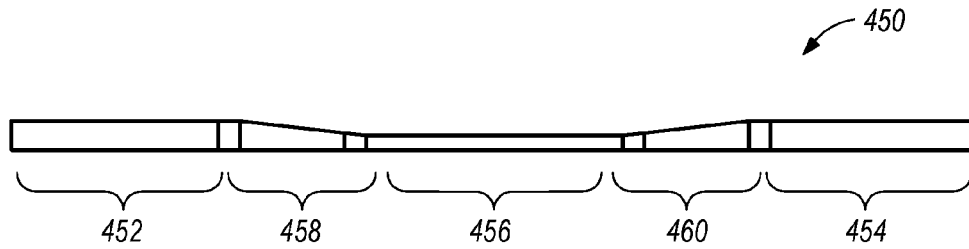
**FIG. 7**



**FIG. 8**

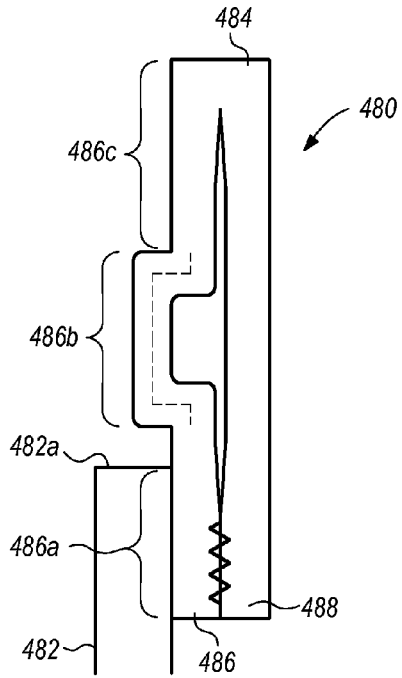


**FIG. 9A**

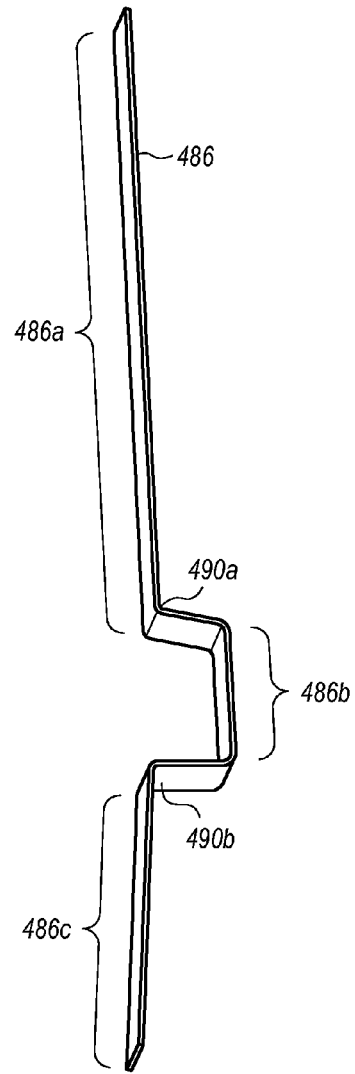


**FIG. 9B**

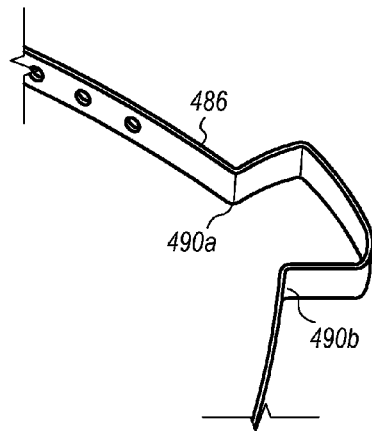




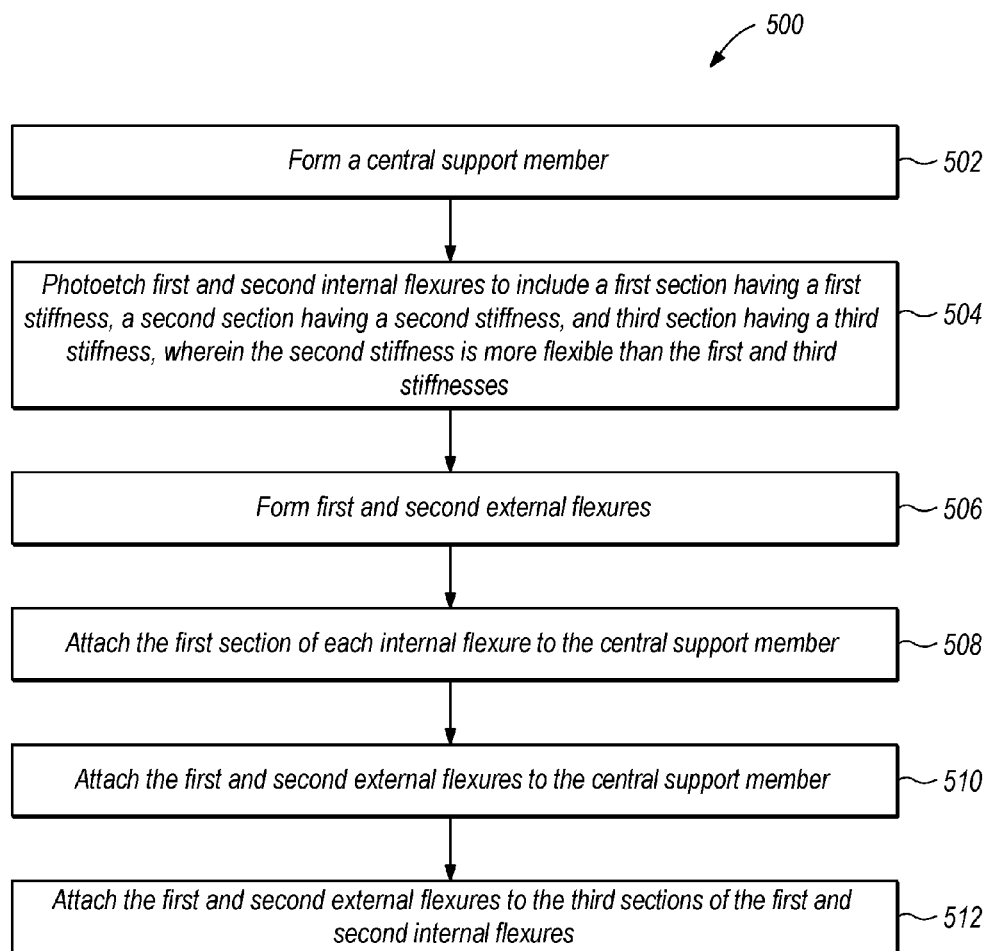
**FIG. 10**



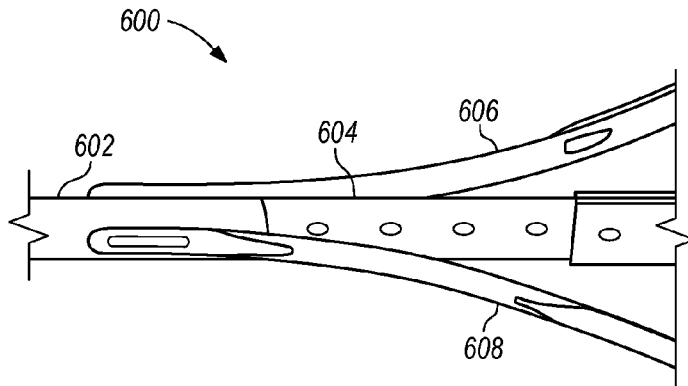
**FIG. 11A**



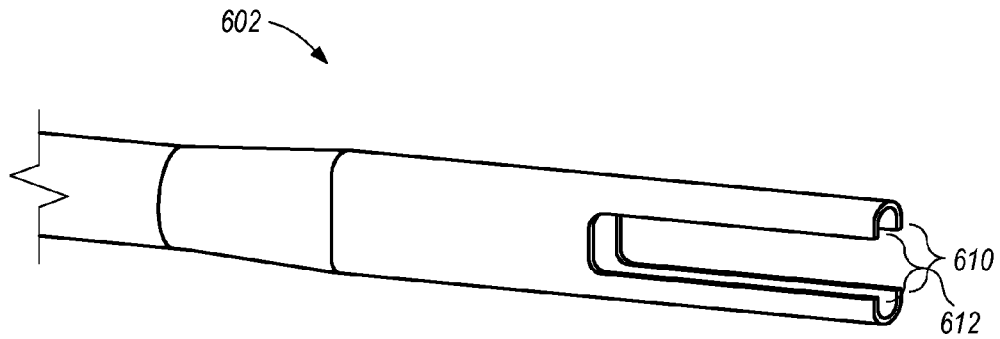
**FIG. 11B**



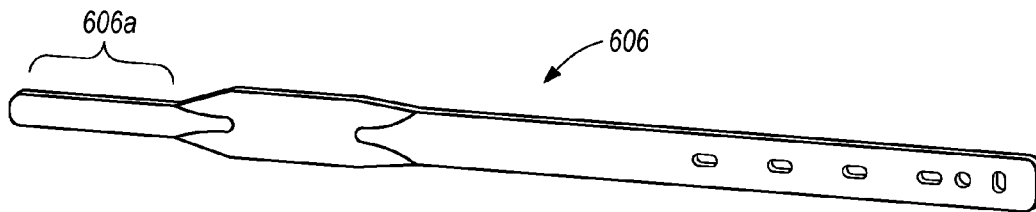
**FIG. 12**



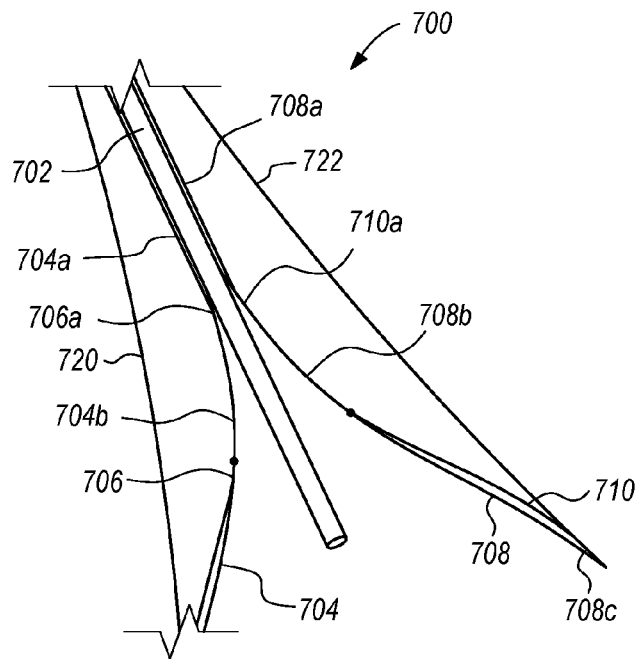
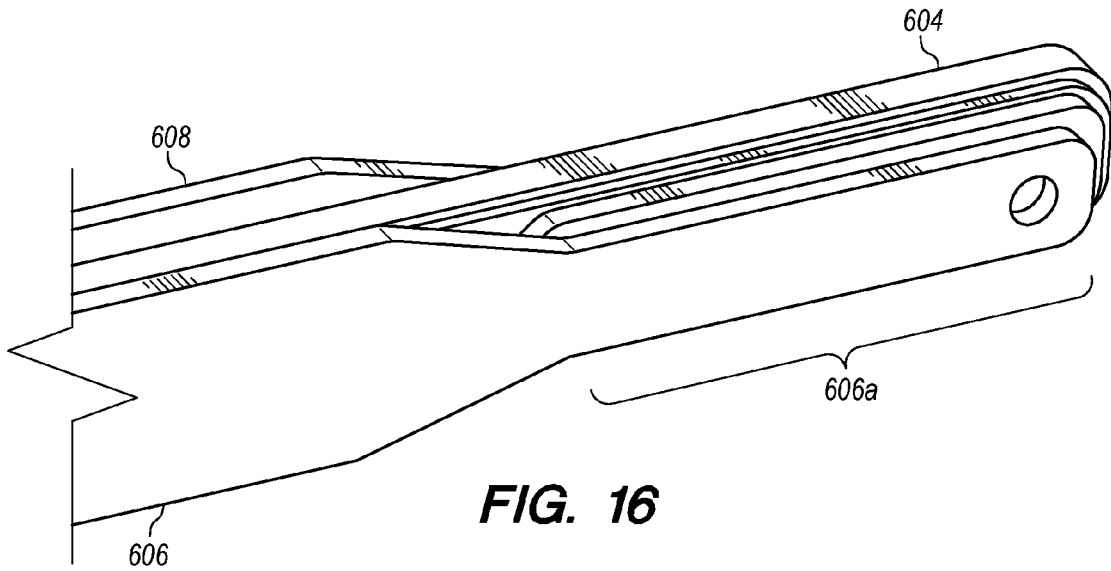
**FIG. 13**

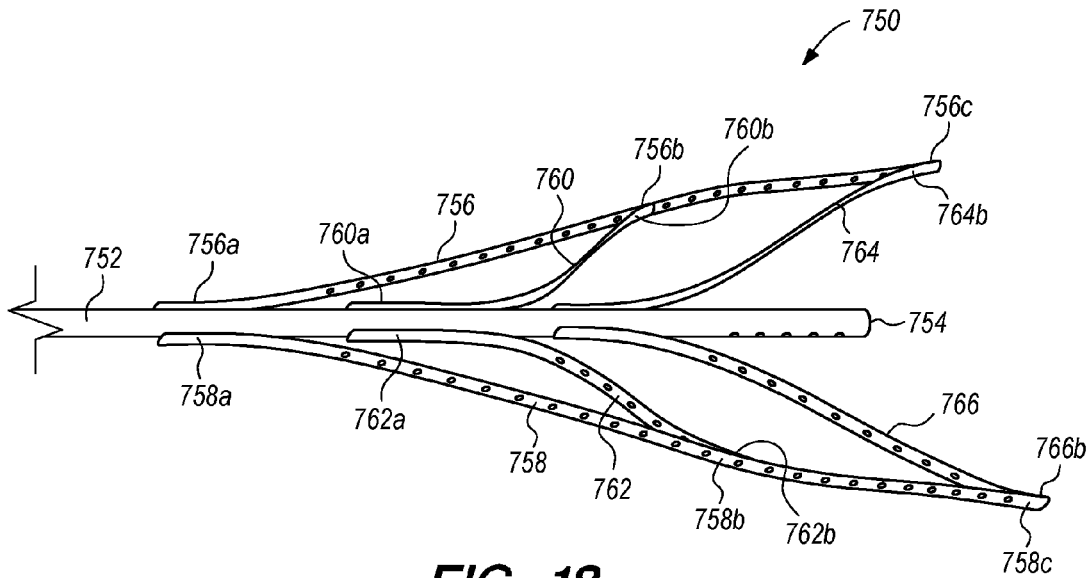


**FIG. 14**

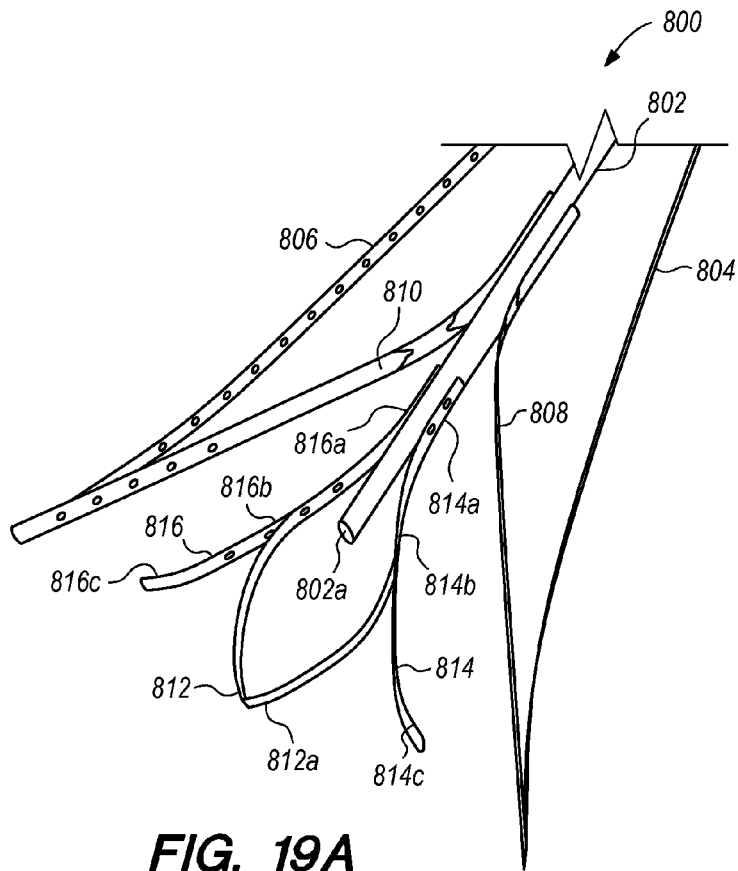


**FIG. 15**

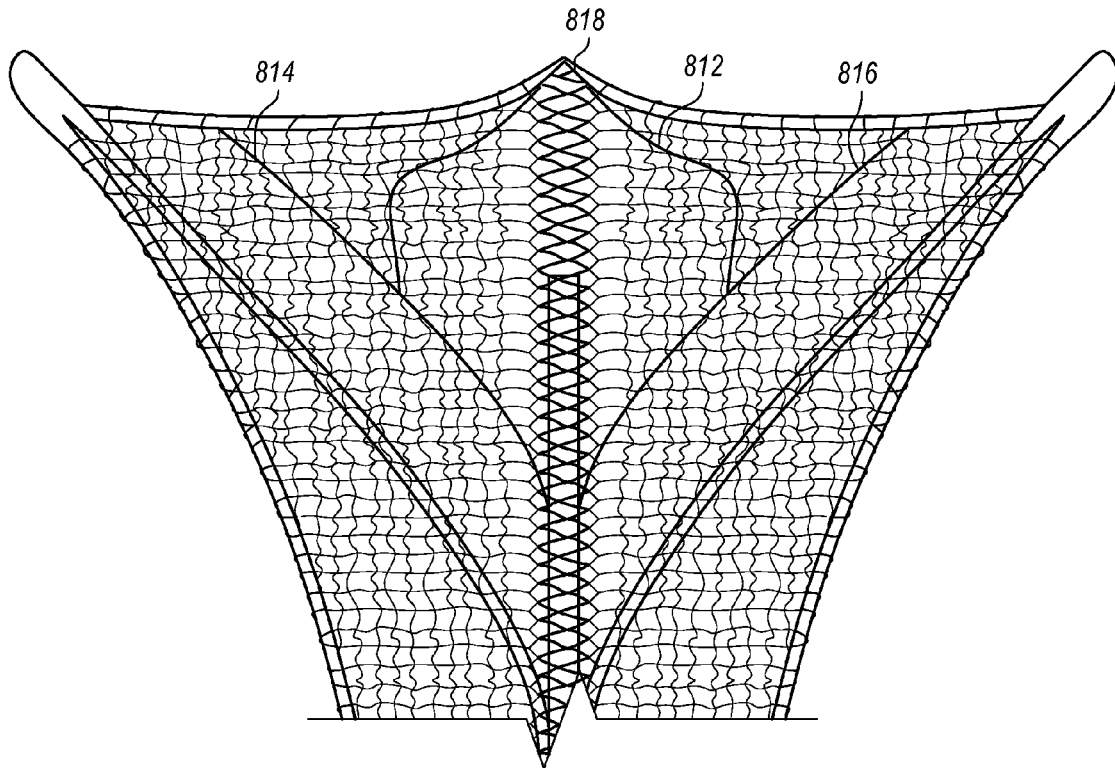




**FIG. 18**

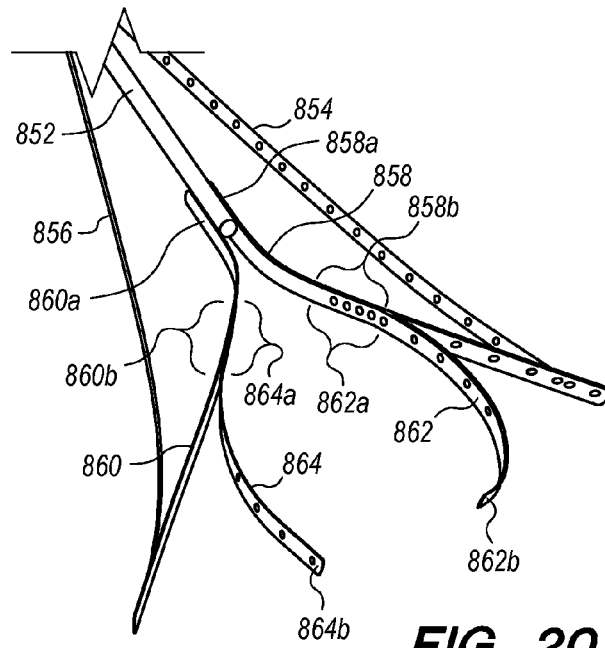


**FIG. 19A**

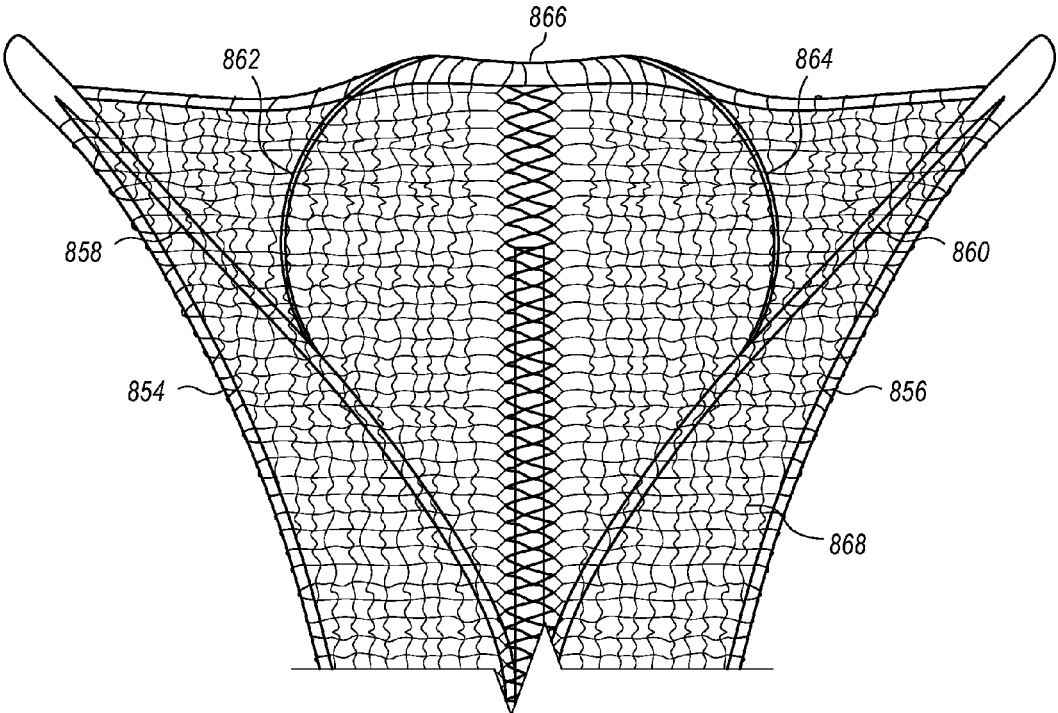


**FIG. 19B**

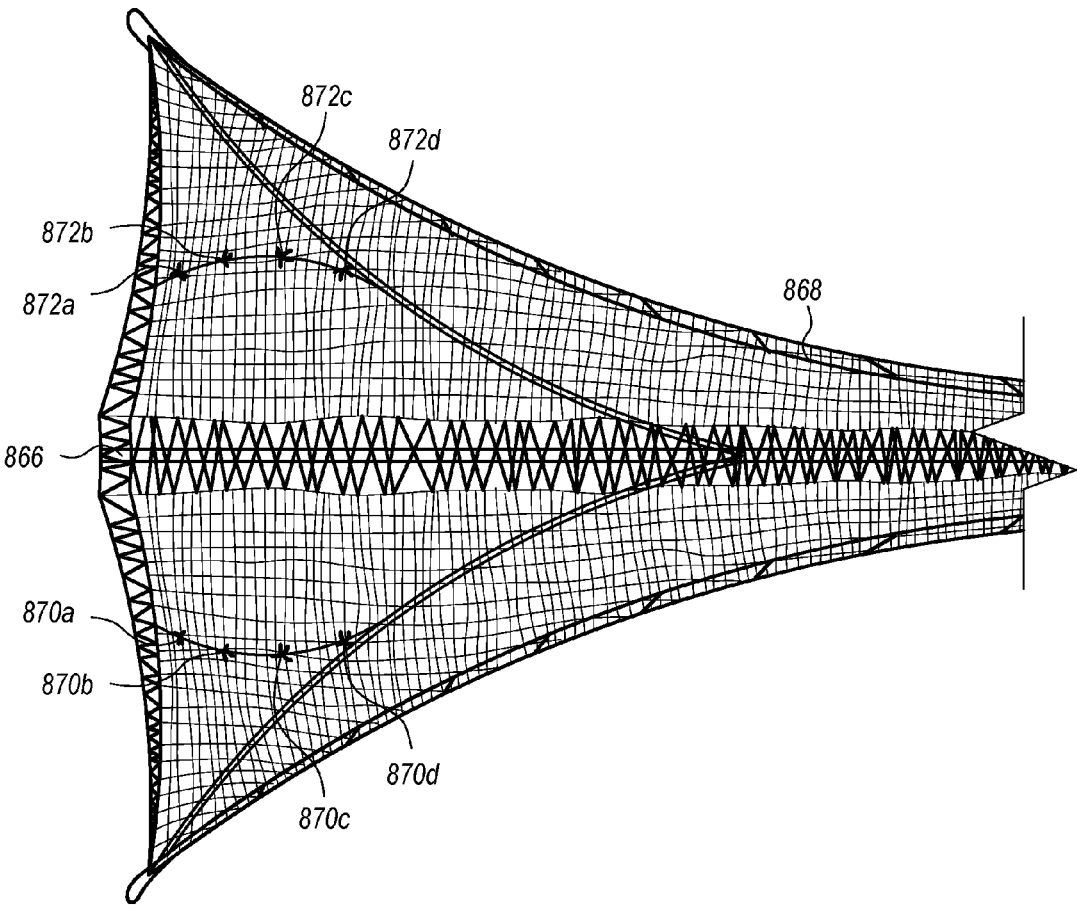
850 →



**FIG. 20A**



**FIG. 20B**



**FIG. 20C**



## VARIABLE STIFFNESS FLEXURE

### BACKGROUND

[0001] Intrauterine medical devices are often inserted through a patient's cervix and then expanded inside the patient's uterus. For example, a uterine ablation procedure may be performed by inserting a sheath through the cervix and then extending an applicator through the distal end of the sheath and expanding the applicator in the uterus. The applicator is expanded inside the patient, out of view of the person performing the procedure. Reliable and proper deployment of the applicator and subsequent robustness of the device are important to avoid complications and potential injury to the patient. Additionally, the applicator should reliably contract back into the sheath for removal from the patient.

### SUMMARY

[0002] Aspects and embodiment are directed to reducing the diameter of the sheath of an intrauterine device while maintaining the strength and robustness of the device. Reducing the diameter of the sheath of an intrauterine device improves its ease of insertion and decreases patient discomfort.

[0003] According to one aspect, a device includes a central support member, first and second internal flexures, and first and second external flexures. The device may be an intrauterine device. The first and second internal flexures each include a first section having a first stiffness, a second section having a second stiffness, and third section having a third stiffness, wherein the second stiffness is more flexible than the first and third stiffness and wherein the first section of each internal flexure is coupled to the central support member. The first and second external flexures are each coupled to the central support member and are each coupled to the third section of the respective first and second internal flexures. The first and second external flexures, in combination with the first and second internal flexures, are configured to extend from a collapsed position parallel to the central support member to a deployed position flexing away from the central support member. In one embodiment, the device is an endometrial ablation device. According to one feature, stiffness refers to the bending characteristics of the flexure.

[0004] According to one embodiment, the first and second internal flexures further include a fourth section having a fourth stiffness and a fifth section having a fifth stiffness. The fourth section is positioned between the first section and the second section and the fifth section is positioned between the second section and the third section. The fourth and fifth stiffnesses are more flexible than the first and third stiffnesses and less flexible than the second stiffness. In one embodiment, the fourth and fifth stiffnesses taper, decreasing in stiffness toward the second section.

[0005] In another embodiment, the device also includes a bridge coupled between the first and second external flexures. The bridge may be configured to fold in the first position and to at least partially extend in the second position. In one embodiment, the device includes a mesh array surrounding the first and second external flexures, the first and second internal flexures and the central support member.

[0006] According to another aspect, a device includes a central support member, first and second internal flexures, and first and second external flexures. In one embodiment, the device is an intrauterine device. The first and second internal flexures each include a first section having a first stiffness and a second section having a second stiffness, wherein the second stiffness is less than the first stiffness and wherein the first section of each internal flexure is coupled to the central support member. The first and second external flexures are each coupled to the central support member and are each coupled to the second section of the respective first and second internal flexures. The first and second external flexures, in combination with the first and second internal flexures, are configured to extend from a collapsed position parallel to the central support member to a deployed position flexing away from the central support member. In one embodiment, the device is an endometrial ablation device.

[0007] According to one aspect, a device includes a central support member having a center line, first and second internal flexures each including first and second sections, and first and second external flexures. The first section is positioned adjacent to the second section, and in one example, the first section is stacked on the second section. The first section includes a middle portion, and the middle portion has a C-shape, wherein the middle portion curves inward toward a center line and curves outward toward the second stacked section. The first and second external flexures are each coupled to the central support member and each coupled near a distal end of the respective first and second internal flexures. The first and second external flexures, in combination with the first and second internal flexures, are configured to extend from a collapsed position parallel to the central support member to a deployed position flexing away from the central support member. In one embodiment, the device is an intrauterine endometrial ablation device.

[0008] In one embodiment, the intrauterine device also includes a sheath configured to enclose the central support member, the first and second internal flexures and the first and second external flexures when in a collapsed and retracted position. In another embodiment, the device includes a mesh array supported by the first and second external flexures, the first and second internal flexures and the central support member. The mesh array may be comprised of a conductive material.

[0009] According to another aspect, a device includes a central support member, first and second sets of internal flexures, and first and second external flexures. The first set of internal flexures includes two internal flexures, and the proximal end of each internal flexure is coupled to the central support member at a first position. The second set of internal flexures includes two internal flexures, and the proximal end of each internal flexure is coupled to the central support member at a second position, wherein the second position is distal to the first position. The first and second external flexures are each coupled to the central support member and are each coupled to distal ends of the first and second sets of internal flexures. The first and second external flexures, in combination with the first and second sets of internal flexures, are configured to extend from a collapsed position parallel to the central support member to a deployed position flexing away from the central support member.

**[0010]** According to one aspect, a device includes a central support member, first and second internal flexures, and first and second external flexures. In one embodiment, the device is an intrauterine device. The first and second internal flexures each include a first section having a first thickness, a second section having a second thickness, and third section having a third thickness, wherein the second thickness is less than the first and third thicknesses and wherein the first section of each internal flexure is coupled to the central support member. The first and second external flexures are each coupled to the central support member and are each coupled to the third section of the respective first and second internal flexures. The first and second external flexures, in combination with the first and second internal flexures, are configured to extend from a collapsed position parallel to the central support member to a deployed position flexing away from the central support member. In one embodiment, the device is an endometrial ablation device.

**[0011]** In one embodiment, the central support member includes two or more support members coupled together. The support members may move relative to one another. The support members may be telescoping support members. In one example, the support members may be slidably coupled together. According to one feature, the first and second internal flexures are attached to a first support member of the central support member, and the first and second external flexures are attached to a second support member of the central support member.

**[0012]** In one embodiment, the first and second internal flexures further include a fourth section having a fourth thickness and a fifth section having a fifth thickness. The fourth section is positioned between the first section and the second section and the fifth section is positioned between the second section and the third section. The fourth and fifth thicknesses are thinner than the first and third thicknesses and thicker than the second thickness. In one embodiment, the fourth and fifth thicknesses taper, decreasing in thickness toward the second section. In another embodiment, the fourth and fifth sections are triangular shaped.

**[0013]** According to one embodiment, the device also includes a bridge coupled between the first and second external flexures. The bridge may be configured to fold in the first position and to at least partially extend in the second position. According to another embodiment, the device also includes a sheath configured to enclose the central support member, the first and second internal flexures and the first and second external flexures when in the first position.

**[0014]** In one embodiment, the device also includes a mesh array surrounding the first and second external flexures, the first and second internal flexures and the central support member. The mesh array may be comprised of a conductive material. In another embodiment, the central support member is a tube.

**[0015]** According to another aspect, a device includes a central support member, first and second internal flexures, and first and second external flexures. In one embodiment, the device is an intrauterine device. The first and second internal flexures each include a first section having a first thickness and a second section having a second thickness, wherein the first thickness is less than the second thickness and wherein the first section of each internal flexure is coupled to the central support member. The first and second external flexures are each coupled to the central support member and are each coupled to the second section of the

respective first and second internal flexures. The first and second external flexures, in combination with the first and second internal flexures, are configured to extend from a collapsed position parallel to the central support member to a deployed position flexing away from the central support member. In one embodiment, the device is an endometrial ablation device.

**[0016]** According to another aspect, a method of manufacturing an intrauterine device includes providing a central support member, providing first and second internal flexures to include a first section having a first stiffness, a second section having a second stiffness, and third section having a third stiffness, wherein the second stiffness is more flexible than the first and third stiffness, providing first and second external flexures, attaching the first section of each internal flexure to the central support member, attaching, at a first location, the first and second external flexures to the central support member, and attaching, at a second location, the first and second external flexures to the third section of the respective first and second internal flexures.

**[0017]** According to one embodiment, providing a central support member includes forming a first hollow elongate tubular member, forming a second hollow tubular member, and coupling the first hollow tubular member with the second hollow tubular member. According to another embodiment, providing of the first and second internal flexures includes forming the first and second flexures such that the first section has a first thickness, the second section has a second thickness, and the third section has a third thickness. According to a further embodiment, the forming is done by photoetching.

**[0018]** Still other aspects, embodiments, and advantages of these exemplary aspects and embodiments, are discussed in detail below. Embodiments disclosed herein may be combined with other embodiments in any manner consistent with at least one of the principles disclosed herein, and references to “an embodiment,” “some embodiments,” “an alternate embodiment,” “various embodiments,” “one embodiment” or the like are not necessarily mutually exclusive and are intended to indicate that a particular feature, structure, or characteristic described may be included in at least one embodiment. The appearances of such terms herein are not necessarily all referring to the same embodiment.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** Various aspects of at least one embodiment are discussed below with reference to the accompanying figures, which are not intended to be drawn to scale. The figures are included to provide illustration and a further understanding of the various aspects and embodiments, and are incorporated in and constitute a part of this specification, but are not intended as a definition of the limits of the invention. In the figures, each identical or nearly identical component that is illustrated in various figures is represented by a like numeral. For purposes of clarity, not every component may be labeled in every figure. In the figures:

**[0020]** FIG. 1 is a side elevation view of an intrauterine therapy application device with an applicator in a retracted position according to aspects of the invention;

**[0021]** FIG. 2 is a side elevation view of the intrauterine therapy application device of FIG. 1, showing the applicator in a deployed position according to aspects of the invention;

[0022] FIG. 3A is a perspective view of an embodiment of an intrauterine therapy application device applicator in a deployed position, according to aspects of the invention;

[0023] FIG. 3B is an elevation view of an embodiment of an intrauterine therapy application device applicator in a deployed position, according to aspects of the invention;

[0024] FIG. 4 is a perspective view of an embodiment of a portion of an intrauterine therapy application device applicator in a collapsed position according to aspects of the invention;

[0025] FIG. 5 is a perspective view of an embodiment of a portion of an intrauterine therapy application device applicator showing internal flexures according to aspects of the invention;

[0026] FIG. 6 is a blown up view of an embodiment of a section of an internal flexure having a varying thickness according to aspects of the invention;

[0027] FIG. 7 is a perspective view of an embodiment of a portion of an intrauterine therapy application device applicator showing internal flexures of varying thickness according to aspects of the invention;

[0028] FIG. 8 is a blown up view of an embodiment of a section of an internal flexure having varying thickness according to aspects of the invention;

[0029] FIG. 9A is a side view of a section of an embodiment of an internal flexure having varying thickness according to aspects of the invention;

[0030] FIG. 9B is a side view of a section of an embodiment of an internal flexure having varying thickness according to aspects of the invention;

[0031] FIG. 10 is a side elevation view of a portion of an embodiment of an intrauterine therapy application device applicator according to aspects of the invention;

[0032] FIGS. 11A-11B show a section of an the internal flexure according to aspects of the invention;

[0033] FIG. 12 is a flow chart of a method of manufacturing an intrauterine therapy application device applicator, according to aspects of the invention.

[0034] FIG. 13 is a perspective view of an embodiment of an intrauterine therapy application device applicator showing a portion of internal flexures according to aspects of the invention;

[0035] FIG. 14 is an elevation view of a portion of an embodiment of a central support member according to aspects of the invention;

[0036] FIG. 15 is an elevation view of a portion of an embodiment of an internal flexure according to aspects of the invention;

[0037] FIG. 16 is a blown up view of a portion of an embodiment of a central support member and internal flexures according to aspects of the invention;

[0038] FIG. 17 is a perspective view of an embodiment of an intrauterine therapy application device applicator according to aspects of the invention;

[0039] FIG. 18 is a perspective view of an embodiment of an intrauterine therapy application device applicator having two sets of internal flexures according to aspects of the invention;

[0040] FIG. 19A is a perspective view of a portion of an embodiment of an intrauterine therapy application device applicator, according to aspects of the invention;

[0041] FIG. 19B is an elevation view of a portion of the embodiment of an intrauterine therapy application device

applicator of FIG. 19A further including a mesh array, according to aspects of the invention;

[0042] FIG. 20A is a perspective view of a portion of an embodiment of an intrauterine therapy application device applicator, according to aspects of the invention;

[0043] FIG. 20B is an elevation view of a portion of the embodiment of an intrauterine therapy application device applicator of FIG. 20A further including a mesh array, according to aspects of the invention; and

[0044] FIG. 20C is an elevation view of a portion of an intrauterine therapy application device applicator having a mesh array, according to aspects of the invention.

#### DETAILED DESCRIPTION

[0045] Various aspects of at least one embodiment are discussed below with reference to the accompanying figures, which are not intended to be drawn to scale. The figures are included to provide illustration and a further understanding of the various aspects and embodiments, and are incorporated in and constitute a part of this specification, but are not intended as a definition of the limits of the invention. In the figures, each identical or nearly identical component that is illustrated in various figures is represented by a like numeral. For purposes of clarity, not every component may be labeled in every figure.

[0046] According to aspects of this disclosure, various structures and methods are provided herein for decreasing a size or diameter of an intrauterine therapy application device in a retracted position, while maintaining its strength and stiffness in expanded and deployed positions. In at least one embodiment, various structures and methods are provided for maintaining the strength of a deployment mechanism of an intrauterine therapy application device by varying the stiffness of at least a portion of the individual flexures of the deployment mechanism.

[0047] According aspects of this disclosure, structure and methods are provided to decrease the stiffness of at least a portion of some of the flexures of a deployment mechanism of an intrauterine therapy application device, without increasing the risk of buckling of the deployment mechanism of intrauterine therapy application device. One advantage of decreasing the stiffness of at least a portion of some of the flexures of the deployment mechanism of the intrauterine therapy application device is a reduced size or diameter of the intrauterine therapy application device in collapsed position or a retracted into a sheath position, which provides for a smaller-diameter sheath while still maintaining the deployment mechanism's strength and stiffness in collapsed and deployed positions. Another advantage is a smaller outer diameter sheath may reduce patient discomfort and decrease the potential for cervical injury during insertion into the uterus.

[0048] By way of introduction and referring to the Figures, illustrated in FIG. 1 is an intrauterine therapy application device includes an applicator 102, a sheath 104, and an RF generator 110. According to one embodiment, the sheath is inserted through the patient's cervix. The applicator may be retracted in a collapsed position within the sheath for insertion into the patient's cervix. The sheath may be inserted through the patient's cervix, and when the distal end 104a of the sheath is inside the uterus, the applicator may be extended into the uterus in a collapsed position and expanded into a deployed state in the uterus. FIG. 3B illustrates an intrauterine therapy application device appli-

cator **102** in a deployed position and having a mesh array **142**. Decreasing the size, such as the width in a collapsed position of the applicator allows for use of a smaller-diameter sheath. A sheath having a smaller outer diameter may reduce patient discomfort, and also decrease the potential for cervical injury during insertion through the cervix and into the uterus. In some embodiments, the deployment mechanism includes internal flexures (see **160, 162** of FIG. **3A**) and external flexures (see **156, 158** of FIG. **3A**). In a deployed position, external flexures (**156, 158** of FIG. **3A**) define the outer contour of the applicator, and internal flexures (**160, 162** of FIG. **3A**) facilitate reliable deployment of the applicator from the sheath into a collapsed position and into a deployed state as well as retraction of the applicator into the collapsed position and into the sheath.

**[0049]** Referring to FIG. **3A**, the intrauterine therapy application device **100** can be spread open by driving an internal central support member **154** forward relative to an external central support member **152**. Depending on the forces provided by the drive mechanism used to actuate the internal central support member, the applicator may or may not open to its maximum width. For example, consider using a screw drive to drive forward the internal central support member **154** and to spread the internal **160, 162** and external **156, 158** flexures. The travel of the central support member (and thus the deployment of flexures) is rigidly coupled to the travel of the screw drive. Even if some mechanical restriction prevents the internal and external flexures from spreading to their full width, the screw drive will continue to try to advance the internal central support member. One disadvantage is that this screw drive can generate significant spreading force in the flexures, and it can result in heavy stress on the flexures.

**[0050]** As a second example, consider introducing a compliant element, such as a spring, between the screw drive and the internal central support member **154**. The spring transmits force from the screw drive to the internal central support member, so that if the external flexures are unrestricted, the flexures will deploy normally to their full width. Alternatively, in the event that the tips of the flexures somehow become restricted, the spring can absorb the screw's travel, allowing the flexures to rest at a sub-maximum width without heavy stress. Thus, the introduction of a compliant element between the screw drive and the internal support member allows for a simple drive mechanism that drives a deployment mechanism that can automatically open to variable maximum widths (i.e. opening to fill a cavity of unknown size). It also controls the spreading force that the deployment mechanism is able to generate.

**[0051]** Functionally, the purpose of the deployment mechanism of the intrauterine therapy application device is to spread the mesh array **142** from a collapsed state into a deployed state. The mesh array is knit from elastic yarn, so a certain level of force is needed simply to spread the mesh array to the desired shape. On top of stretching the mesh array, the deployment mechanism must be capable of generating additional spreading force to ensure that the deployment mechanism still opens properly if resistance is encountered. Simultaneously, it is desirable for the deployment mechanism to be as small as possible and to be as mechanically durable as possible.

**[0052]** One approach considered by the Applicants for a deployment mechanism used internal flexures made of a single-thickness piece of material. These single-thickness

internal flexures had a relatively consistent stiffness and, therefore, a relatively consistent bending radius. The resulting deployed shape of the internal flexure was approximately an arc. For most scenarios, this single-thickness internal flexure provided a structure that was sufficiently mechanically durable. However, this arc can be susceptible to damage under mechanically disadvantageous loading conditions. There are a few solutions that were considered to reduce this susceptibility.

**[0053]** A first approach to improving the durability of the deployment mechanism is that the strength of the internal flexure could be increased so that a greater mechanical stress would be required to damage the internal flexure. One way to do this would be to add material to the internal flexure, either increasing the thickness or height of the internal flexure. However, a drawback of this approach is that it would increase the overall size of the deployment mechanism. Additionally, increasing the thickness of the internal flexure could increase the rigidity of the internal flexure so much that it would be unable to conform to the desired arc profile without permanently deforming.

**[0054]** A second approach to improving the durability of the deployment mechanism is to make the entire internal flexures more compliant/resilient so that the deployment mechanism can endure significant mechanical manipulation and displacement without undergoing permanent deformation. This approach could be achieved, for example, using either a thinner or lower-height internal flexure, by selecting a more flexible material for the internal flexures, or decreasing a width of the entire internal flexures. While this approach could reduce the size of the deployment mechanism, the reduction in the resilience of the entire flexures of the deployment mechanism can be a problem. Applicants discovered that prototypes with such compliant flexures though flexible and resilient, lacked the mechanical strength needed to sustain the desired spreading forces and deploy the mesh array. Applicants discovered that prototypes with such compliant flexures result in decreased integrity of the deployment mechanism of the applicator and an increased chance of buckling of the deployment mechanism of the applicator during deployment from the sheath and/or collapsing of the applicator. When an applicator buckles, the flexures of the deployment mechanism bend at an unintended angle and may lead to an overall shape of the deployment mechanism and the applicator being compromised. A further disadvantage of such modified flexures and deployment mechanism is that the buckling of the applicator may also lead to difficulty or inability to retract the applicator into its sheath or expand the applicator into its expanded position.

**[0055]** To generate adequate spreading forces in a smaller, sufficiently robust deployment mechanism, Applicants discovered a more complex approach that solves the above-noted issues. Specifically, Applicants discovered that it is desirable for a distal portion of the internal flexures to be made stronger, but for the internal flexures to still be capable of bending enough to generate sufficient lateral spreading of the mesh array. One solution considered was a strong, rigid internal flexure, connected by a hinge to the central support member. But a robust hinge would be difficult to fit in such a small space and therefore was not used. Another solution is to build a living hinge into the internal flexure. This structure and arrangement has the advantages of being compact, strong, and favorable from a manufacturing per-

spective. Ultimately, with such a structure and arrangement, the same array spreading performance and improved mechanical durability can be delivered in a smaller package than a single-thickness flexure design. The performance improvement of this deployment mechanism is most noticeable when the deployment mechanism is actuated by the compliant drive mechanism described earlier.

[0056] Referring now to the Figures, a detailed description of various embodiments of such an intrauterine therapy application device, deployment mechanism, and applicator structure will now be discussed. FIG. 1 is a side elevation view of an intrauterine therapy application device 100 with an applicator 102 in a retracted position inside a hollow sheath 104. The intrauterine therapy application device 100 includes a handle 106, and is coupled via a cable 120 to a radiofrequency signal generator 110 and via a tube 128 to a vacuum source 112. The radiofrequency generator 110 generates an electrical signal, for example a radiofrequency signal, and transmits it to the applicator 102 through the cable 120, which is ultimately coupled to the applicator through the handle 106. The vacuum source 112 is connected to the handle 106 at the vacuum port 122 and creates suction in the distal end of the applicator 102. According to one feature, the distal end 104a of the sheath 104 of the intrauterine therapy application device 100 is configured to be inserted into a patient's cervix.

[0057] The handle 106 includes a distal grip 124 and a proximal grip 126. During use, the proximal grip 126 is squeezed toward the distal grip 124, to cause the applicator 102 to extend out from the sheath 104, as shown in FIG. 2. As shown in FIG. 2, the applicator 102 is extended out from the sheath 104 in a collapsed position. As the applicator 102 extends out from the sheath 104 in the collapsed position, it also expands as shown in the perspective view of the deployed applicator illustrated in FIGS. 3A and 3B.

[0058] FIG. 3A is a perspective view of a portion of an intrauterine therapy application device applicator 102 in a deployed position, according to an embodiment of the invention. The applicator 102 includes an external central support member 152, an internal central support member 154, external flexures 156 and 158 and internal flexures 160 and 162. The proximal end of the internal central support member 154 is coupled to the distal end of the external central support member 152, so as to provide a telescoping arrangement. The proximal ends 156a and 158a of the external flexures 156 and 158 are attached to the outside of the external central support member 152 near the distal end of the external support member 152. The proximal ends 160a and 162a of the internal flexures 160 and 162 are attached to the outside of the internal central support member 154, near the proximal end of the internal central support member 154. It is to be appreciated, as will be discussed below for example with respect to FIGS. 14-16 that in other embodiments, the proximal ends 160a and 162a of the internal flexures 160 and 162 may be attached to the inside of the internal central support member 154, or the proximal ends 160a and 162a of the internal flexures 160 and 162 may be attached into the wall of the internal central support member 154. The external flexures 156 and 158 and the internal flexures 160 and 162 are attached to the external 152 and internal 154 support members such that the external flexures 156 and 158 and internal flexures 160 and 162 flexures lie in the same plane.

[0059] The external flexures 156 and 158 in one position extend outward away from being parallel with the central support members 152 and 154 to form a V-shape. According to one embodiment, the external flexures 156 and 158 extend laterally away from the external central support member 152, flaring outwards toward the distal ends 156b and 158b. Similarly, the internal flexures 160 and 162 extend laterally away from the internal central support member 154, forming a flared V-shape. The second sections 160b and 162b of the internal flexures 160 and 162, adjacent to the proximal ends 160a and 162a, gradually extend laterally away from the internal central support member 154. A third section 160c and 162c of each internal flexure 160 and 162 extends substantially laterally and longitudinally away from the internal central support member 154. The distal end 160d of the first internal flexure 160 is attached to a distal end 156b of the first external flexure 156, and a distal end 162d of the second internal flexure 162 is attached to the distal end 158b of the second external flexure 158.

[0060] As shown in FIG. 3A, the central support member of the device applicator 102 includes external central support member 152 coupled internal central support member 154. In other embodiments, the applicator 102 may include three or more support members coupled together. The external 152 and internal 154 central support members may move relative to one another. In one example, the external 152 and internal 154 central support members may be telescoping support members. In another example, the external 152 and internal 154 central support members may be slidably coupled together.

[0061] According to aspects of the device, a transverse ribbon 164 can extend between the distal ends 156b and 158b of the external flexures 156 and 158. In one embodiment, the transverse ribbon has a corrugated shape, and includes a plurality of creases 166 and 168, such that when the intrauterine device 102 is in the collapsed position, as shown in FIG. 4, the transverse ribbon 164 is folded along the creases 166 and 168.

[0062] Referring back to FIG. 3A, according to one embodiment, the external central support member 152 and the internal central support member 154 are hollow elongate tubes. When a suction is applied to the applicator 102, for example from the suction source 112 shown in FIG. 1, fluid, vapor, liquid, and/or tissue may be suctioned through hollow elongate tubular internal support member 154, away from the patient.

[0063] According to one aspect, the external flexures 156, 158 and internal flexures 160, 162 include multiple apertures 172. During use inside a patient, the apertures allow fluid, vapor, liquid and/or tissue to flow through the flexures and move within the uterus. According to aspects of the device, as shown in the illustrative embodiment, the transverse ribbon 164 also includes multiple apertures.

[0064] FIG. 3B is a perspective view of the portion of an intrauterine therapy application device applicator 102 in a deployed position and having a mesh array 142, according to an embodiment of the invention. The mesh array 142 surrounds the applicator 102. The mesh array 142 may be knitted from a nylon and spandex knit and plated with gold, silver, or another conductive material. The mesh array 142 is conformable, permeable, and carries current. The mesh array 142 is attached to the external flexures 156, 158 with strands of thread 140a and 140b. The strands of thread 140a, 140b may be nylon. The strands of thread 140a, 140b are

sewn through the mesh array 142 and around the external flexures 156, 158. Some examples of a mesh array are described in U.S. Pat. No. 6,813,520 to Truckai et al., which is hereby incorporated by reference herein in its entirety.

[0065] FIG. 4 is a perspective view of an intrauterine therapy application device with the applicator 102 illustrated in a collapsed position. In the collapsed position, the external flexures 156, 158 and the internal flexures 160, 162 extend laterally parallel with the external 152 and internal 154 central support members. The transverse ribbon 164 is folded along the creases 166, 168 shown in FIG. 3A. During use of an intrauterine therapy application device, such as the device 100 described with respect to FIG. 1, the applicator 102 is in a collapsed position inside the sheath 104 while the sheath 104 is inserted through the cervix. When the applicator 102 is extended distally from the distal end of the sheath 104, it expands to the deployed position shown in FIG. 3A.

[0066] According to features of this disclosure, the internal flexures may be designed to include at least one flexible section adjacent to one or more rigid sections. In one embodiment, a flexible section is positioned between two more rigid sections. The flexible section facilitates bending outward, away from the central support member, allowing the internal flexures to expand laterally away from the central support member to create a V-shape. FIG. 5 is a perspective view of an embodiment of an intrauterine therapy application device applicator 202 showing an internal central support member 204, external flexures 206, 208, and internal flexures 210, 212 having a flexible section and two rigid sections. The first internal flexure 210 and second internal flexure 212 each include at least three sections 210a, 210b, 210c and 212a, 212b, 212c. A proximal section 210a, 212a of each internal flexure is attached to or coupled to the central support member 204 and has a first thickness, a middle section 210b, 212b of each internal flexure has a second thickness, and a distal section 210c, 212c of each internal flexure has a third thickness. According to one embodiment, the second thickness is less than the first thickness and less than the third thickness, so that the middle section 210b, 212b is configured to bend more readily than the respective first and third sections, which facilitates the flexures 210, 212 to angle laterally away from the internal central support member 204. The first sections 210a, 212a and third sections 210c, 212c sections are stiffer than the second sections 210b, 212b. In one embodiment, the first thickness is substantially the same as the third thickness, but it is also contemplated that the first and third thicknesses can be different.

[0067] It is to be understood that stiffness refers to the bending characteristics of a flexure. Regions of a flexure that are more resistant to bending are considered to be stiffer, or have a greater stiffness, than regions of a flexure that bend more easily. It is appreciated that several properties of flexure construction can be controlled to adjust stiffness and create a flexure with two or more portions, each having a different stiffness. For example, selected manufacturing processes can be used to alter a material's modulus of elasticity. The manufacturing processes can be used selectively on different areas of a flexure to create a flexure with different moduli of elasticity in different areas of the flexure. In another example, a flexure may be constructed of multiple materials, each material having a different modulus of elasticity. In a further example, the cross-sectional profile of

a flexure, such as the thickness and/or width of the flexure may be adjusted to create a flexure having multiple portions, each portion having a different stiffness. Adjusting the cross-sectional profile of the flexure locally alters the flexure's bending moment of inertia, thereby rendering that portion of the flexure either more resistant to bending or less resistant to bending. In further embodiments, other methods and characteristics may be used to control the stiffness of different portions of a flexure.

[0068] FIG. 6 is a blown up top elevation view of a portion of an internal flexure 220 having a varying thickness, according to an embodiment of the invention. As shown in FIG. 6, internal flexure 220 includes a proximal section 220a having a first thickness, a middle section 220b having a second thickness, and a distal section 220c having a third thickness. According to one embodiment, the second thickness is less than the first thickness and the third thickness, and the middle section 220b is configured to bend. For example, when pressure is applied to the distal section 220c of the internal flexure 220, pushing it away from a central support member 204, the internal flexure 220 bends at the middle section 220b because the middle section 220b is less stiff than the distal section 220c. As shown with respect to FIG. 5, the distal sections 210c, 212c of the first internal flexure 210 and second internal flexure 212 remain relatively straight and rigid, while the lateral angling occurs at the middle sections 210b, 212b.

[0069] Referring now to FIGS. 7-8, according to another embodiment, the internal flexures include strain relief portions to decrease the possibility of undesirable bending or breaking. FIG. 7 is a perspective view of an ablation device applicator 302 showing an internal central support member 304, external flexures 306, 308, and internal flexures 310, 312. According to aspects of this applicator, the internal flexures 310, 312 have varying thickness and include strain relief portions. The internal flexures 310, 312 each include a proximal section 310a, 312a, a middle section 310b, 312b, and a distal section 310c, 312c. The proximal sections 310a, 312a and the distal sections 310c, 312c each include strain relief portions 314a, 314b (See also FIG. 8). The strain relief portions 314a, 314b are triangular-shaped portions located at an end of each section 310a, 312a and 310c, 312c where the proximal sections 310a, 312a and the distal sections 310c, 312c attach to the middle section 310b, 312b, as described in greater detail below with respect to FIG. 8.

[0070] FIG. 8 is a blown up view of a portion of internal flexure 312 having varying thickness and strain relief portions 314a, 314b according to an embodiment of the invention. The internal flexure 312 includes proximal section 312a, middle section 312b, and distal section 312c. A distal end 314a of the proximal section 312a has a triangular shape and acts as a strain relief to relieve stress at the interface between the proximal section 312a and the middle section 312b. A proximal end 314b of the distal section 312c similarly has a triangular shape and acts as a strain relief to relieve stress at the interface between the distal section 312c and the middle section 312b. It is appreciated that in other embodiments, the strain relief portions 314a, 314b may be other shapes, such as rounded or semi-circular. The middle section 312b is configured to be more flexible than the proximal section 312a and the distal section 312c, such that the internal flexure 312 bends along the middle section 312b.

[0071] According to the embodiment of FIG. 8, the proximal section 320a has a first thickness, the middle section

**320b** has a second thickness, and the distal section **320c** has a third thickness. According to one feature, the second thickness is less than the first thickness and the second thickness is also less than the third thickness. It is contemplated that the first thickness and the third thickness can be substantially the same thickness or different thickness.

[0072] According to another embodiment, the proximal section **312a** has a first width, the middle section **312b** has a second width, and the distal section **312c** has a third width. According to one feature, the second width is narrower than the first width, and the second width is narrower than the third width. It is contemplated that the first width and the third width can be substantially the same or different. It is to be appreciated that alternate embodiments can easily be provided where the second section is wider than the first and third sections.

[0073] Referring to FIG. 7, similar to the internal flexures **210-212** illustrated in the embodiment of FIG. 5, the internal flexures **310**, **312** include at least one flexible section positioned between two stiffer sections. The flexible section is configured to bend outward, away from the central support member, allowing the distal end of the internal flexures to expand laterally away from the central support member to create a V-shape. According to one embodiment, the second sections **310b**, **312b** are configured to bend, allowing the internal flexures **310**, **312** to angle laterally away from the internal central support member **304**. The first sections **310a**, **312a** and third sections **310c**, **312c** are stiffer than the second sections **310b**, **312b**. The second sections **310b**, **312b** are more flexible so as to facilitate bending at the second sections **310b**, **312b**. In one example, the first sections **310a**, **312a** and third sections **310c**, **312c** are rigid or substantially rigid.

[0074] FIG. 9A is a side view of a section of an internal flexure **400** having varying thickness, according to an embodiment of the invention. The internal flexure **400** has at least two different thicknesses. In particular, a thickness of the middle section **406** is less than a thickness of the rest of the flexure **400**. It is contemplated that the rest of the flexure can have substantially the same or different thicknesses. In the illustrated embodiment, the proximal **402** and distal **404** sections of the flexure **400** have substantially the same thickness, and the first transition area **408** and second transition area **410** have substantially the same thickness as the proximal **402** and distal **404** sections. In one example, the transition areas **408** and **410** are welded to the section **406**. It is to be appreciated that the areas of different thickness can also be provided by other structures. For example, each of the transition areas **408** and **410** may be etched together, such that each transition area **408** and **410** is a single piece of material. In another example, the entire flexure **400** is etched as a single piece of material. In a further example, the transition areas **408** and **410** each include two layers of stacked material that are bonded together by various techniques known in the art. For example, the first transition area **408** includes a first bottom layer **418** and first top layer **420**, and the second transition area **410** includes a second bottom layer **428** and second top layer **430**. In some embodiments, the internal flexure **400** may include additional transitional areas between the middle section **406** and the proximal section **402** and distal section **404**.

[0075] For example, FIG. 9B is a side view of a section of an internal flexure **450** having two tapering thickness sec-

tions **458**, **460**, according to another embodiment of the invention. In this embodiment, a thickness of a middle section **456** is less than a thickness of the rest of the flexure **450**, and a thickness of the proximal section **452** and a thickness of the distal section **454** is greater than the thickness of the rest of the flexure **450**. It is contemplated that the thickness of the proximal section and the distal section can be the same or different. The internal flexure also includes a first transitional region **458**, positioned between the proximal section **452** and the middle section **456**, which has a varying thickness that tapers from the thickness of the proximal section **452** to the thickness of the middle section **456**. Similarly, the second internal flexure also includes a transitional region **460**, positioned between the distal section **454** and the middle section **456**, which has a varying thickness that tapers from the thickness of the distal section **454** to the thickness of the middle section **456**.

[0076] It is to be appreciated that varying the thicknesses of the internal flexure **400** of FIG. 9A and the internal flexure **450** of FIG. 9B provides for the overall diameter of the intrauterine device applicator in a collapsed position to be decreased, while maintaining its strength and stiffness. Decreasing the overall diameter in a collapsed position, of the applicator allows for use of a smaller-diameter sheath. A sheath with a smaller outer diameter may also reduce patient discomfort, and also decrease the potential for cervical injury during insertion. Thus, one advantage of the varying thicknesses of the internal flexures **400** and **450** is that they provide for the outer diameter of the applicator to be decreased, while maintaining the reliability of the deployment of the applicator from the sheath and the retraction of the applicator back into the sheath.

[0077] FIG. 10 is a side elevation view of another embodiment of a portion of an intrauterine therapy application device **480**, including a central support member **482** and an internal flexure **484** having a first section **486** and a second section **488**. According to aspects of the disclosure, it may be desirable to control both the lateral and vertical flexibility of the internal flexures of the applicator. This can be accomplished with the internal flexure **484** of FIG. 10. The first section **486** is attached to the central support member **482** and the second section **488** is attached to a proximal portion **486a** of the first section **486** and extends parallel to the first section **486**. The first section **486** includes a middle portion **486b**, positioned just past the distal end **482a** of the central support member **482**. The middle portion **486b** of the first section **486** curves inward away from the second section **488** of the internal flexure **484**, extends longitudinally, parallel to the second section **488** but positioned a distance away from the second section **488**, and then curves back toward the second section **488** of the internal flexure **484**. The distal portion **486c** of the first section **486** of the internal flexure **484** is attached to the second section **488** of the internal flexure **484**. According to one feature, the shape of the first section **486**, including the curved middle portion **486b**, increases the durability and reliability of the internal flexure **484**.

[0078] FIG. 11A shows the first section **486** of the internal flexure **484** in a relaxed position and FIG. 11B shows the first section **486** of the internal flexure **484** in an expanded position. According to one feature, the jog in the middle portion **486b** of the first section **486** isolates the flexibility and rigidity of the first section **486** to selected parts of the

first section **486** of the flexure. For example, first bend **490a** and second bend **490b** provide areas of flexibility.

[0079] In one example, each of the stacked sections **486**, **488** is half the thickness of an internal flexure without such stacked sections, so that the thickness of the internal flexure **484** is about the same as the thickness of a single-layer internal flexure. For example, the internal flexure **484** can be a substitute for the internal flexures **160**, **162** of FIG. 3A. According to one feature, the internal flexure **484** formed from two stacked sections **486** and **488** has a decreased lateral stiffness compared to an internal flexure formed from a single layer. According to another feature, the internal flexure **484** formed from two stacked sections **486** and **488** has about the same vertical stiffness as an internal flexure formed from a single layer. Thus, the internal flexure of FIG. 10 has a decreased lateral stiffness and a vertical stiffness that is about the same as the internal flexure of the embodiment of FIG. 3A.

[0080] FIG. 12 is a flow chart showing one embodiment of a method **500** of manufacturing an intrauterine device. At step **502**, a central support member is provided. At step **504**, first and second internal flexures are formed using a photo etching (or photochemical machining) process. The first and second internal flexures include a first section having a first stiffness, a second section having a second stiffness, and a third section having a third stiffness, with the second stiffness more flexible than the first and third stiffnesses, according to the various embodiments discussed herein.

[0081] In one example, the photo etching process includes printing the shape of one or more internal flexures onto optically clear and dimensionally stable photographic film. The photographic film shows a negative image of the internal flexures, such that the areas to be etched are black, and the area that will become the internal flexures are clear. Generally, two sheets of photographic film are used. The two sheets are optically and mechanically registered to form the top and bottom halves of the part to be etched (the internal flexure).

[0082] Metal sheets for etching into internal flexures are cut to size, cleaned and then laminated on both sides with a UV-sensitive photoresist. A coated metal sheet is placed between the two sheets of photographic film. A vacuum is created to ensure intimate contact between the photographic film and the coated metal sheet. The coated metal sheet is then exposed in UV light that allows the areas in the clear sections of the photographic film to be hardened. After exposure, the plate is developed by washing away the unexposed resist, leaving the areas to be etched unprotected.

[0083] An etchant is sprayed on both sides of the developed plate, causing the unprotected areas of the plate to corrode away, leaving the photo etched internal flexures. The etchant may be an aqueous solution of acid, such as ferric chloride. In one example, before spraying the etchant on the developed plate, the etchant is heated. The etching process may take place in a multi-chambered machine that has driven-wheel conveyors to move the plates and arrays of spray nozzles above and below the plates. According to one feature, the top and bottom of the developed plate can be etched at different rates. In one example, etching the top and bottom of the developed plate at different rates allows for better control over the thickness of the resulting internal flexures, and allows for better control over the thickness of the flexible section of the internal flexures. After etching the developed plate, it is neutralized and rinsed, the remaining

resist is removed, and the sheet of internal flexures is cleaned and dried. According to various embodiments, the photo etching process described above may be used to form any part of the intrauterine device.

[0084] Still referring to FIG. 12, at step **506**, the first and second external flexures are provided. The first and second external flexures may be formed using a photo etching process as described above with respect to forming the first and second internal flexures. At step **508**, a first section of each internal flexure is attached to the central support member. At step **510**, a proximal end of each of the first and second external flexures is attached to the central support member. At step **512**, a distal end of each of the first and second flexures is attached to the third section of the first and second internal flexures. Attachment may be done by any means known to those of skill in the art.

[0085] According to another embodiment, a stamping process may be used to form the internal flexures. A stamping process would involve producing a flat pattern of metal using a punch and die method, punching out the selected pattern. The resulting flat piece of metal may be locally deformed using a coining process, which can be used to change the shape of the piece of metal to have a higher bending moment of inertia in selected regions, thereby increasing the stiffness of the selected regions.

[0086] FIGS. 13-16 show a portion of another embodiment of a medical device applicator including a notched tubular central support member and mating internal flexures. The intrauterine device applicator **600** includes a tubular proximal central support member **602**, internal flexures **606** and **608**, and a distal central support member **604**. The internal flexures **606** and **608** are inserted into notches in the proximal central support member **602**, and welded in place. For example, FIG. 14 shows the proximal central support member **602**, including notches **610** and **612**. The proximal end of an internal flexure, such as the proximal end **606a** of the internal flexure **606** shown in FIG. 15 is inserted into the notches **610**, **612** of the central support member **602** shown in FIG. 14. The proximal end of the internal flexure can be secured to the central support member. For example, the internal flexure may be welded to the central support member.

[0087] FIG. 16 shows an exploded view of one end of the combination of the distal central support member **604** and the internal flexures **606** and **608**. As shown in FIG. 16, the internal flexures **606** and **608** may be coupled to the distal central support member **604**. The combination of the internal flexures **606** and **608** and the central support member **604** may be coupled to the proximal central support member **602**. For example, the combination including internal flexures **606** and **608** and the central support member **604** may be inserted into the proximal central support member **602** and secured in place by various techniques known to those of skill in the art.

[0088] FIG. 17 shows a portion of another embodiment of an intrauterine device applicator **700** having central support member **702**, internal flexures **704**, **706**, **708**, and **710**, and external flexures **720** and **722**. Internal flexures **704**, **706** are stacked, and internal flexures **708**, **710** are stacked. Internal flexures **704**, **708** are joined to the central support member **702** at proximal locations **704a** and **708a**, respectively, and internal flexures **706**, **710** are joined to the central support member **702** at proximal locations **706a** and **710a**, respectively. Internal flexures **704**, **706** are joined to external



flexure **720** at a distal location **704c**, and internal flexures **708**, **710** are joined to external flexure **722** at distal location **708c**. As shown in FIG. 17, the stacked pairs of internal flexures **704**, **706** can be joined at a middle location **704b**. Similarly, internal flexures **708**, **710** can be joined at a middle location **708b**. It is appreciated that joining methods and structure may include any of welding, tying, bonding, or any other joining method and structure used in the art.

[0089] According to one embodiment, the first **704** and second **706** stacked sections are both the same length. For this embodiment, in the deployed state, internal flexure **704** is forced to bend at a slightly different radius than internal flexure **706**, causing internal flexures **704**, **706** to separate in the distal region, as shown in FIG. 17. It is to be understood that according to this disclosure, this separation behavior is herein referred to as oil-canning. It is to be appreciated that other embodiments as disclosed herein do not exhibit such oil-canning. For example, the embodiments shown in FIGS. 10, 11A and 11B prevent oil-canning by introducing a local compliant region that allows for the end-to-end length of the flexure to change slightly in an intentional manner.

[0090] FIG. 18 shows another embodiment of an intrauterine device applicator **750** having two sets of internal flexures, shown in an expanded position. The intrauterine device **750** includes a proximal central support member **752**, a distal central support member **754**, external flexures **756**, **758**, a first set of internal flexures **760**, **762** and a second set of internal flexures **764**, **766**. The proximal ends **760a**, **762a** of each flexure of the first set of internal flexures **760**, **762** are coupled to the distal central support member **754** at a first location **754a**. The distal ends **760b**, **762b** of each flexure of the first set of internal flexures **760**, **762** are coupled to a middle portion **756b**, **758b** the external flexures **756**, **758**. The proximal ends **764a**, **766a** of the second set of internal flexures **764**, **766** are coupled to the distal central support member **754** at a second location **754b**, which second location is distal to the first location. The distal ends **764b**, **766b** of the second set of internal flexures **764**, **766** are coupled to the distal ends **756c**, **758c** of the external flexures **756**, **758**. According to one feature, by utilizing three or more flexures and/or strategic location of the joints of the flexures, the shape of the intrauterine device in the expanded position can be controlled to reliably match complex anatomy better than when using a more basic two-flexure design. In one embodiment, the internal flexures **760**, **762**, **764**, **766** each have a thickness about half as thick as the internal flexures **160**, **162** shown in FIG. 3A.

[0091] According to any of the embodiments disclosed herein, the ribbon **164** shown by way of example in FIGS. 3A-3B may be replaced with alternative mesh support designs. It is appreciated that the ribbon **164** shown in FIGS. 3A-3B takes up a large amount of cross-sectional space in the retracted position, as shown by way of example in FIG. 4. According to various embodiments, FIGS. 19A-B and 20A-C show intrauterine devices with alternative embodiments of arms to support a mesh array. The arms may be used in place of a ribbon to reduce the outer diameter of an intrauterine device in a retracted position. According to various examples, the mesh support arms mechanically support the distal end **818** of the mesh array, preventing the mesh array from pulling back proximally and/or toward the central support members. Additionally, the mesh support arms provide vertical support, mechanically separating the top of the mesh array from the bottom of the mesh array,

which may help prevent an alternating current short through the mesh array when energy is delivered to the medical device after it is inserted in a patient.

[0092] FIG. 19A is a perspective view of a portion of an embodiment of an intrauterine ablation device applicator **800** in a deployed position. The applicator **800** includes a central support member **802**, external flexures **804**, **806**, internal flexures **808**, **810**, arms **814**, **816**, and a central bridge **812**. The proximal ends **814a**, **816a** of the arms **814**, **816** are coupled to the central support member **802**, and the arms **814**, **816** extend laterally away from the central support member **802**. The attachment of the proximal ends **814a**, **816a** of the arms **814**, **816** to the central support member **802** provides flexibility to the arms for lateral extension.

[0093] As shown in FIG. 19A, each end of a central bridge **812** is coupled to a middle portion **814b**, **816b** of each arm **814**, **816**. In an expanded position, the center **812a** of the central bridge **812** extends longitudinally beyond the distal end **802a** of the central support member **802**. When a mesh array is positioned about the intrauterine ablation device applicator **800**, as shown in FIG. 19B, the center **812a** of the central bridge **812** supports the distal end **818** of the mesh array. According to one embodiment, the arms **814**, **816** and the central bridge **812** can be compressed toward the center line of the central support member **802** for retraction into a sheath, such as the sheath **104** of FIG. 1.

[0094] According to one feature, attaching the arms **814**, **816** to a more proximal location than the distal end of the external flexures, in comparison to where the ribbon **164** of FIG. 3A is attached, results in a device with a smaller outer diameter in a retracted position. In a retracted position, the ribbon **164** of the illustrative embodiment of FIG. 3A is folded multiple times, resulting in eight layers of stacked ribbon material. In contrast, the applicator shown in FIG. 19A includes four layers of arm **814**, **816** and central bridge **812** material in the retracted position to provide a reduced diameter in the retracted position. According to one embodiment, the arms **814**, **816** and the central bridge **812** are coated in an electrically insulating coating, such as parylene. The coating on the surfaces of the arms **814**, **816** and the central bridge **812** increases the thickness of the arms **814**, **816** and the central bridge **812** (or, when used on the applicator **102**, increases the thickness of the folded ribbon **164**).

[0095] FIG. 20A is a perspective view of a portion of another embodiment of an intrauterine ablation device applicator **850** having arms **862**, **864** shown in an expanded position. The applicator **850** includes a central support member **852**, external flexures **854**, **856**, internal flexures **858**, **860**, and arms **862**, **864**. The proximal ends **862a**, **864a** of the arms **862**, **864** are coupled to a middle portion **858b**, **860b** of the internal flexures **858**, **860**. The arms **862**, **864** curve laterally outward, and then curve back in toward the center line defined by the central support member **852**. The distal ends **862b**, **864b** of the arms **862**, **864** are directed inward toward the center line. FIG. 20B is an elevation view of a portion of the intrauterine ablation device applicator **850** of FIG. 20A with a mesh array cover **868** disposed thereabout. FIG. 20C is an elevation view of a portion of the intrauterine ablation device applicator **850** of FIG. 20A having a mesh array anchored to the arms **862**, **864** in multiple locations **870a-d**, **872a-d**. By anchoring the arms to the array in one or more locations, the system relies on the combined strength of the arms interacting with the array,

providing improved mechanical strength and robustness of the system without increasing the size of the arms. According to one feature, the arms **862**, **864** prevent the top and bottom parts of the mesh array from coming in contact with one another. According to another feature, the arms **862**, **864** prop up the distal end of the mesh array.

**[0096]** As discussed above, decreasing the thickness of the structure that maintains the extension of the mesh array at the distal end of the applicator **852** allows for a decreased outer diameter of a sheath enclosing the applicator **852** in a retracted position. The applicator **852** includes only two arms **862**, **864**, which are attached to the internal flexures **858**, **860** distal to the distal end of the central support member **852**. Thus, the applicator **852** can be positioned within a substantially smaller diameter sheath in the retracted position than, for example, the applicator **102** shown in FIGS. **3A**, **3B**, and FIG. **4**.

**[0097]** Having described above several aspects of at least one embodiment, it is to be appreciated various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be part of this disclosure and are intended to be within the scope of the invention. Accordingly, the foregoing description and drawings are by way of example only.

What is claimed is:

**1-19.** (canceled)

**20.** An intrauterine ablation device, comprising:  
an elongate member;

an energy applicator operatively coupled to a distal end portion of the elongate member, the energy applicator comprising a tissue contacting member and an expandable-collapsible support structure underlying the tissue contacting member, the expandable-collapsible support structure comprising a first flexure having a first flexure distal tip, and a second flexure having a second flexure distal tip, wherein the expandable-collapsible support structure is adjustable between a collapsed configuration in which the first and second flexure distal tips are closely apposed to one another, and an expanded configuration in which the first and second flexure distal tips are spaced apart from one another; and

a first arm having a proximal portion coupled to the first flexure, and a second arm having a proximal portion coupled to the second flexure,

wherein the first and second arms comprise respective inwardly curved shapes relative to the first and second flexures, such that respective first and second distal ends of the first and second arms extend towards each other and away from the first and second flexure distal tips when the expandable-collapsible support structure is in the expanded configuration, and

wherein the respective distal ends of the first and second arms comprise a distal bumper configured to urge the energy applicator into contact with a fundal wall of the uterus.

**21.** The intrauterine ablation device of claim **20**, wherein the distal bumper is disposed between the first and second flexure distal tips when the expandable-collapsible support structure is in the expanded configuration.

**22.** The intrauterine ablation device of claim **20**, wherein the first and second arms comprise respective flexible ribbons and/or thin flexible membranes.

**23.** The intrauterine ablation device of claim **20**, further comprising a tubular member, wherein the elongate member is slidably disposed within the tubular member.

**24.** An intrauterine ablation device, comprising:  
an elongate member configured for transcervical insertion;

an energy applicator operatively coupled to the elongate member, the energy applicator comprising a tissue contacting member and an expandable-collapsible support structure underlying the tissue contacting member, the expandable-collapsible support structure comprising a first outer flexure and a second outer flexure, each of the outer flexures having a respective outer surface in lateral contact with an inner surface of the tissue contacting member, and a first inner flexure and a second inner flexure, wherein the expandable-collapsible support structure is adjustable between a collapsed configuration in which the first and second inner flexures are closely apposed to one another, and an expanded configuration in which the first and second inner flexures are spaced apart from one another; and  
a distal bumper comprising a first arm, the first arm having a proximal portion coupled to a middle portion of the first inner flexure and a distal portion in contact with the inner surface of the tissue contacting member when the expandable-collapsible support structure is in the expanded configuration,

wherein the distal bumper is configured to urge the tissue contacting member into contact with a fundal wall of the uterus when the expandable-collapsible support structure is in the expanded configuration.

**25.** The intrauterine ablation device of claim **24**, wherein the distal bumper further comprises a second arm having a proximal portion coupled to a middle portion of the second inner flexure and a distal portion in contact with the inner surface of the tissue contacting member when the expandable-collapsible support structure is in the expanded configuration.

**26.** The intrauterine ablation device of claim **25**, wherein the first and second arms comprise respective flexible ribbons and/or thin flexible membranes.

**27.** The intrauterine ablation device of claim **25**, wherein the first and second arms comprise respective arcuate configurations defining respective convex surfaces that face each other when the expandable-collapsible support structure is in the expanded configuration.

**28.** The intrauterine ablation device of claim **27**, wherein the respective arcuate configurations of the first and second arms further define respective concave surfaces in which the concave surface of the first arm faces the first inner flexure and the concave surface of the second arm faces the second inner flexure when the expandable-collapsible support structure is in the expanded configuration.

**29.** The intrauterine ablation device of claim **24**, further comprising a tubular member, wherein the elongate member is slidably disposed within the tubular member.

**30.** The intrauterine ablation device of claim **24**, wherein a distal tip of the first outer flexure is coupled to a distal tip of the first inner flexure, and a distal tip of the second outer flexure is coupled to a distal tip of the second inner flexure.

**31.** An intrauterine ablation device, comprising:  
an elongate member configured for transcervical insertion;

an energy applicator operatively coupled to the elongate member, the energy applicator comprising a tissue contacting member and an expandable-collapsible support structure underlying the tissue contacting member, the expandable-collapsible support structure comprising outer flexures in lateral contact with an inner surface of the tissue contacting member and inner flexures disposed in between the outer flexures; and a distal bumper having a lateral surface, the lateral surface being coupled to a middle portion of one of the inner flexures, wherein the lateral surface is in contact with the inner surface of the tissue contacting member when the expandable-collapsible support structure is in the expanded configuration,

wherein the distal bumper is configured to urge the energy applicator into contact a fundal wall of the uterus upon distal advancement of the device within the uterus.

**32.** The intrauterine ablation device of claim **31**, wherein the distal bumper comprises flexible ribbons and/or thin flexible membranes.

**33.** The intrauterine ablation device of claim **31**, further comprising a tubular member, wherein the elongate member is slidably disposed within the tubular member.

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