(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
04 July 2019 (04.07.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/126875 A1

(51) International Patent Classification:
B32B 3/26 (2006.01) *A61F 5/01* (2006.01)
A61F 13/04 (2006.01) *B32B 3/30* (2006.01)

(21) International Application Number:
PCT/CA2018/051668

(22) International Filing Date:
24 December 2018 (24.12.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

62/708,796	26 December 2017 (26.12.2017)	US
62/761,926	13 April 2018 (13.04.2018)	US
62/762,335	01 May 2018 (01.05.2018)	US
62/917,348	04 December 2018 (04.12.2018)	US
62/917,589	17 December 2018 (17.12.2018)	US

(72) Inventor; and
(71) Applicant: **BARBERIO, Alessandro** [CA/CA]; 14845/6 Yonge Street, Unit 523, Aurora, Ontario L4G 6H8 (CA).

(74) Agent: **HEER, Christopher**; 36 Lombard Street, Suite 500, Toronto, Ontario M5C 2X3 (CA).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

WO 2019/126875 A1

(54) Title: IMPROVED TUBULAR VENTING DEVICE FOR SURGICAL CASTS AND OTHER ORTHOPEDIC DEVICES

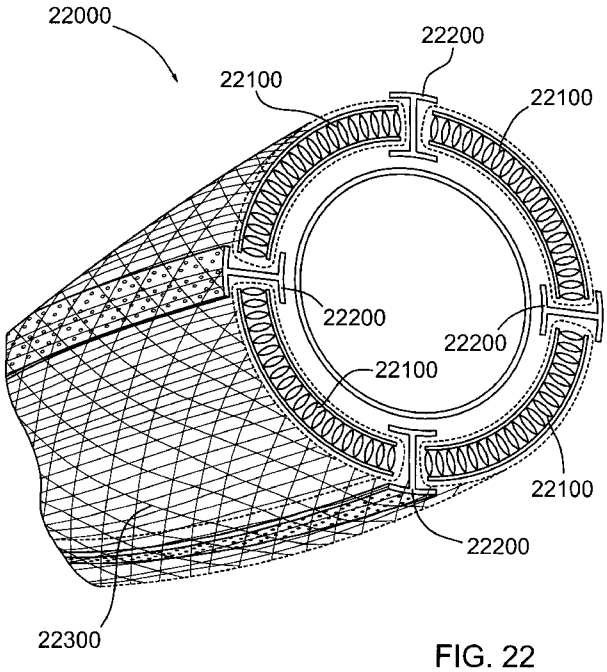


FIG. 22

(57) Abstract: Described is a venting device including a flexible outer covering defining an outer surface and an inner surface, a set of helicoidal venting strips, and a set of helicoidal buffers. The outer covering has a first end and a second end and a longitudinal axis therebetween. Each venting strip is anchored to the inner surface and extends substantially between the first end and the second end and the set of venting strips is arranged substantially helicoidal and defines a set of helicoidal seams therebetween. The set of helicoidal buffers includes a buffer covering an inner opening of each seam of the set of helicoidal seams where each buffer is configured to shield the inner opening of the corresponding seam from penetration and each buffer is anchored to at least one of the outer covering and a neighbouring venting strip of the set of venting strips.

[Continued on next page]

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

IMPROVED TUBULAR VENTING DEVICE FOR SURGICAL CASTS AND OTHER ORTHOPEDIC DEVICES

FIELD OF THE INVENTION

[0001] The present specification relates generally to venting devices, and specifically to venting devices for surgical casts and other orthopedic devices.

BACKGROUND OF THE INVENTION

[0002] The adequate ventilation of human skin or other animal skin is often desirable. For example, if a patient has a broken bone in their arm they will often receive a cast on the arm to assist in the healing process. However, a cast or other covering over skin can often result in heat buildup, bacterial buildup and related discomfort.

[0003] Venting of skin can be achieved by providing a path between ambient air and the skin which is substantially open to the passage of air. However, while a variety of known ventilation devices can be used, many continue to seek an easily-applied venting device which can be readily produced and transported.

SUMMARY OF THE INVENTION

[0004] In an embodiment of the present invention, there is provided a venting device, comprising: a flexible outer covering defining an outer surface and an inner surface, the outer covering defining a first end and a second end and a longitudinal axis therebetween; a set of helicoidal venting strips, each venting strip anchored to the inner surface and extending substantially between the first end and the second end, the set of venting strips arranged substantially helicoidal and defining a set of helicoidal seams therebetween; a set of helicoidal buffers, the set of helicoidal buffers including a buffer covering an inner opening of each seam of the set of helicoidal seams, each buffer configured to shield the inner opening of the corresponding seam from penetration, each buffer anchored to at least one of the outer covering and a neighbouring venting strip of the set of venting strips.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The principles of the invention may better be understood with reference to the accompanying figures provided by way of illustration of an exemplary embodiment, or embodiments, incorporating principles and aspects of the present invention, and in which:

[0006] FIG. 1 is a schematic diagram of an injured person standing up and a schematic diagram of an injured person lying down;

[0007] FIG. 2 is a schematic diagram of a first broken arm and a schematic diagram of a second broken arm;

[0008] FIG. 3 is a schematic cutaway diagram of a cast mounted on an arm, a perspective view of a cast mounted on an arm, and a schematic diagram of a thermostat indicating an increasing temperature;

[0009] FIG. 4 is a schematic diagram of a suffering patient and a schematic diagram of a venting operation;

[0010] FIG. 5 is a schematic view of an injured patient and a cross sectional view of a venting apparatus resting on a forearm under a cast;

[0011] FIG. 6 is a cut away view of a venting apparatus mounted on an arm under a cast, according to an embodiment;

[0012] FIG. 7 is a cut away view of a venting apparatus mounted on an arm under a cast, according to an embodiment;

[0013] FIG. 8 is an exploded view of a venting apparatus mounted on an arm under a cast, according to an embodiment;

[0014] FIG. 9 is a partial cross-sectional view of a fabric buffer material, a cross sectional view of a fabric buffer material, and a schematic view of a resiliency test of a fabric buffer material;

[0015] FIG. 10 is a perspective view of an outer cover, a perspective view of a set of buffers and venting strips, and a perspective view of a venting apparatus, according to an embodiment;

[0016] FIG. 11 is a perspective view of an outer cover, a perspective view of a set of buffers and venting strips, and a perspective view of a venting apparatus, according to an embodiment;

[0017] FIG. 12 is a first perspective view of a venting material being inserted into a tubinette to form a venting strip, according to an embodiment;

[0018] FIG. 13 is a second perspective view of the venting material and tubinette of FIG. 12;

[0019] FIG. 14 is a perspective view of the venting material and tubinette of FIG. 12 forming the venting strip;

[0020] FIG. 15 is a perspective view of a venting strip, according to an embodiment, resting on a skin surface;

[0021] FIG. 16 is a bottom plan partial cut-away view of a venting strip, according to an embodiment;

[0022] FIG. 17 is a top plan partial cut-away view of the venting strip of FIG. 16;

[0023] FIG. 18 are first and second perspective views of a set of venting strips and a set of buffers being brought together to form a venting device, according to an embodiment;

[0024] FIG. 19 is a cross sectional view of the venting device of FIG. 18, resting on a skin surface;

[0025] FIG. 20 is a cross sectional view of the venting device of FIG. 18, resting on a skin surface under a cast;

[0026] FIG. 21 is a perspective view of a venting device, according to an embodiment;

[0027] FIG. 22 is a perspective view of a venting device, according to an embodiment;

[0028] FIG. 23 is a perspective view of a venting device, according to an embodiment;

[0029] FIG. 24 is a side partial-cutaway view of a venting device, according to an embodiment, mounted on an arm;

[0030] FIG. 25 is a side partial-cutaway view of a venting device, according to an embodiment, mounted on an arm;

[0031] FIG. 26 is a first cross-sectional view of a venting device, according to an embodiment;

[0032] FIG. 27 is a second cross-sectional view of the venting device of FIG. 26;

[0033] FIG. 28 is an isometric, schematic illustration of an example venting material, with portions broken away for purposes of illustration;

[0034] FIG. 29 is a cross-sectional view of a first venting device, according to an embodiment, and a cross-sectional view of a second venting device, according to an embodiment;

[0035] FIG. 30 is a cross-sectional view of a venting device, according to an embodiment, received between a cast and a skin surface;

[0036] FIG. 31 is a cross sectional view of a decorative disc mounted on a venting device, according to an embodiment;

[0037] FIG. 32 is a cross-sectional view of a venting device, according to an embodiment;

[0038] FIG. 33 is a cross-sectional view of the venting device of FIG. 32;

[0039] FIG. 34 is a cross-sectional view of a venting device, according to an embodiment;

[0040] FIG. 35 is a perspective view of a buffer, according to an embodiment;

[0041] FIG. 36 is a perspective view of a venting device, according to an embodiment, mounted on a delivery tube;

[0042] FIG. 37 is a perspective view of the venting device of FIG. 36, next to a vented subject;

[0043] FIG. 38 is a perspective view of the vented subject of FIG. 37 inside the delivery tube of FIG. 36;

[0044] FIG. 39 are perspective views of the vented device of FIG. 36 being removed from the delivery tube and placed onto the vented subject of FIG. 37;

[0045] FIG. 40 is a perspective view of a supporting user reconfiguring the venting device of FIG. 36;

[0046] FIG. 41 is a perspective view of the supporting user of FIG. 39 further reconfiguring the venting device of FIG. 36; and

[0047] FIG. 42 is a perspective view of the supporting user of FIG. 39 securing the venting device of FIG. 36.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0048] The description that follows, and the embodiments described therein, are provided by way of illustration of an example, or examples, of particular embodiments of the principles of the present invention. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the invention. In the description, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings are not necessarily to scale and in some instances proportions may have been exaggerated in order more clearly to depict certain features of the invention.

[0049] Priority is claimed to United States provisional patent application number 62/708,796, filed December 26, 2018, United States provisional patent application number 62/761,926 filed April 13, 2018, United States provisional patent application number 62/762,335 filed May 1, 2018, a United States provisional patent application mailed to the United States Patent and Trademark Office on November 30, 2018 by the present applicant and entitled IMPROVED TUBULAR VENTING DEVICE FOR SURGICAL CASTS AND OTHER ORTHOPEDIC DEVICES, and a United States provisional patent application mailed to the United States Patent and Trademark Office on December 14, 2018 by the present applicant and entitled IMPROVED TUBULAR VENTING DEVICE FOR SURGICAL CASTS AND OTHER ORTHOPEDIC DEVICES, each of which are hereby incorporated by reference.

[0050] An aspect of this description relates to a venting device for use in covering a surface of skin. An aspect of this description relates to a venting device for use between the skin of a patient and a covering. An aspect of this description relates to a venting device for use under a cast or sling or brace or splint or compression device.

[0051] In the below, embodiments of a venting device are described in relation to casts and slings mounted on an arm of a user. FIG. 1 depicts a first user 100 and a second user 200, and FIG. 2 depicts a first user arm 110 and a second user arm 210. When a bone in an arm or other limb of an individual is broken, treatment often involves the application of a cast or the use of a sling or the application of a compression device.

[0052] An example of an immobilizing fiberglass cast is depicted in FIG. 3. Cast 300 is applied to arm 310. As often happens with an immobilizing cast, heat, odour, and bacteria are trapped between arm 310 and cast 300.

[0053] As depicted in FIG. 4, trapped heat, odour, or bacteria can cause discomfort to patient 400 on whom a cast 410 is mounted. As a result, patient 400 may attempt to relieve the discomfort by inserting a probing object 420 under cast 410.

[0054] However, if a venting device is used underneath a cast, much discomfort can be alleviated. For example, user 500 of FIG. 5 is wearing cast 510 on arm 520, but venting device 530 has been placed between cast 510 and arm 520 to maintain a venting space between the cast and the arm through which venting air may pass. Venting devices increase air flow beneath a cast and help to reduce bacteria, heat, and odour buildup.

[0055] While venting devices are depicted and described herein in use with casts and slings, it is to be understood that venting devices could also be used alone, could be modified to include inherent elements such as cast or sling-like elements, or could be used with other devices such as compression devices.

[0056] A variety of materials and configurations may be used to form a venting device, provided the device assists in defining a venting space through which venting air may pass. FIGs. 6 and 7 depict two venting materials which may be used, a protrusion layer and a fabric-spacer layer, respectively. Venting material, such as fabric-spacer material, may be designed in some embodiments to be stretchable in four ways, but two ways (lengthwise and widthwise) will do in some embodiments.

[0057] Venting device 600 of FIG. 6 is mounted between cast 610 and arm 620. Venting device 600 includes a protrusion material which includes a protrusion sheet 604 and a cover

sheet 602, discussed further below. Venting device 700 of FIG. 7 is mounted between cast 710 and arm 720. Venting device 700 includes a fabric-spacer material, discussed further below.

[0058] FIG. 8 shows an exploded view of a venting device incorporating a protrusion material. Protrusion material 800 includes a protrusion sheet 810 forming a plurality of protrusions 820, each protrusion 820 corresponding to an underside cavity (not shown). Protrusion material 800 also includes a cover sheet 830, the protrusion layer and the cover sheet defining a venting space therebetween. The protrusion material 800 is placed between cast 840 and skin 850 to allow air to pass between cast 840 and skin 850. Sheets 810 and 830 are perforated to allow for easy air circulation. Sheets of a protrusion layer, such as 810 and 830, may be formed of medical silicone or thermoformable material, for example. In some embodiments, protrusions of a protrusion material must be strong enough to withstand external pressures. In some embodiments, the protrusions of a protrusion material are domed or partially domed with a cavity on the opposing side. In various embodiments, protrusions can be round, square, rectangular, or any geometric shape, or a combination of shapes. In some embodiments, the cavities formed opposite protrusions are designed to be interfacing with the skin of a user to provide a smooth and comfortable resting cushioning surface. In some embodiments, a protrusion sheet and a cover sheet are free to move relative one another, such as free to shift within the limits of an envelop such as the tubinette described below. In some embodiments, a protrusion sheet and a cover sheet are secured to one another and not free to move relative one another. In some embodiments, no cavity is provided opposite a protrusion, however a cavity is preferred.

[0059] FIG. 9 shows further details of a fabric-spacer material. Fabric-spacer material 900 of FIG. 9 has a top layer 910 and a bottom layer 920 separated by a set of threads or fabric elements 930. The set of threads or fabric elements 930 includes threads of varying resiliency to vary the anticipated density and height of device 900 when placed over a user's skin. Top and bottom layers 910 and 920 are porous fabric layers allowing air circulation. Fabric-spacer material may be made, for example, of hypoallergenic polyester or nylon. Fabric-spacer material is generally lighter and less expensive than protrusion material.

[0060] Fabric-spacer materials are used in many applications such as tennis shoes, backpacks, car seat cushions, and bras. Fabric-spacer materials can often be designed for particular uses,

such as by varying the resiliency of interior materials, top layer materials or bottom layer materials. In some embodiments, a fabric-spacer venting strip has a surface treatment to apply non-slip silicone or anti-bacterial coating or adhesive or a combination.

[0061] In some embodiments, fabric-spacer materials are used which are designed to have a high air permeability, such as a permeability of more than 5 cubic feet per minute, more than 50 cubic feet per minute, or more than 90 cubic feet per minute.

[0062] In some embodiments of the present invention a venting device is formed which includes an outer tubular flexible covering, such as a netting or similar, for use in anchoring a set of strips of venting material separated from one another by buffers. Buffers assist in allowing the use of venting devices having a plurality of venting strips without the risk that poor application of the venting devices results in the skin of a user being pinched between venting strips. In some embodiments, buffers are perforated through one or more panels of the buffer to permit air, such as atmospheric or environmental air, to pass. In some embodiments, buffers are extruded. In some embodiments, buffers are formed of flexible, hypoallergenic, and hydrophilic material. In some embodiments, buffers are thermoformed buffers or include thermoformed flexible solid protrusions. In some embodiments, a buffer is made of medical silicone, ethyl vinyl acetate ("EVA"), polyester, gel, foam, Plastazote™, polyurethane or another hypoallergenic and flexible substitute or a combination of the above.

[0063] FIG. 10 depicts an embodiment of a venting device 10000. Venting device 10000 includes an outer netting 10100 formed into a tubular outer covering. Venting device 10000 also includes a set of strips of venting material 10200 separated by a set of buffers 10300. The set of strips of venting material 10200 and the set of buffers 10300 are covered by outer netting 10100 and each independently secured to outer netting 10100. Independent securing of each strip and buffer allows the strips and buffers to shift relative to neighbouring strips and buffers when the venting device 10000 is twisted. In some embodiments, an outer covering is a netting or other elastic material. In some embodiments, an outer cover is a tube of flexible material. In some embodiments, an outer covering is a tubular expandable stockinette.

[0064] Twisting of the venting device 10000 may be used to adjust a standardized size for use with a particular limb or other vented subject. For example, venting device 10000 may be

manufactured in a number of standard sizes. In some embodiments, when a venting device is needed an appropriate size is selected, a limb or other vented subject is inserted into the venting device, and the venting device is then twisted to modify the shape of the venting device to match the contours of the limb or other vented subject. In some embodiments, once the venting device is applied to a limb or other vented subject to substantially match the contours of the limb or other vented subject, the venting device is secured to the vented subject or an adjacent surface, such as via surgical adhesive tape, to hold the venting device in the desired position. In some embodiments, once a venting device is applied and secured, a cast, compression device, sling, or related apparatus is applied over the venting device. In some embodiments, larger venting devices are used for adults, smaller ones for children, larger ones for torsos, smaller ones for arms, and custom ones in some situations.

[0065] In some embodiments, a venting device can also be squeezed to assist in having the venting device match the contours of a vented subject, in addition to or as an alternative to twisting. For example, a venting device can be squeezed to an appropriate shape and then a cast or other covering added to cover it and hold it in the squeezed position.

[0066] FIG. 11 depicts another example of a venting device. Venting device 11000 includes an outer netting 11100, inside the outer netting 11100 a set of venting strips 11200 and buffers 11300 are secured. Buffers 11300 are 'H' shaped buffers having a separation panel between a lower shielding panel and an upper securing panel, as will be discussed further below.

[0067] While strips of venting material such as fabric-spacer material or protrusion material may be anchored directly to an outer covering in a venting device, they may also be contained in a fabric or netting of their own which is in turn anchored to the outer covering of the venting device. In some embodiments, each strip of venting material is contained in a tubinette, such as a tubinette formed of netting or loose fabric. In some embodiments, a tubinette is a protective, hydrophilic tubinette. In some embodiments, a tubinette includes a moisture absorbent, porous, cotton fabric. In some embodiments, a strip of venting material is enclosed in a tubinette but not otherwise secured to the tubinette, such as to leave the strip of venting material free to shift within the tubinette to allow for easier twisting of a venting device.

[0068] FIGs. 12 to 14 depict a venting strip 12000. Venting strip 12000 includes a strip of fabric-spacer material 12100 covered by a fabric tubinette 12200. Fabric-spacer material 12100 includes an upper layer 12110, a lower layer 12120, and a threads layer 12130. Upper and lower layers 12110 and 12120 are porous to allow for free air movement. Similarly, tubinette 12200 is porous, for example tubinette 12200 may be a netting or loose fabric. As depicted in FIGs. 13 and 14, fabric material 12100 is inserted inside tubinette 12200 to form a venting strip 12000.

[0069] FIGs. 15 to 17 depicts a venting strip formed without fabric-spacer material. Venting strip 15000 includes an outer tubinette 15100 inside which is a venting sandwich. The venting sandwich is formed of a protrusion layer 15200 and a base layer 15300. The protrusion layer 15200 includes a set of protrusions 15210 directed towards the base layer 15300. Opposite the protrusions are a set of cavities 15220, and protrusion layer 15200 and base layer 15300 each define a set of apertures therethrough, 15230 and 15310 respectively, to allow freer flow of air. As depicted, venting strip 1500 is placed adjected a layer of skin 15400 and defines a venting space adjacent the skin 15400, the venting space defined between protrusion layer 15200 and base layer 15300. As shown particularly in FIG. 17, protrusions 15210 are separated by channels, lengthwise and widthwise channels. Channels also assist in increasing the flexibility of venting strip 15000.

[0070] In forming venting devices, venting strips are brought together, separated by buffers. An embodiment is shown in FIGs. 18 to 20. Venting strips 18100 are each formed of a tubinette 18110 around a strip of fabric-spacer material 18120. Buffers 18200 each include a separation panel 18210 for separating adjacent venting strips, a shielding panel 18220 for shielding a user's skin 18300 from being caught between venting strips, and a securing panel 18230 for use in securing the buffer to an outer covering 18400 of a venting device. As depicted particularly in FIG. 20, tubinettes 18110 are secured to outer covering 18400 via stitches 18500 holding a thread of the tubinette to a thread of the outer covering. The buffers are secured to the outer covering via pieces of double-sided adhesive tape (not shown) mounted on a covering-facing surface of the securing panel 18230 and adhered to outer covering 18400. As depicted in FIG. 20, a venting device formed of the venting strips 18100, the buffers 18200, and the outer covering 18400 may be used in venting skin 18300 covered by cast 18600 such as a fiberglass or plaster of Paris cast.

[0071] In some embodiments, stitching holding one component to another may be a single loop or knot of thread, such as a surgical threaded knot. In some embodiments, stitching holding one component to another may be a line of stitching in the usual manner. Similarly, when double-sided adhesive tape or other adhesive is used, in some embodiments the adhesive is a single piece of adhesive while in some embodiments it is a strip or large patch of adhesive. Where intermittent anchoring points are used, in some embodiments each anchoring point is separated by intervals of approximately 3 to 6 cm in a string of anchoring points along the length of a venting strip or buffer. In some embodiments, where adhesive is used the adhesive anchor points may be 3 to 5 cm apart, and where thread is used the thread anchor points may be 4 to 6 cm apart. In some embodiments, an adhesive to be used is an ultraviolet-curable adhesive.

[0072] FIGs. 21 to 23 depict three embodiments of venting devices. Venting device 21000 includes a first venting strip 21110, a second venting strip 21120, a third venting strip 21130, and a fourth venting strip 21140. Each venting strip is spaced from adjacent venting strips by a shielding buffer provided to keep the tubular layer from pinching the skin of a user. Buffers 21200 are 'H' shaped channels which each include a barrier panel 21210 a shielding panel 21220 and a securement panel 21230. Venting device 21000 also includes an outer netting 21300. Outer netting 21300 is provided to hold the components of venting device 21000. For example, double-sided tape may be applied to the upper surface of each securement panel 21230 to interface with threads of outer netting 21300 to hold each buffer 21200 to outer netting 21300, and the tubinettes of the venting strips may be stitched to the outer netting 21300.

[0073] In venting device 21000 the venting strips are a combination of fabric-spacer strips and protrusion sandwich strips. Venting strips 21110 and 21130 are fabric-spacer strips, while venting device 21120 and 21140 are protrusion sandwich strips.

[0074] While venting device 21000 uses a mix of fabric-spacer strips and protrusion sandwich strips, in some embodiments all venting strips are fabric-spacer strips, and in some embodiments all venting devices are protrusion sandwich strips.

[0075] Venting device 22000 is an example of a venting device in which all venting strips 22100 are fabric-spacer strips, separated by buffers 22200 and held by netting 22300. Venting

device 23000 is an example of a venting device in which all venting strips 23100 are protrusion sandwich strips, separated by buffers 23200 and held by netting 23300.

[0076] As depicted in FIGs. 24 and 25, venting devices may be mounted on a limb or other vented subject. In FIGs. 24 and 25 venting devices 24000 and 25000 are mounted on arms 24100 and 25100, respectively. Venting devices 24000 and 25000 allow air to pass through to interface with the skin of the underlying arms.

[0077] While venting devices 21000, 22000, and 23000 each includes four venting strips and four buffers, in other embodiments other numbers of buffers and stirps may be used. The number of buffers and strips to be used depends on the anticipated flexibility needs, the size of the venting device, and other factors. For example, Venting device 26000 of FIGs. 26 and 27 includes eight venting strips 26100 and eight buffers 26200. Venting device 26000 again includes a mix of fabric-spacer strips and protrusion sandwich strips. Although the fabric-spacer strips and protrusion sandwich strips alternate in venting device 26000, any mix may be used.

[0078] As indicated in FIG. 27, tubinettes 26110 of venting strips 26100 are stitched to outer netting 26300 using thread loops 26400. Each venting strip is roughly 3 cm in width. Buffers 26200 are adhered to outer netting 26300 via double-sided adhesive strips (not shown) mounted on securement panel 26330 and interfacing with the portion of outer netting 26300 above each securement panel 26330.

[0079] FIG. 28 depicts a simple venting material 28000 as was disclosed in United States patent number 7,250,034 which is hereby incorporated in its entirety by reference. The venting material of FIG. 31 is an additional example of a venting material which may be used in forming venting strips for use in forming a venting device, in some embodiments.

[0080] Buffers have thus far been depicted as ‘H’ shaped buffers, however in some embodiments other shapes may be used. For example, buffers 29100 of FIG. 29 are ‘T’ shaped buffers, which can be used with venting strips such as fabric-spacer strips 29200 or protrusion sandwich strips 29300. In some embodiments, a ‘T’ shaped buffer is used as venting device using the ‘T’ shaped buffer will face less mechanical stress because the ‘T’ buffers have less material than the ‘H’ buffers.

[0081] An example of a venting device using 'T' shaped buffers is depicted in FIG. 30. Venting device 30000 includes a set of buffers 30100 separating a set of fabric-spacer strips 30200, the buffers 30100 and strips 30200 secured to an outer netting 30300. Venting device 30000 is placed between cast 30400 and skin 30500. Venting device 30000 includes a decorative disc 30600 adhered to outer netting 30300, decorative disc 30600 may be a logo or advertisement or set of instructions or warnings or other message. Each venting strip 30200 is secured to outer netting 30300 via a set of pieces of double-sided adhesive tape 30700. As indicated, buffers 30100 each includes a set of apertures to allow air to move through the buffer between venting strips. Buffers may also have apertures in the shielding panel to allow air to move interface with skin beneath the shielding panel.

[0082] Decorative disc 30600 is shown in greater detail in FIG. 30. Decorative disc 30600 has a decorative layer 30610 held by a double-sided adhesive layer 30620. Double-sided adhesive layer 30620 has a first adhesive layer 30622, a base layer 30624, and a opposite adhesive layer 30626. In some embodiments, double-sided adhesive tape segments are disc segments, such as 10 mm in diameter. In some embodiments a decorative disc is used which is 10 mm in diameter. A decorative disc may be made of paper, plastic, gel, silicone, polyurethane, cork, compressed cotton, foam, or any material which is hypoallergenic and can stand the sterilization processes.

[0083] The use of 'T' shaped buffers rather than 'H' shaped buffers removes the securement panel which is used for mounting adhesive in securing the buffers to an outer netting. Buffers can be secured in to an outer netting a variety of ways without a securement panel. For example, FIGs. 32 and 33 depict venting device 32000. Venting device 32000 includes venting strips 32100, buffers 32200 and outer covering 32300. As before, venting strips 32100 are secured to outer covering 32300, such as by stitching or adhesive. However, in Venting device 32000, buffers 32200 are secured to venting strips 32100 instead of directly to outer covering 32300. Each buffer 32200 is secured to only one venting strip 32100, so that each pair of buffer and venting strip is free to move relative each adjacent pair of buffer and venting strip. Buffer 32200 is secured to venting strip 32100 via double-sided adhesive tape 32400.

[0084] As depicted in FIG. 32, venting device 32000 also includes additional cushioning 32500 between each buffer 32200 and each venting strip 32100. Cushioning is provided in some

embodiments to assist in the comfort of the user, and is porous and air permeable. Cushioning may be, for example, cotton padding.

[0085] However, securing buffers to venting strips is not the only option for securing 'T' shaped buffers. For example, venting device 34000 of FIG. 34 has buffers 34200 secured to netting 34300 via stitching 34400, and venting strips 34100 secured to netting 34300 via adhesive 34500.

[0086] In a further example, buffer 35200 of FIG. 35 has a separation panel 35210, a shielding panel 35220 and a set of mounting panels 35230. The set of mounting panels is a regularly-spaced set of panels attached to the separation panel opposite the shielding panel and provided to form mounting points for double sided adhesive to secure the buffer 35200 to netting 35300.

[0087] FIGs. 36 to 42 depict a method of mounting a venting device 36000 onto a user arm 37000.

[0088] Venting device 3600 is formed of a set of venting strips and buffers secured to an outer netting, as described above. In the embodiment depicted in FIG. 36, venting device 36000 is mounted on a tube 36100 for delivery. As depicted in FIG. 37 a user chooses a venting device of roughly equivalent size to the limb on which it is to be mounted. Arm 37000 is compared to venting device 36000 to determine if an appropriate match is found. For example, as depicted in FIG. 38, if arm 37000 fits within delivery tube 36100, the venting device of this embodiment mounting method is determined to be appropriately sized.

[0089] As depicted in FIG. 39, venting device 36000 is removed from delivery tube 36100 and inserted over arm 37000 by supporting user 39000. In some embodiments, a venting subject is inserted into a delivery tube and then the delivery tube is removed from under the venting device to leave the venting device in position around the venting subject. As depicted in FIGs. 40 to 42, supporting user 39000 then twists venting device 36000 to form venting device 36000 into a position which substantially matches the contours of arm 37000. Supporting user 39000 then secures the venting device to uncovered surfaces of arm 37000 using adhesive tape 42000, such as surgical tape.

[0090] Venting strips are arranged helicoidally in manufacturing to permit easier twisting. In some embodiments, the helicoidal arrangement is not pronounced.

[0091] In some embodiments, a venting device can also be used in compression therapy. For example, a venting device, or an element thereof such as an outer covering, may be sized smaller than a venting subject such as an arm so that the venting device applies a compressive force to the venting subject when mounted. In another example, the venting device itself may be larger than a venting subject, but may be formed into a size smaller than the venting subject by twisting the device.

[0092] Throughout this description specific embodiments have been described in which various elements are anchored to other elements via adhesive or stitching, however it is to be understood that other securing or anchoring elements may be used as well, such as hook-and-loop fasteners, buttons, magnets, ultraviolet adhesives, and other mechanical fasteners.

[0093] In some embodiments, a venting strip is made of a combination of fabric-spacer material and a protrusion sheet. For example, when a fiberglass cast is compressed to form it around a target surface, it may result in compression to a fabric-spacer material which may damage the ability of the fabric-spacer material to facilitate air flow, therefore a protrusion sheet may be incorporated into the fabric-spacer material to provide support for the fabric-spacer material and increase its resiliency. However, in some embodiments the buffers provide support, in some embodiments the use of a combination of fabric-spacer strips and protrusion strips provides the required resiliency, and in some embodiments the fabric-spacer material is inherently sufficiently resilient or is for use alone or with non-compressed devices.

[0094] Many of the embodiments of a venting device depicted and described have a tubular member having open first and second ends, however it is to be understood that in some embodiments a venting device may incorporate further extensions of venting material for particular uses. For example, a venting device for use with an arm cast may include a strap for use in passing between a user's thumb and the user's fingers in the form of a strap over the hand if the cast is expected to also incorporate such an extension.

[0095] In some embodiments, a venting device is sterilized and transported in a manner to maintain sterilization until use, such as sealed in plastic. In some embodiments, venting devices incorporate silver ions to limit the growth of bacteria. In some embodiments a venting device is medicated. For example, one or more components are coated with antimicrobial agents. For example, the buffers may be coated with antimicrobial agents.

[0096] In some embodiments, a venting device is between 1 and 20 mm thick. In some embodiments each venting strip is between 1 and 20 mm thick. In some embodiments, each fabric-spacer material is between 1 and 20 mm thick. In some embodiments each tubinette of a venting strip includes two or more layers of venting material, such as two layers of fabric-spacer material or two layers of protrusion material or a layer of fabric-spacer material and a layer of protrusion material. In some embodiments, in which a venting strip includes two or more layers of venting material, each of the layers of venting material can have an independently designed set of physical or chemical characteristics.

[0097] In some embodiments, a venting device is a venting sheet rather than a venting tube. In some embodiments a venting device is used also as a load absorption device for the comfort of a wearer. In some embodiments, all or substantially all elements of a venting device are perforated or include apertures, such as to allow air movement.

[0098] Various embodiments of the invention have been described in detail. Since changes in and or additions to the above-described best mode may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to those details but only by the appended claims.

What is claimed is:

1. A venting device, comprising:

   a flexible outer covering defining an outer surface and an inner surface, the outer covering defining a first end and a second end and a longitudinal axis therebetween;

   a set of helicoidal venting strips, each venting strip anchored to the inner surface and extending substantially between the first end and the second end, the set of venting strips arranged substantially helicoidal and defining a set of helicoidal seams therebetween; and

   a set of helicoidal buffers, the set of helicoidal buffers including a buffer covering an inner opening of each seam of the set of helicoidal seams, each buffer configured to shield the inner opening of the corresponding seam from penetration, each buffer anchored to at least one of the outer covering and a neighbouring venting strip of the set of venting strips.

2. The venting device of claim 1, wherein the outer covering is tubular.

3. The venting device of claim 1, wherein the first and second venting strips are fabric-spacer strips.

4. The venting device of claim 1, wherein the first and second venting strips are protrusion strips.

5. The venting device of claim 1, wherein the first venting strip is a fabric-spacer strip and the second venting strip is a protrusion strip.

6. The venting device of claim 5, wherein the protrusion strip includes a cover sheet and an underlying protrusion sheet, the protrusion sheet forming a plurality of protrusions and corresponding cavities.

7. The venting device of claim 1, wherein each venting strip of the set of venting strips includes a venting material strip and a tubinette envelope.

8. The venting device of claim 7, wherein the tubinette is anchored to the outer cover and the venting material strip is free to shift within the tubinette envelope.

9. The venting device of claim 1, wherein each buffer of the set of buffers includes a separation panel forming a barrier between adjacent venting strips and a shielding panel affixed to the separation panel opposite the outer covering.

10. The venting device of claim 9, wherein each buffer is anchored to one of the adjacent venting strips.

11. The venting device of claim 9, wherein each buffer is anchored to the outer covering.

12. The venting device of claim 9, wherein each buffer further comprises a set of mounting panels attached to the separation panel opposite the shielding panel and provided for use as anchor points for securing the outer cover to the corresponding buffer.

13. The venting device of claim 9, wherein each buffer defines a set of apertures therethrough to allow the movement of air therethrough.

14. The venting device of claim 1, wherein the outer covering is a netting.

15. The venting device of claim1, wherein the outer covering is a loose fabric.

16. The venting device of claim 1, wherein each venting strip is anchored to the outer covering via one or more of a thread knot and an adhesive segment.

17. The venting device of claim 1, wherein each buffer is anchored to at least one of the outer covering and a neighbouring venting strip of the set of venting strips via one or more of a thread knot and an adhesive segment.

18. The venting device of claim 1, further comprising a decorative panel secured to the outer surface of the outer covering.

19. Use of the venting device of claim 1 as a venting layer underlying a post-surgical device mounted on a user.

20. Use of the venting device of claim 1 as a venting layer underlying one of a cast, a sling, and a compression device.

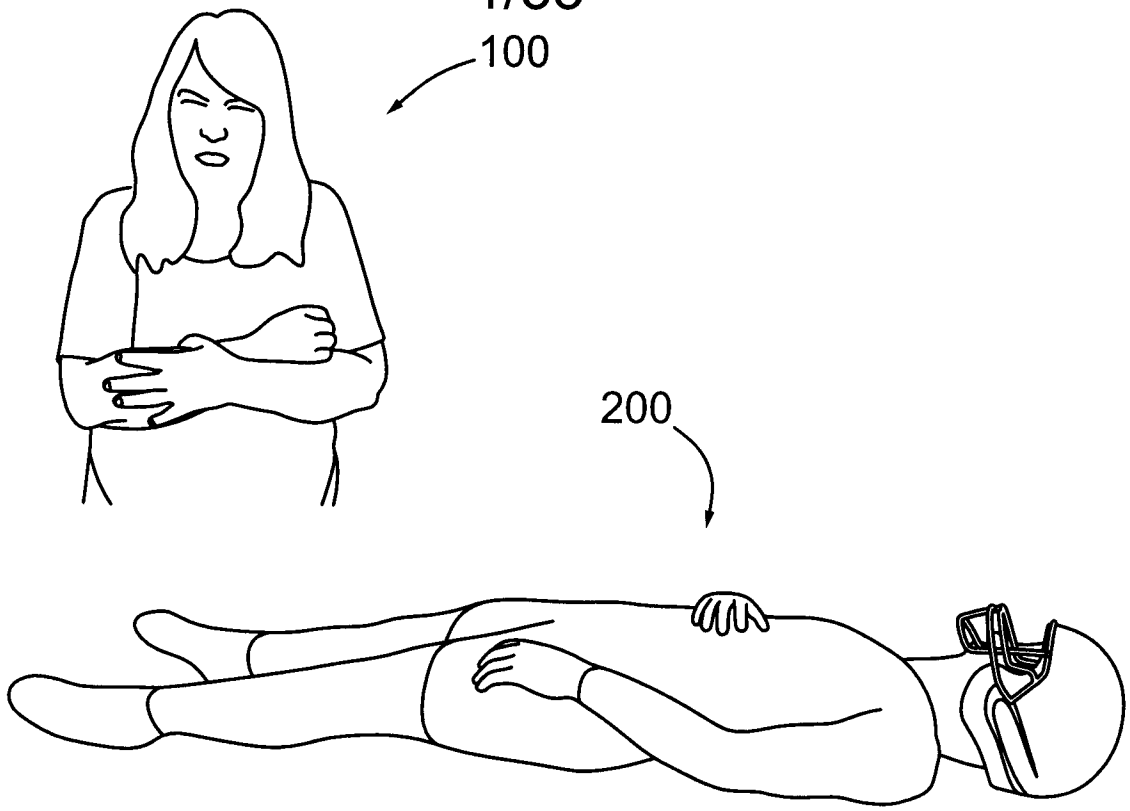


FIG. 1

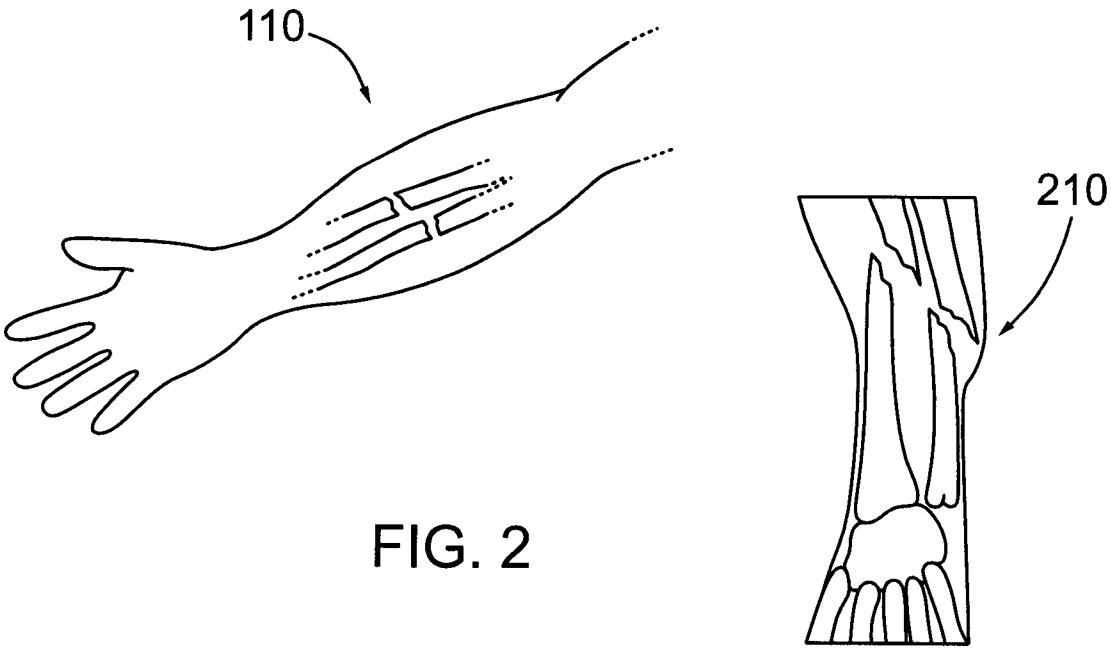
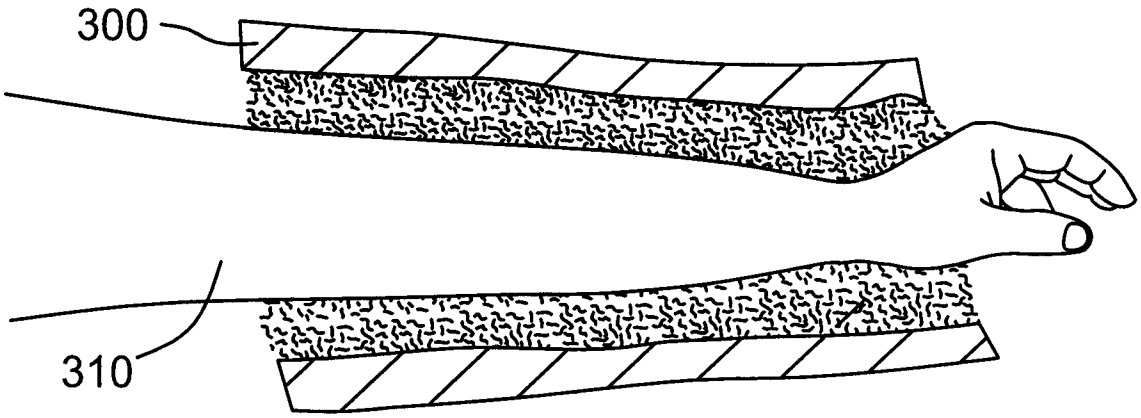


FIG. 2



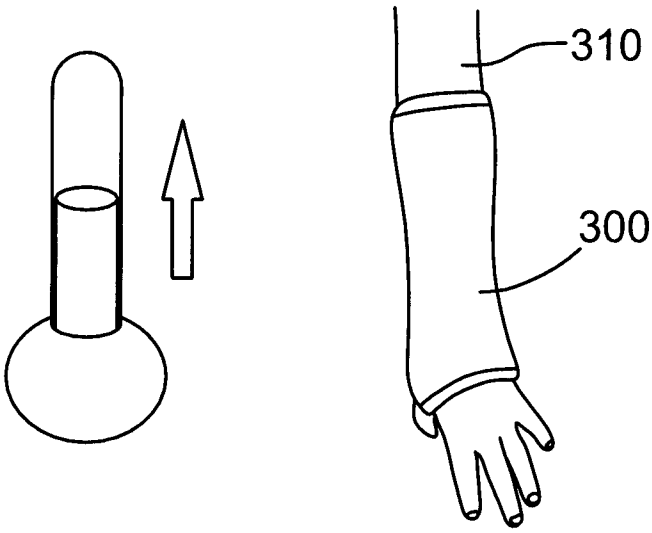


FIG. 3

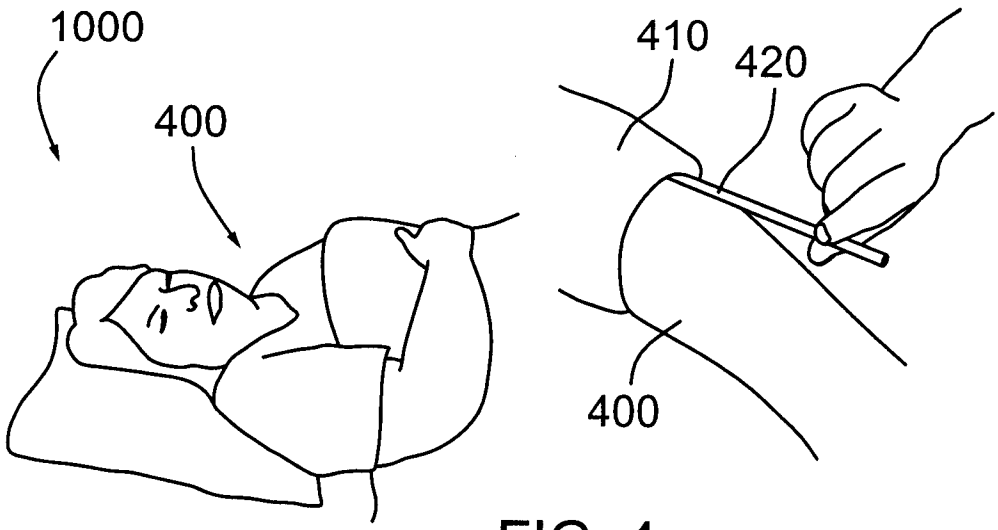


FIG. 4

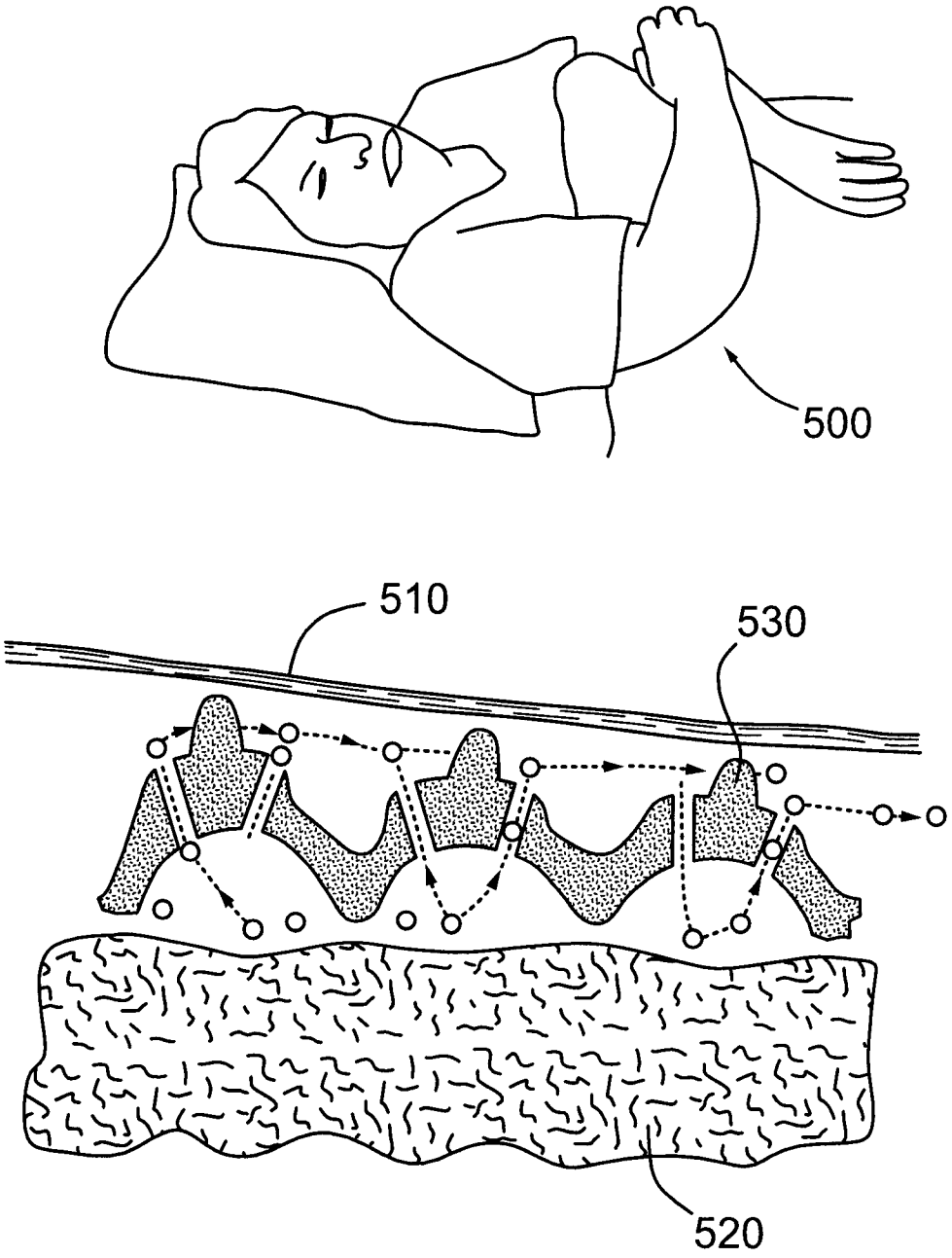


FIG. 5

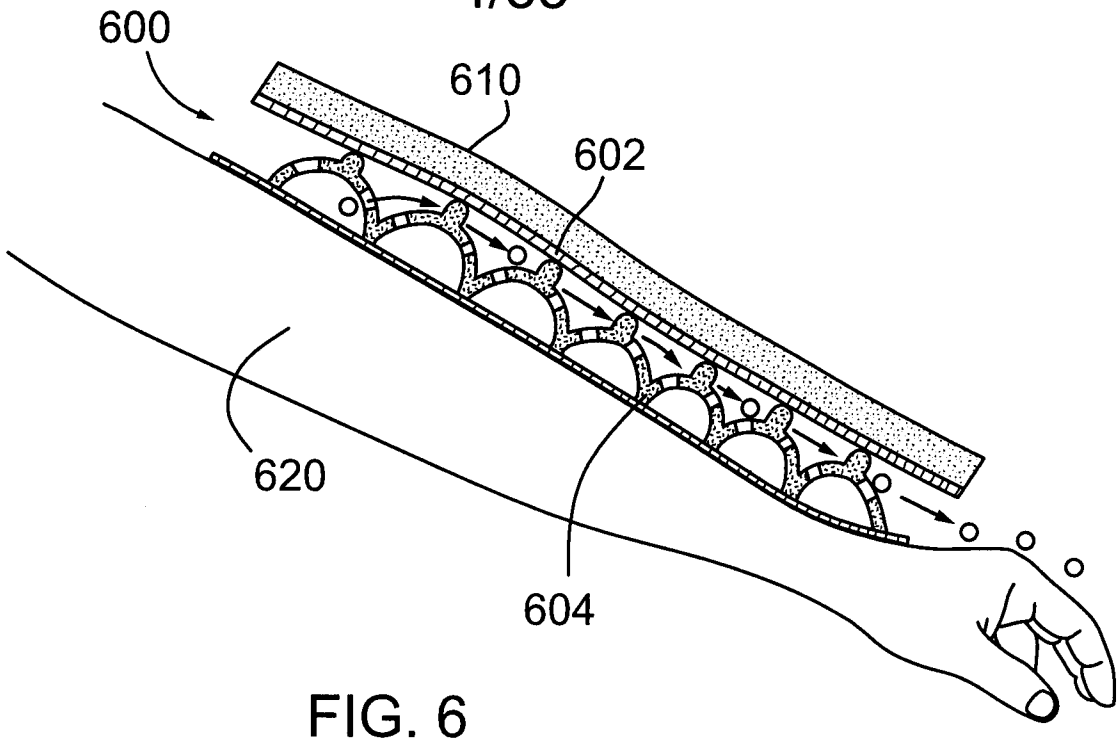


FIG. 6

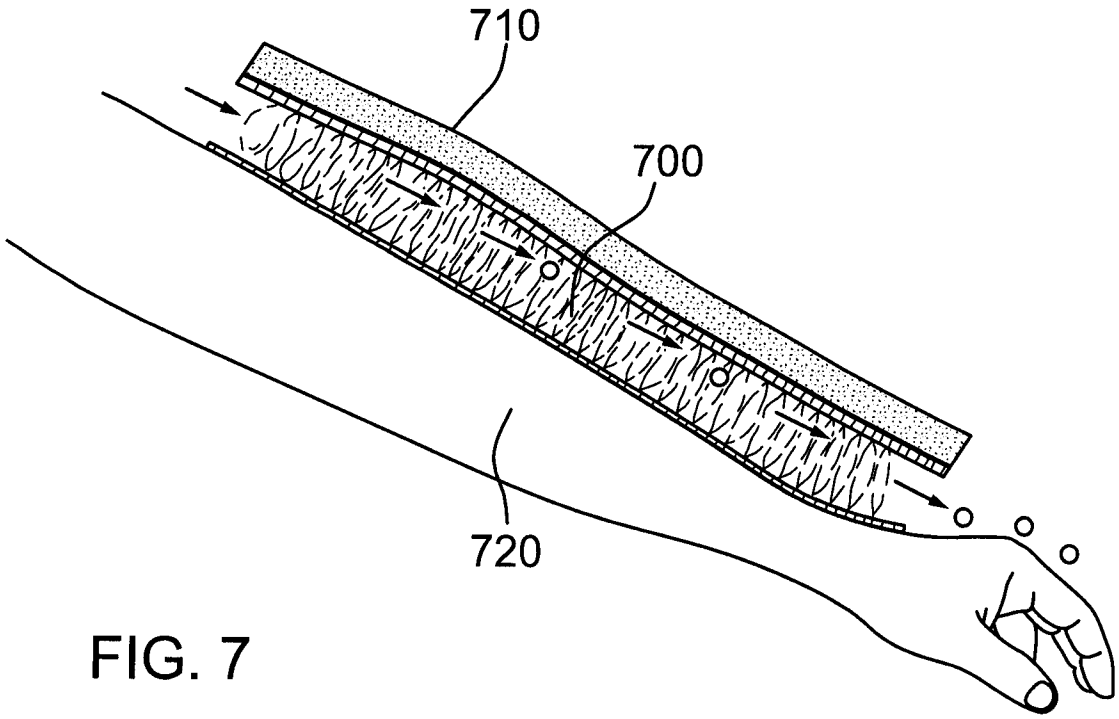


FIG. 7

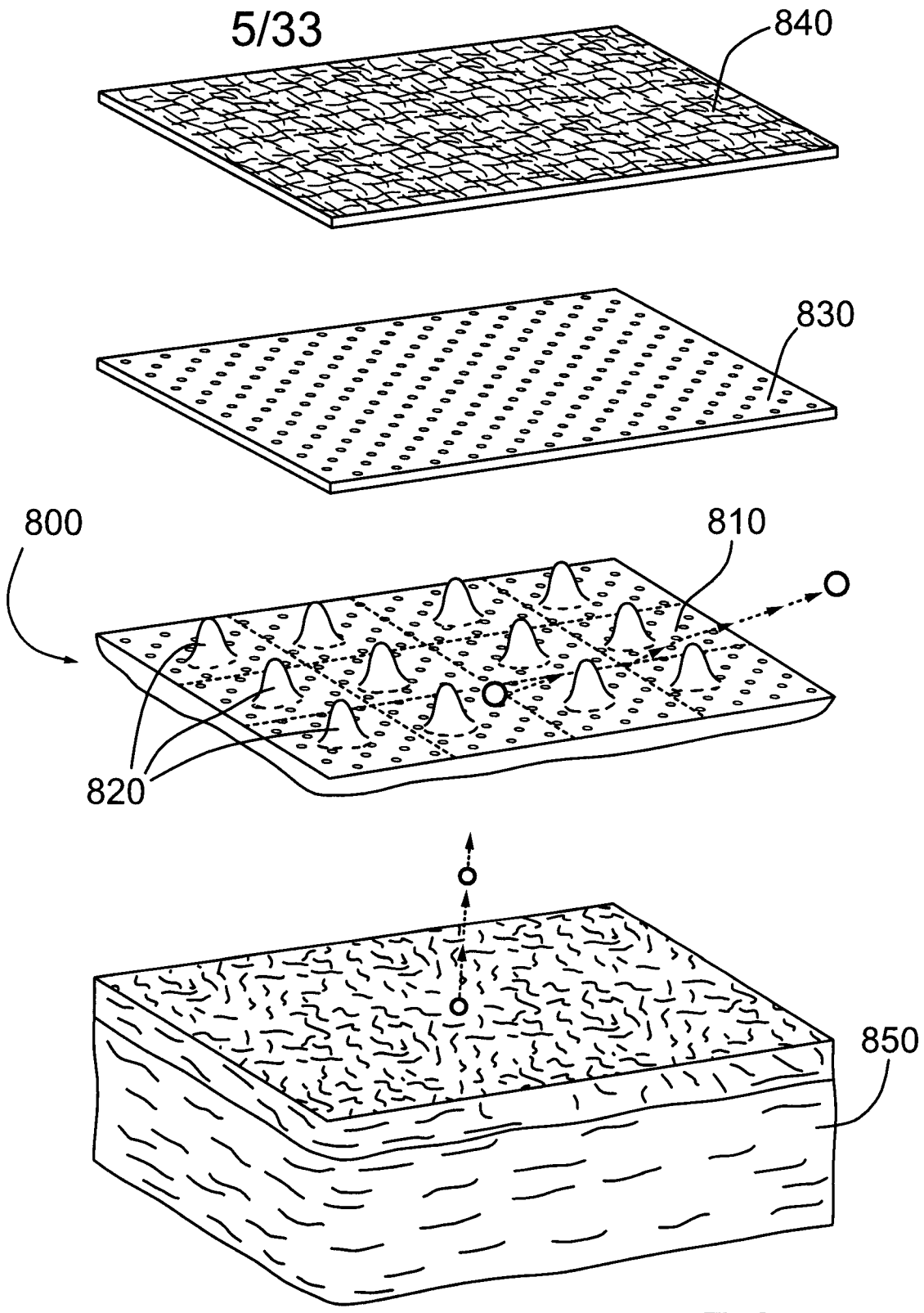


FIG. 8

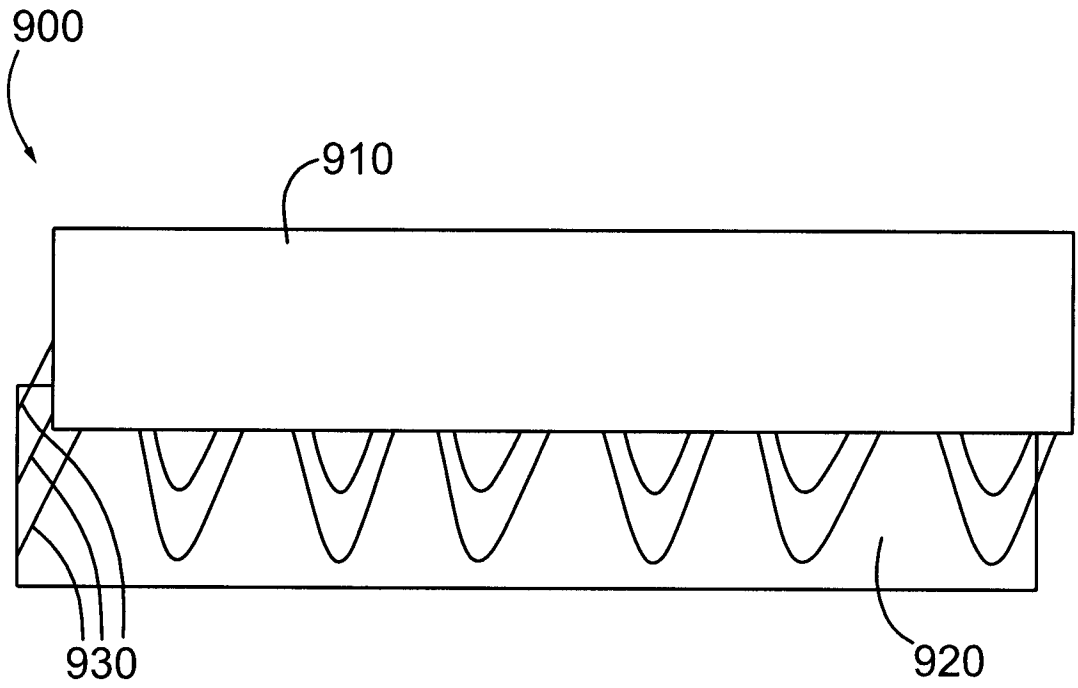


FIG. 9

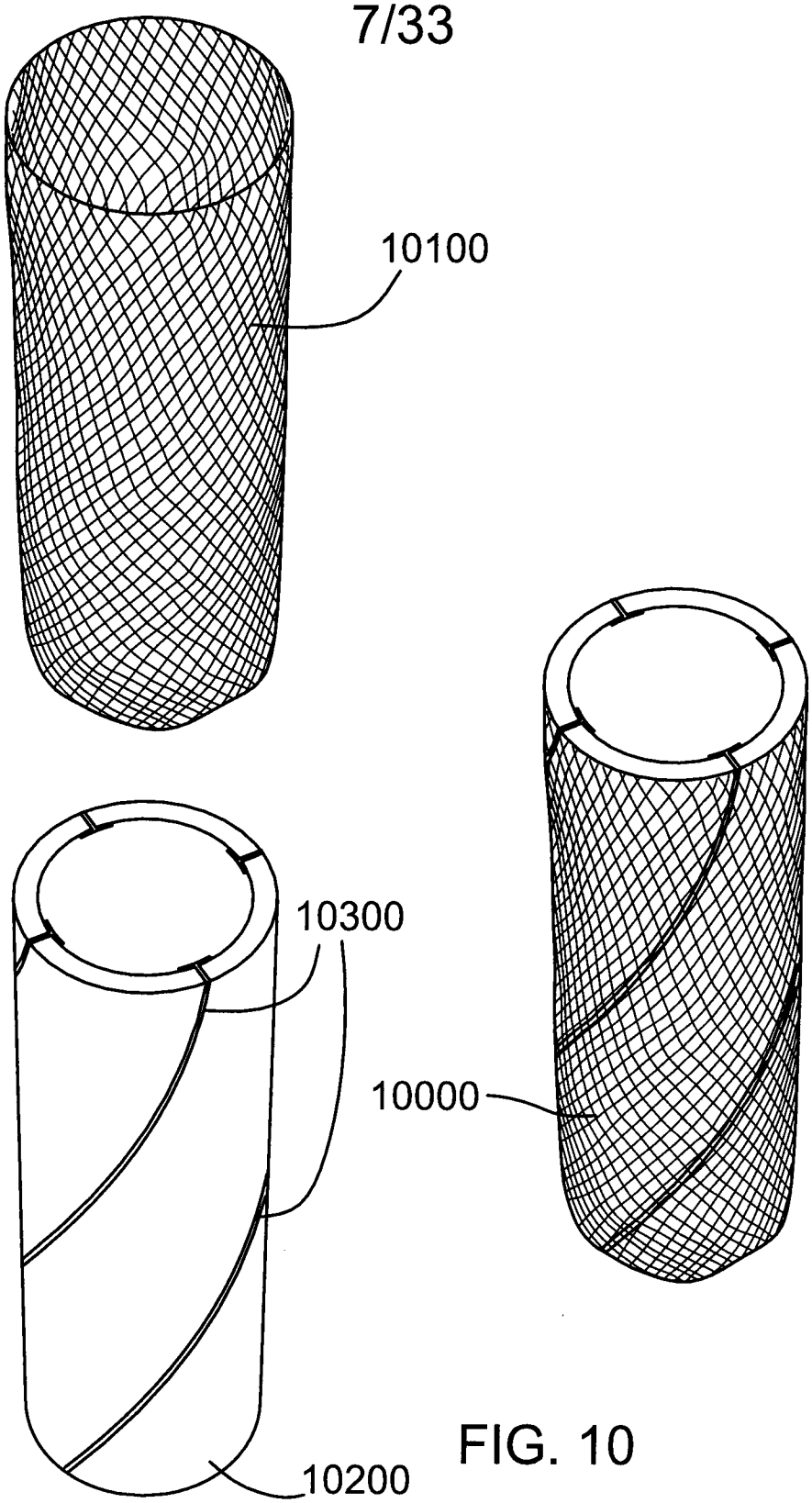


FIG. 10

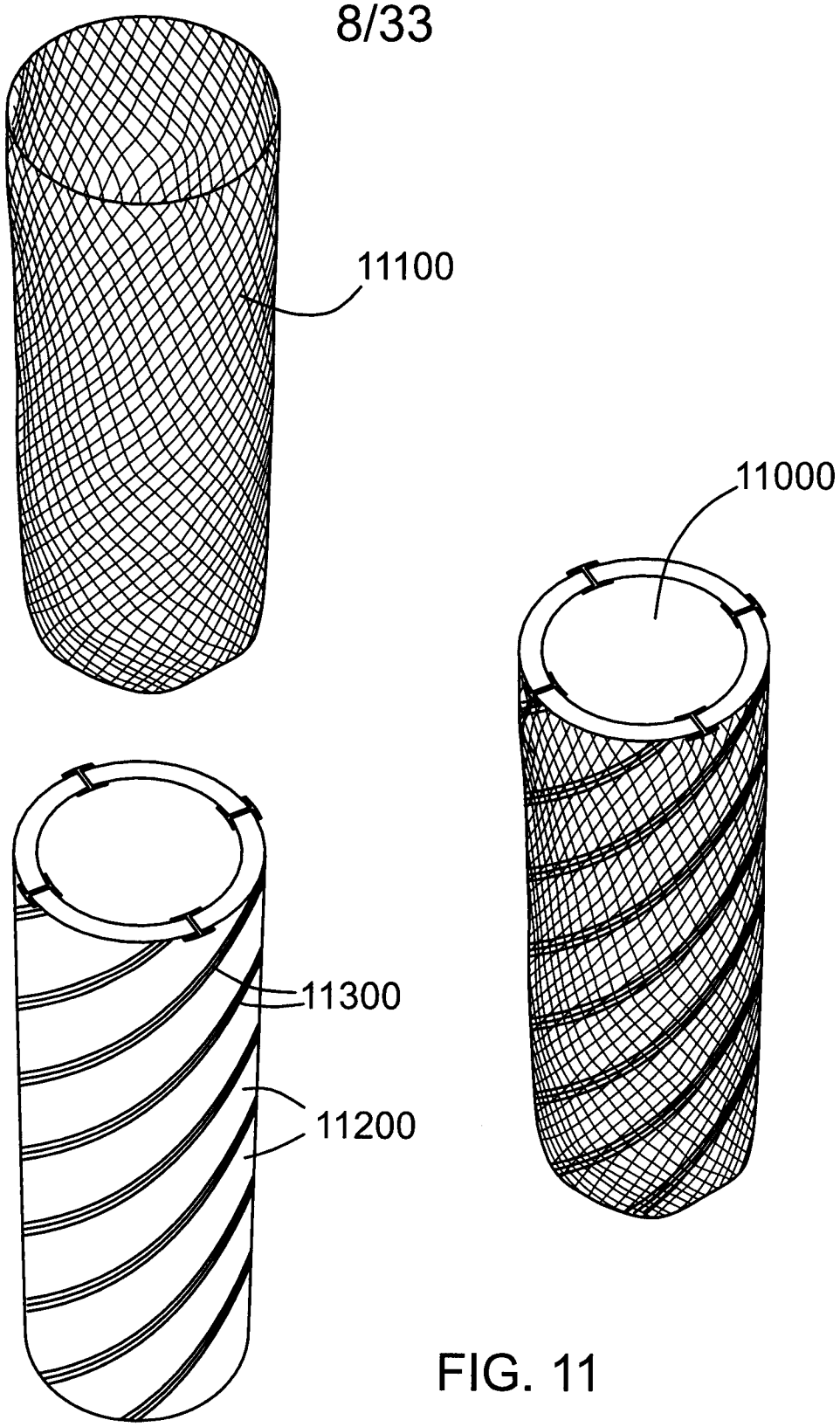


FIG. 11

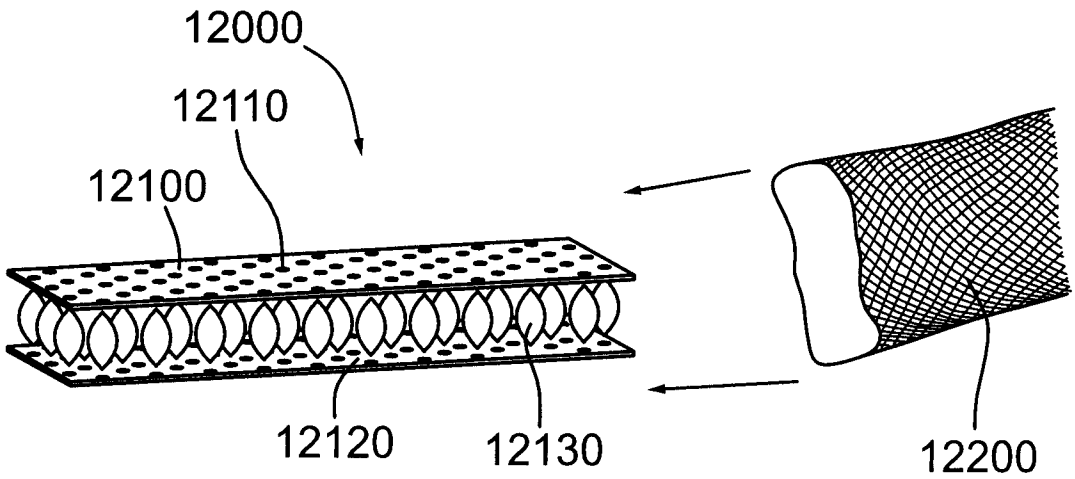


FIG. 12

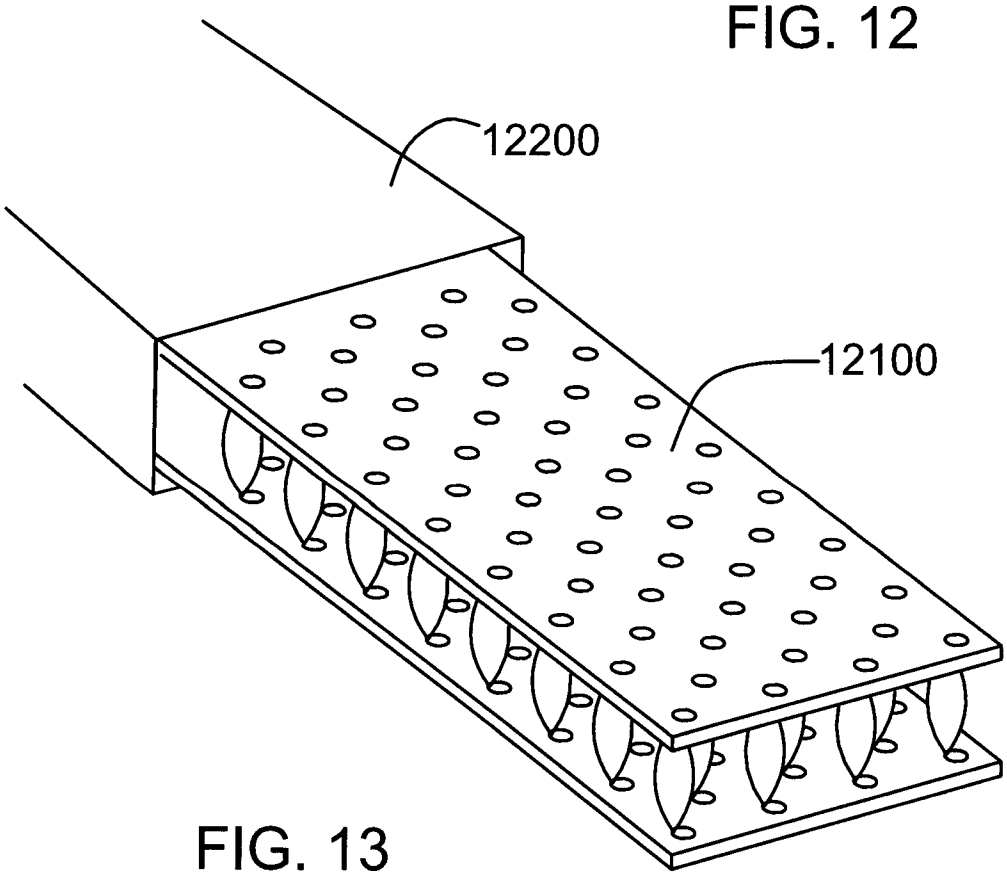


FIG. 13

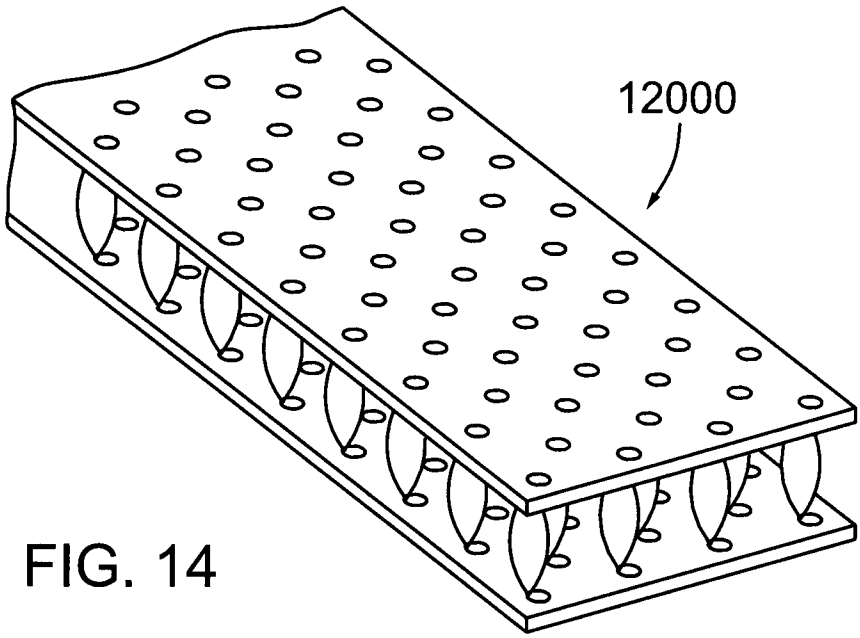


FIG. 14

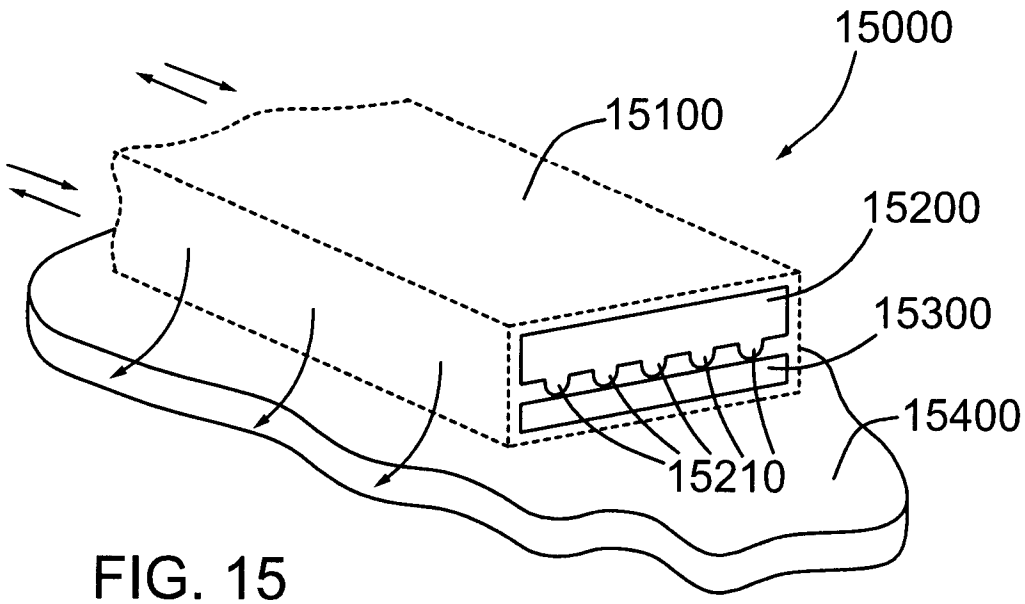


FIG. 15

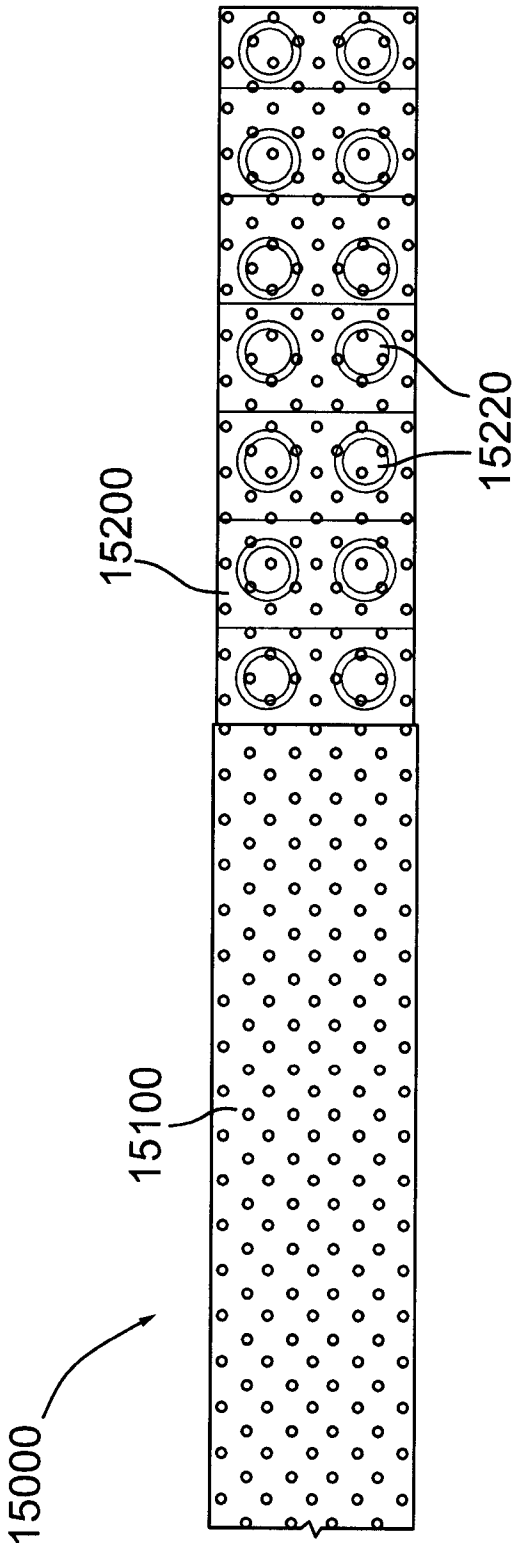

15200
15220
15100
15000

FIG. 16

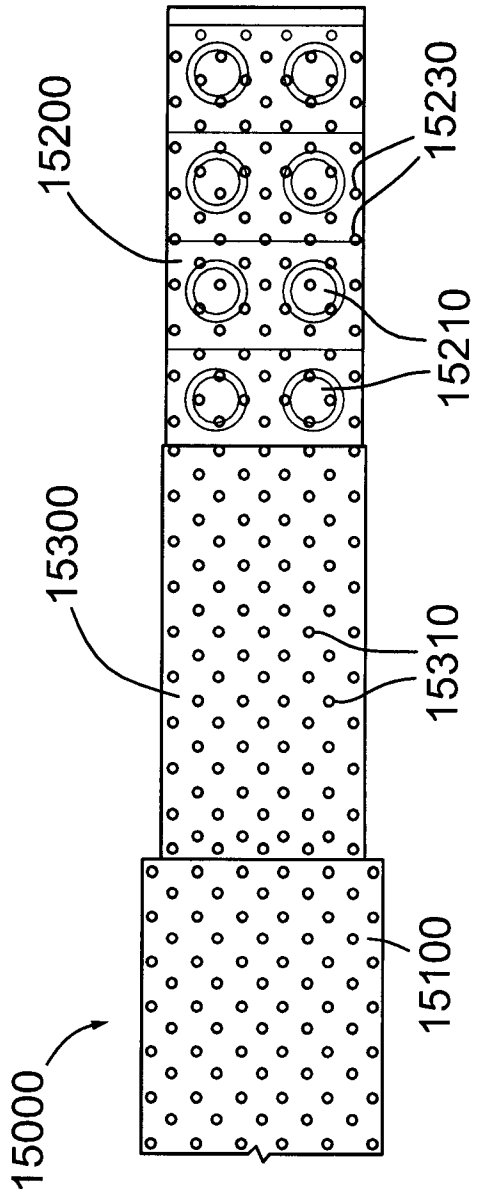
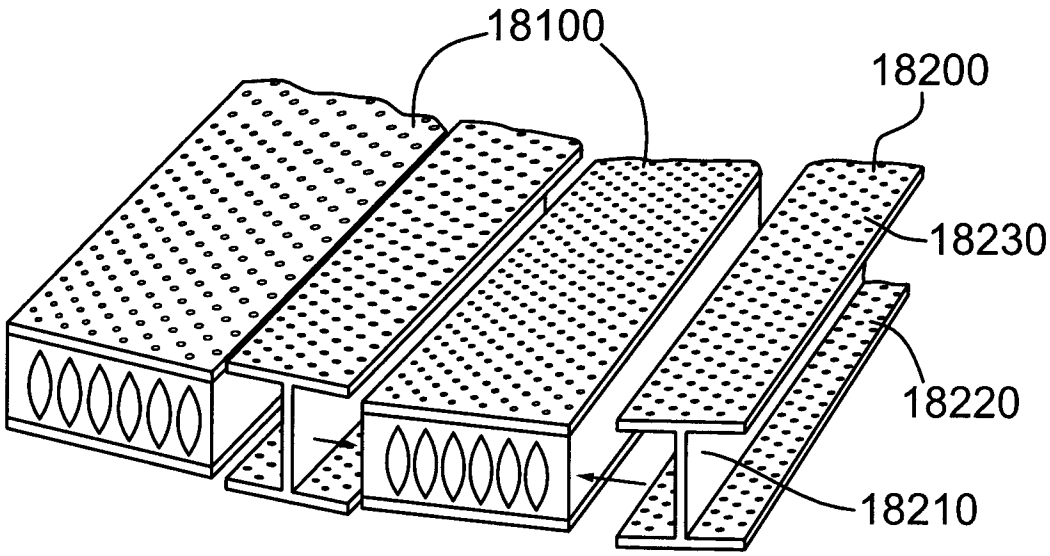

15200
15230
15210
15300
15310
15100
15000

FIG. 17



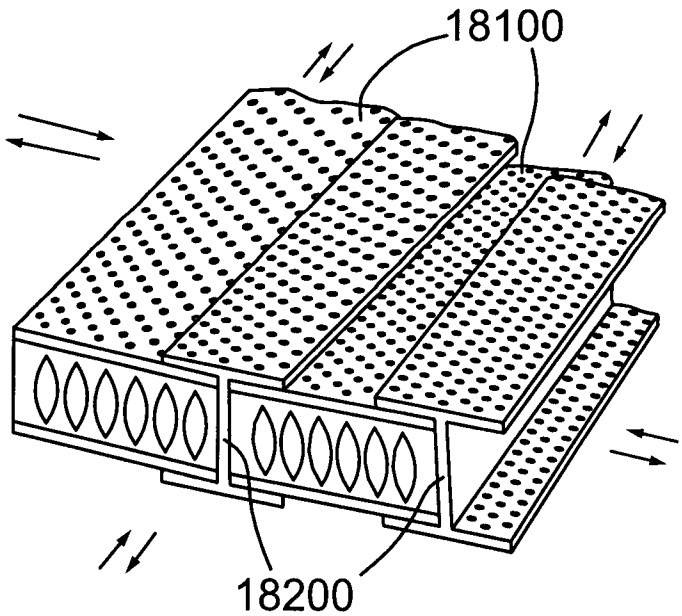


FIG. 18

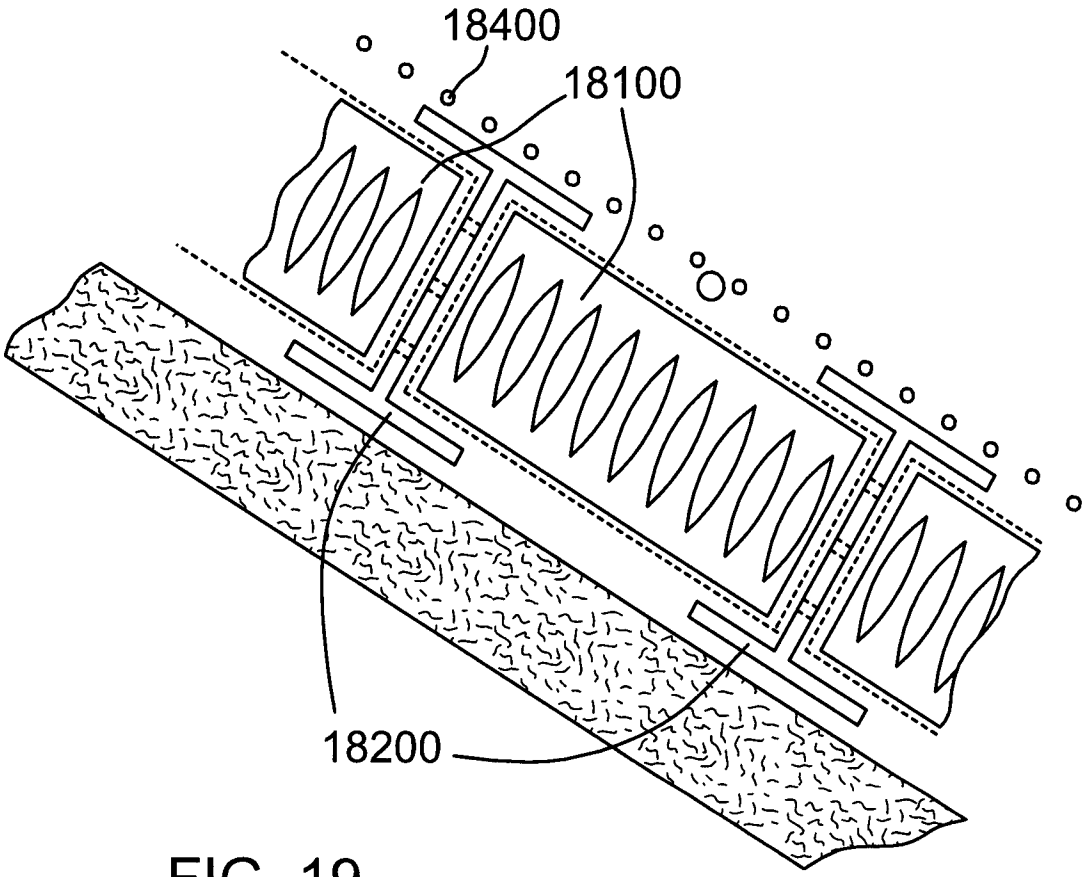


FIG. 19

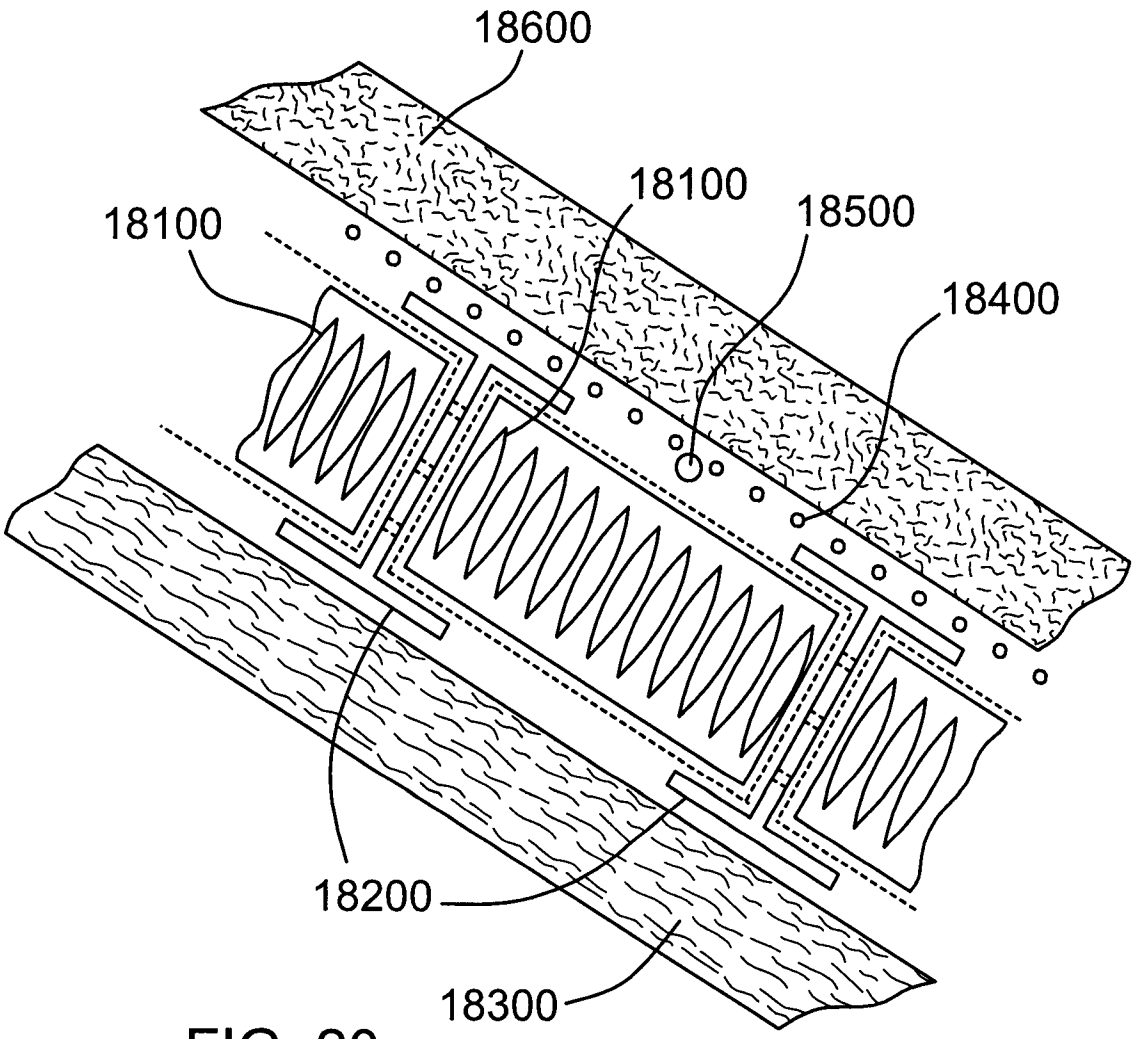


FIG. 20

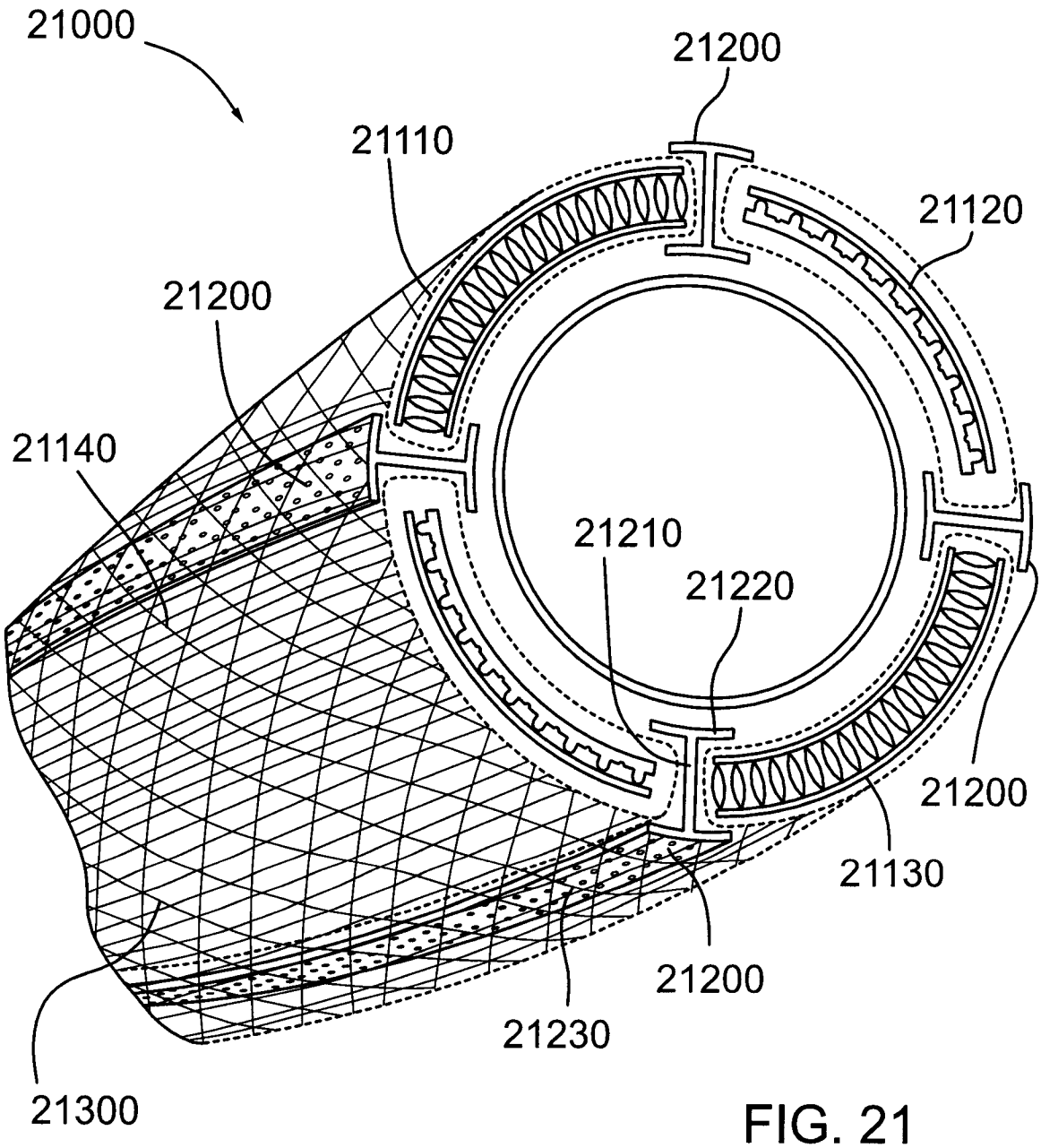

21000
21200
21110
21120
21200
21140
21210
21220
21200
21130
21200
21230
21300

FIG. 21

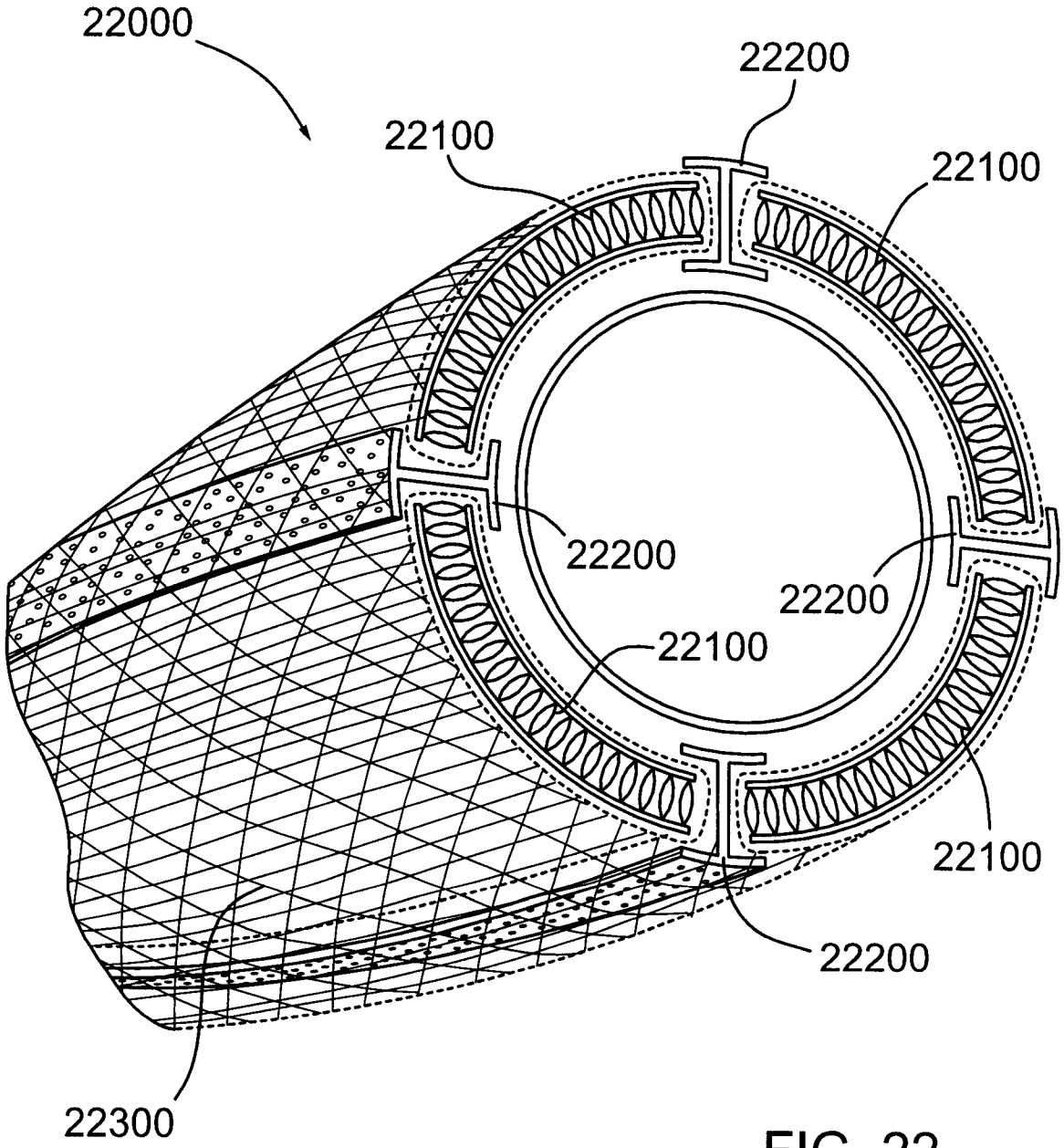

22000
22200
22100
22100
22200
22200
22100
22100
22200
22300

FIG. 22

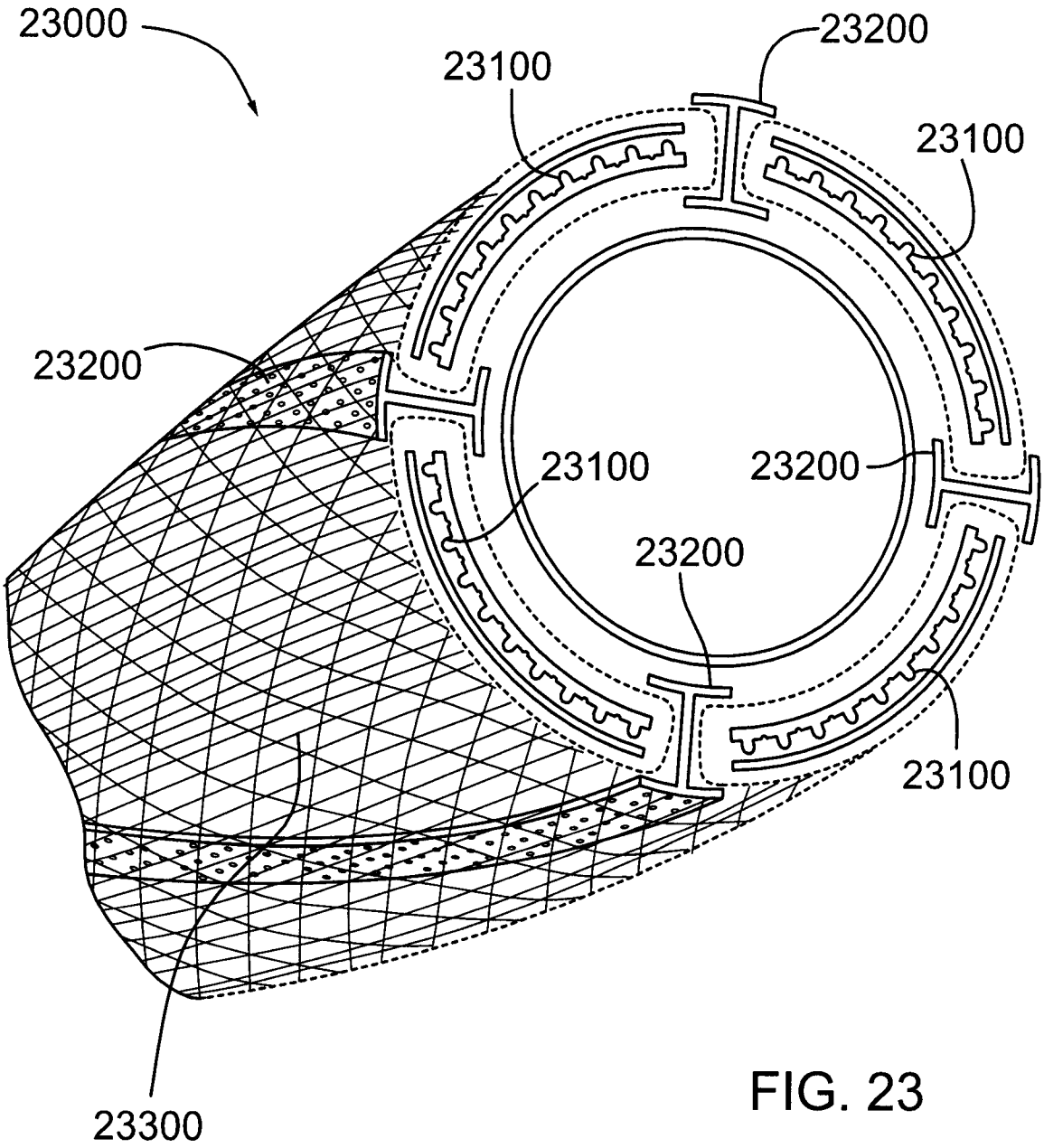

23000
23100
23200
23100
23200
23100
23200
23200
23100
23300

FIG. 23

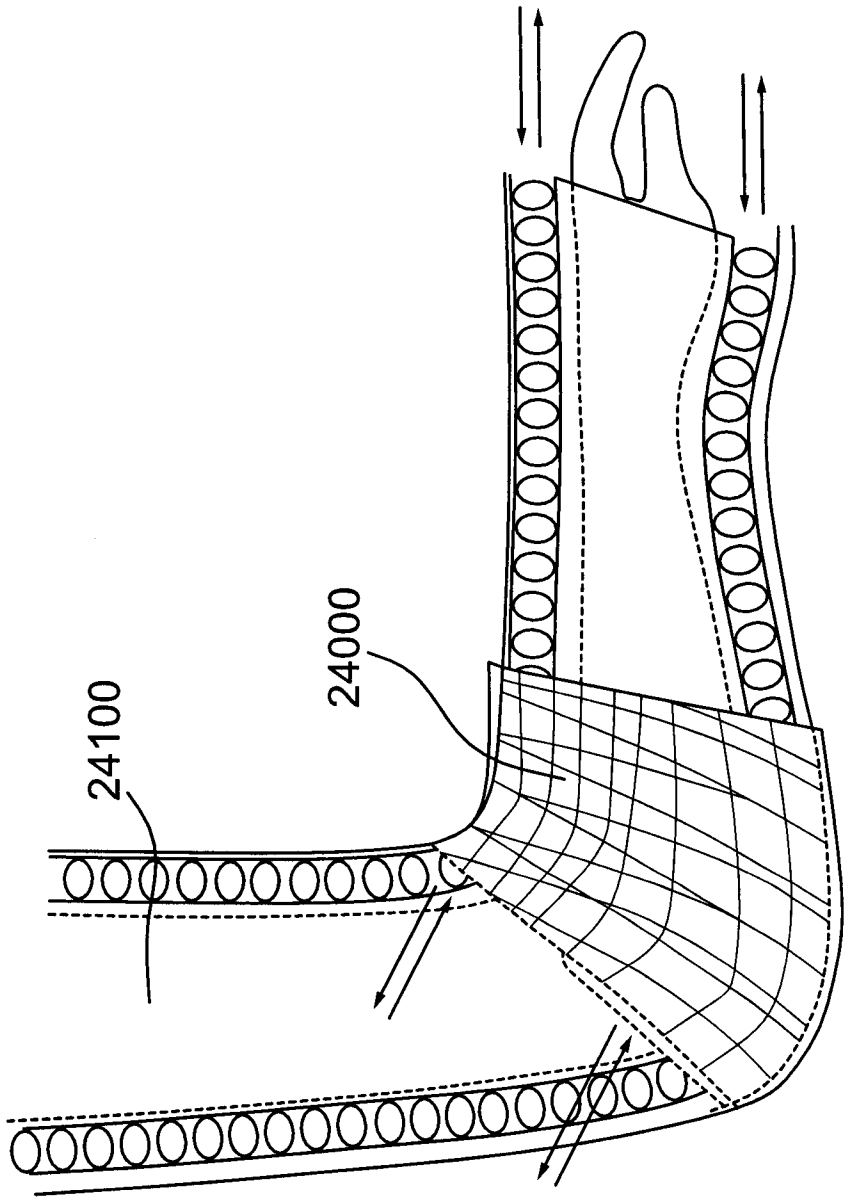


FIG. 24

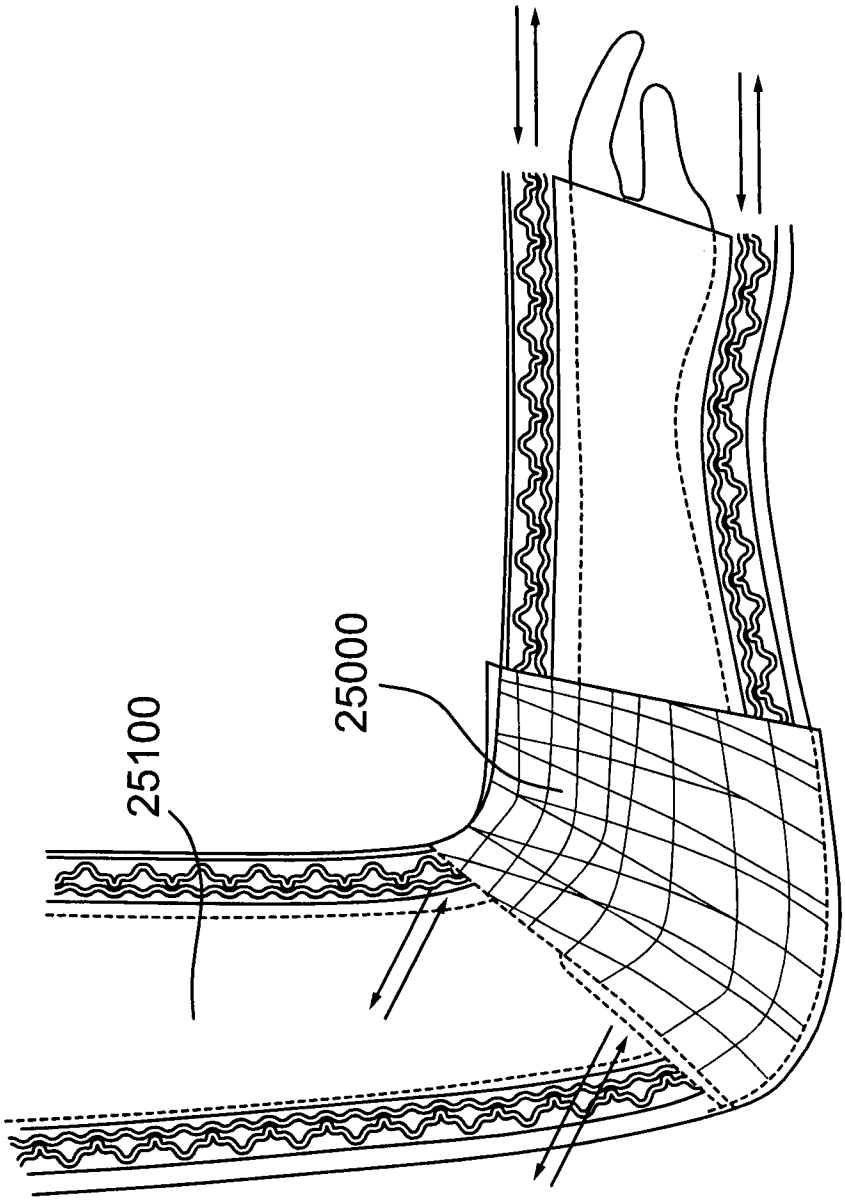


FIG. 25

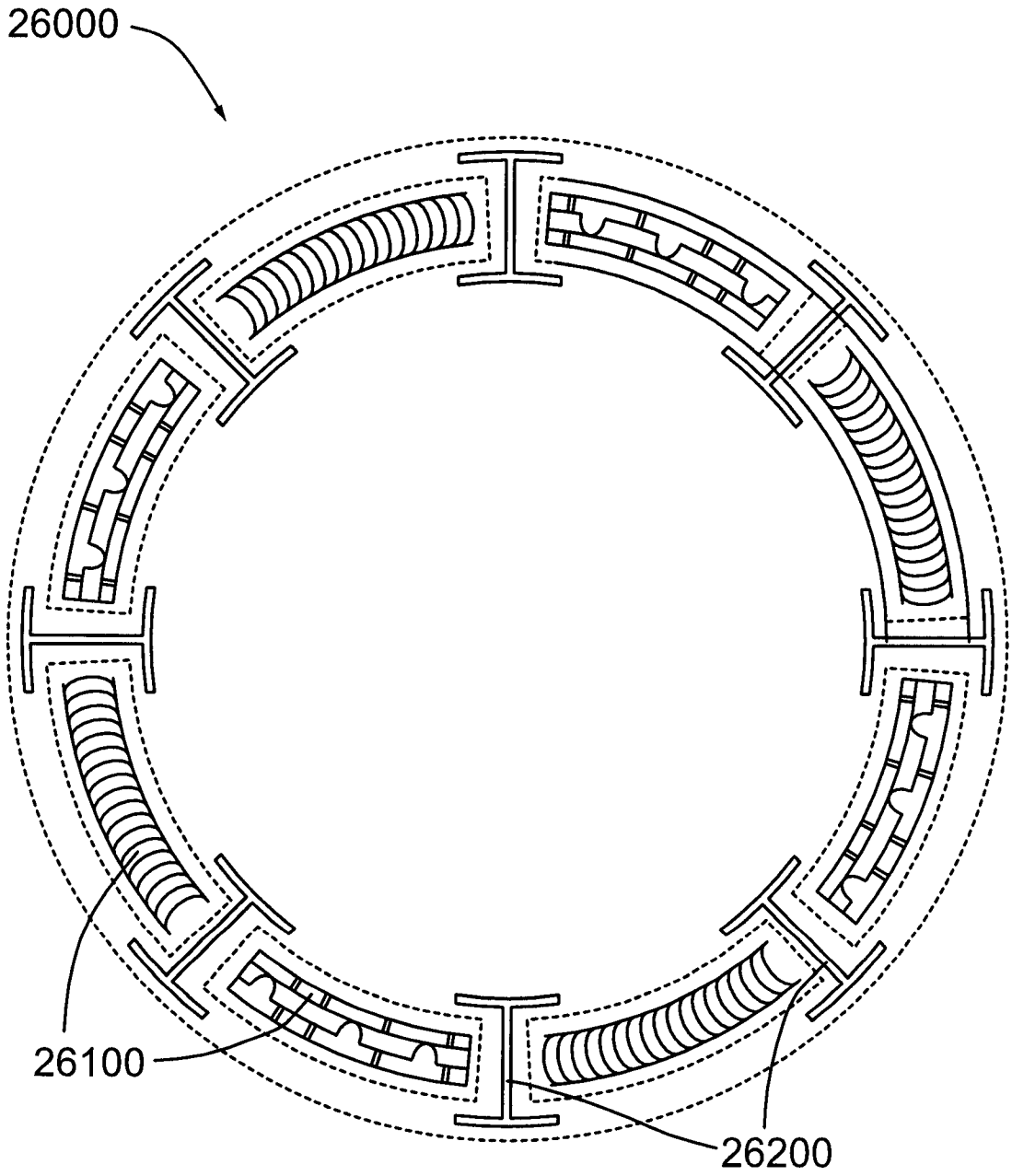


FIG. 26

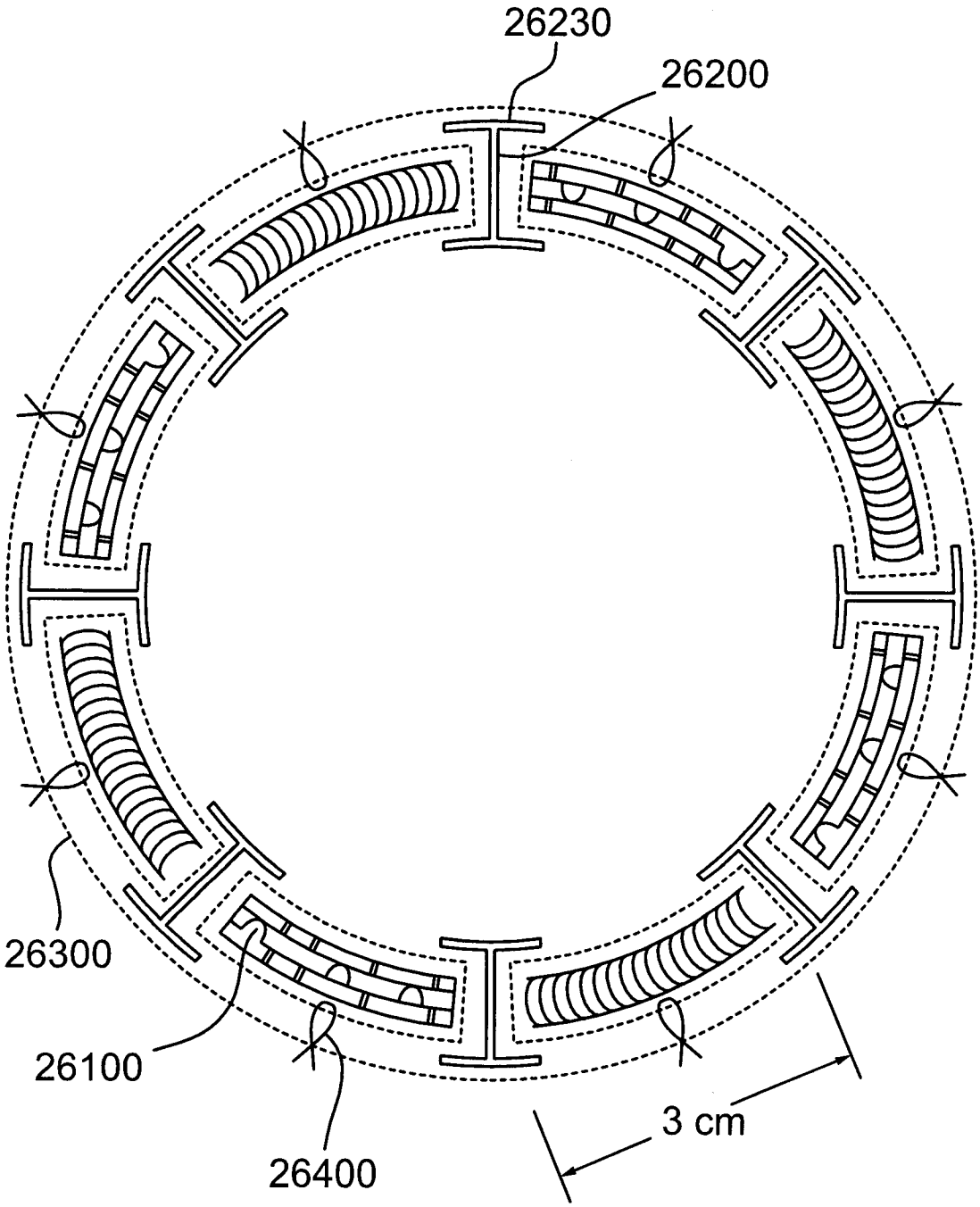


FIG. 27

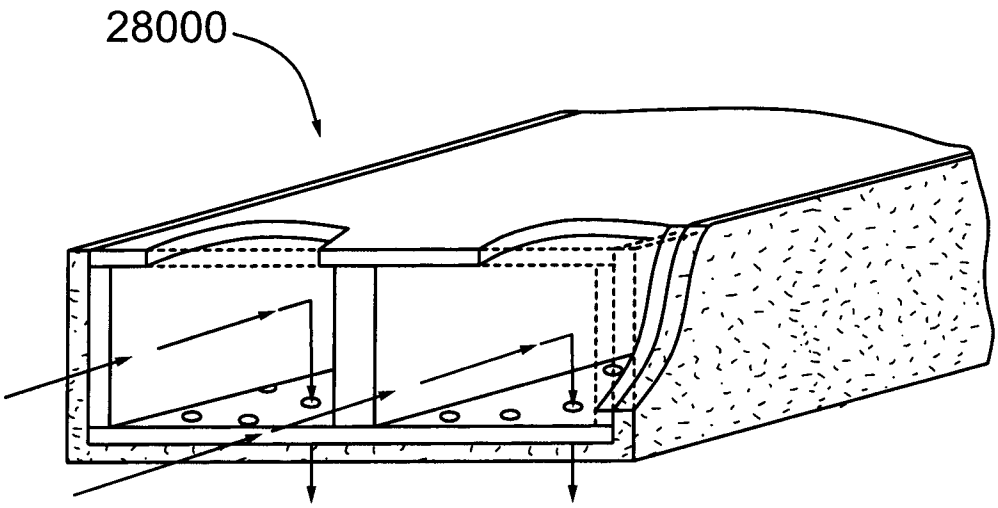


FIG. 28

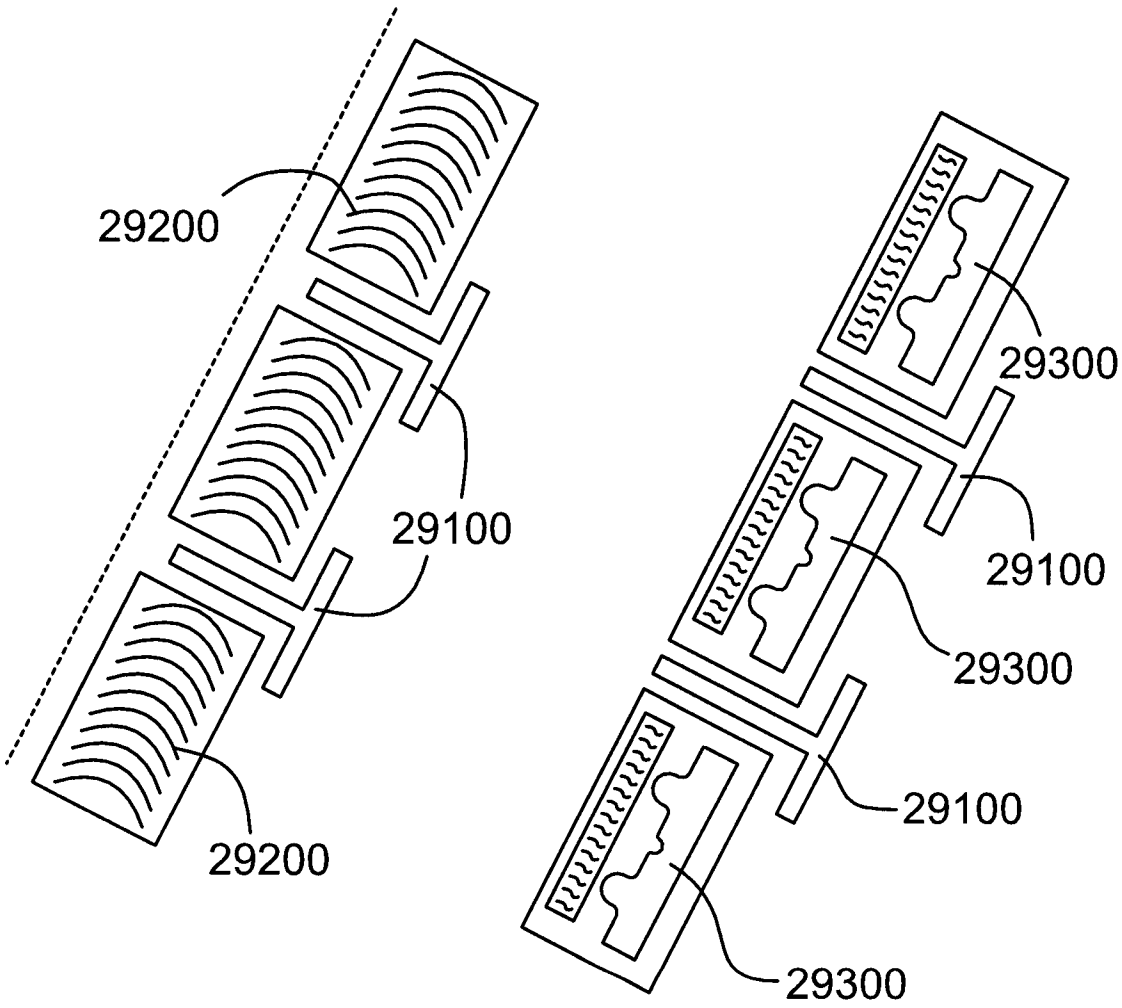


FIG. 29

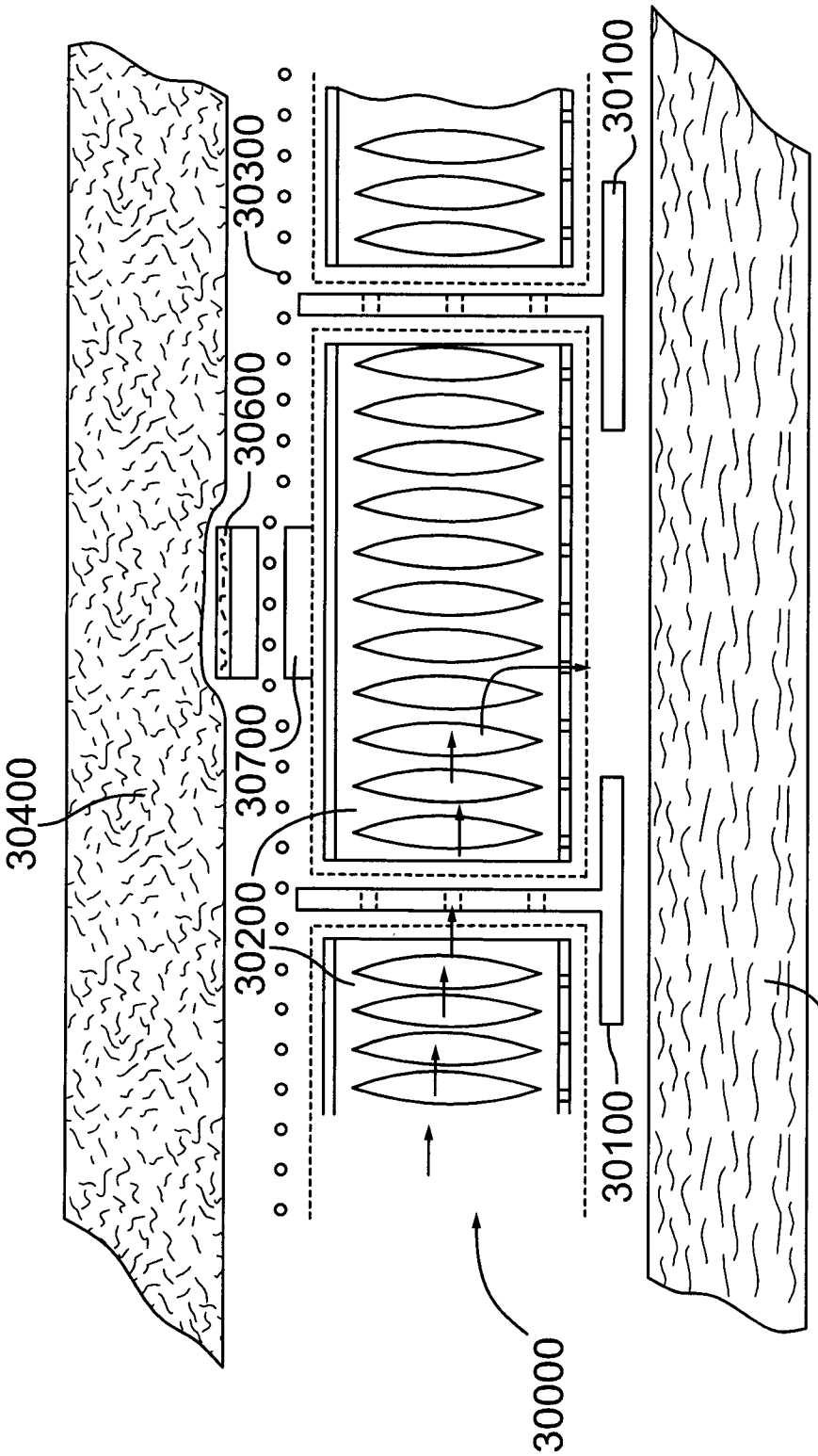


FIG. 30

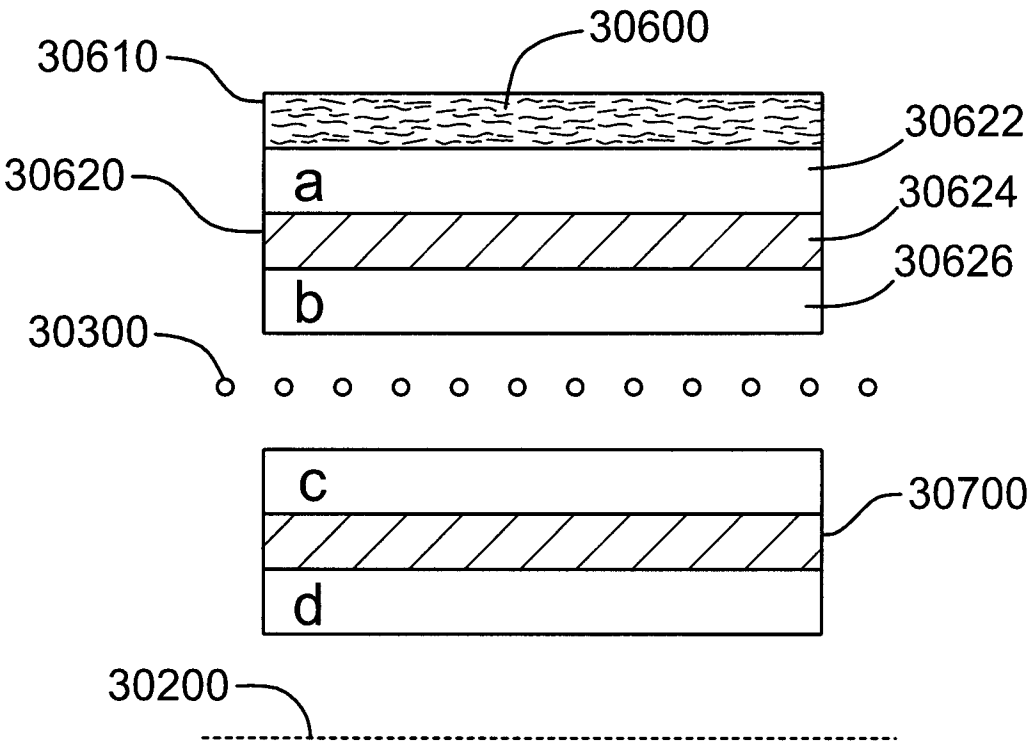


FIG. 31

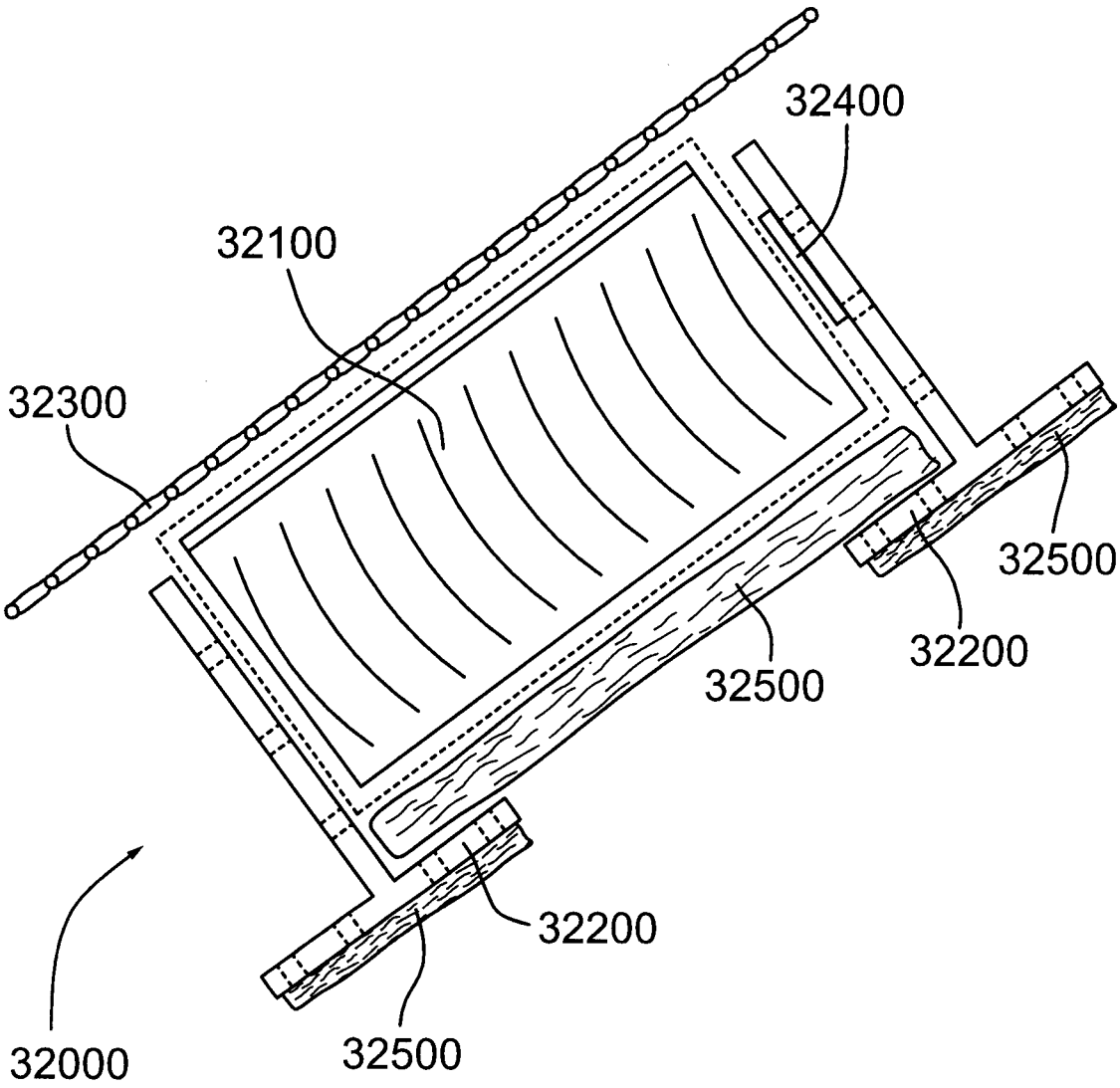


FIG. 32

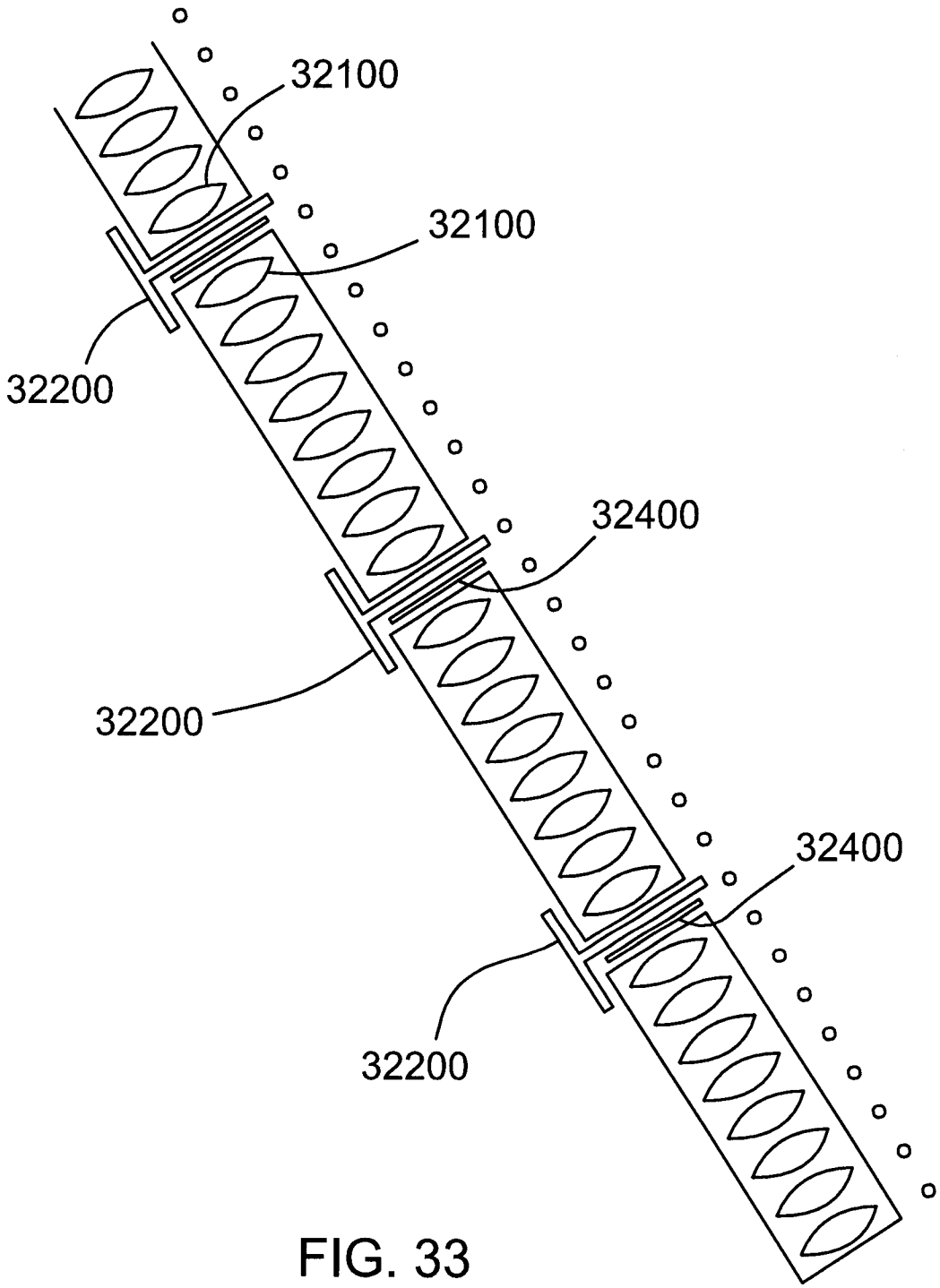


FIG. 33

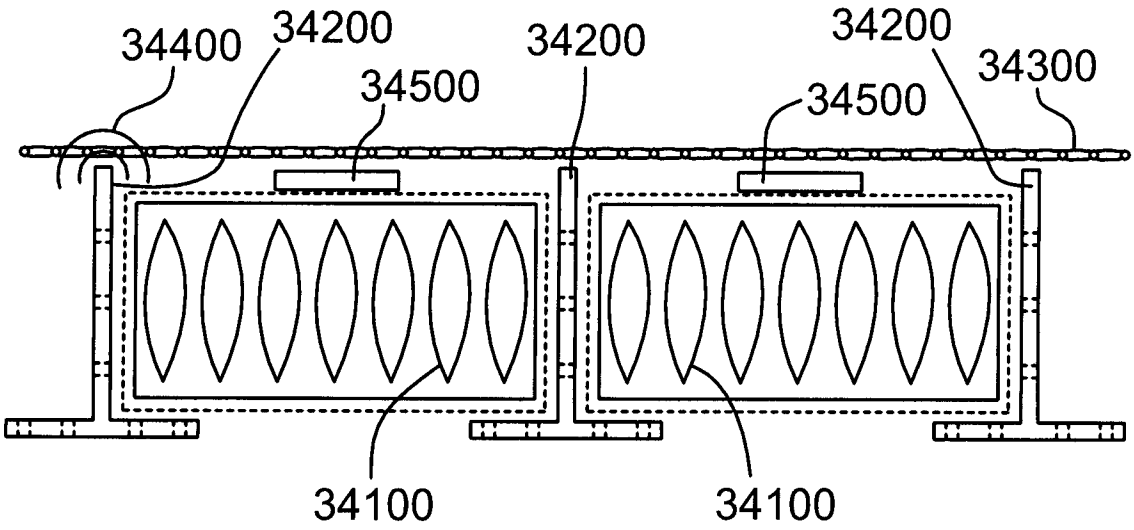

34400
34200
34500
34200
34200
34500
34300
34100
34100

FIG. 34

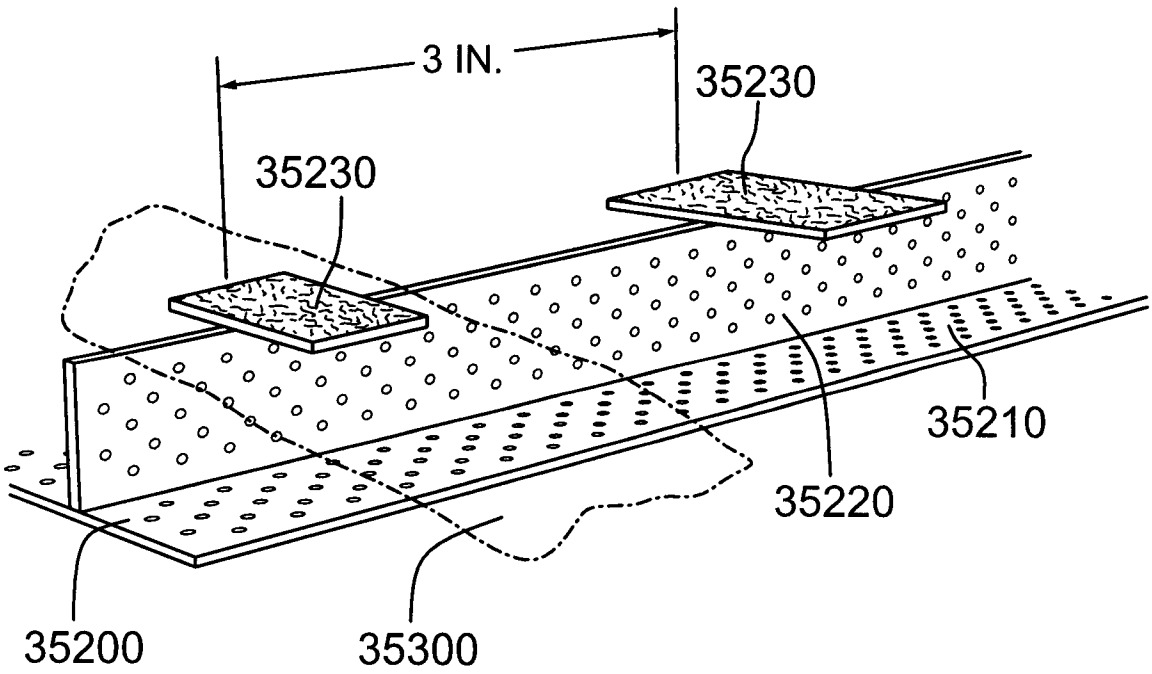

3 IN.
35230
35230
35210
35220
35200
35300

FIG. 35

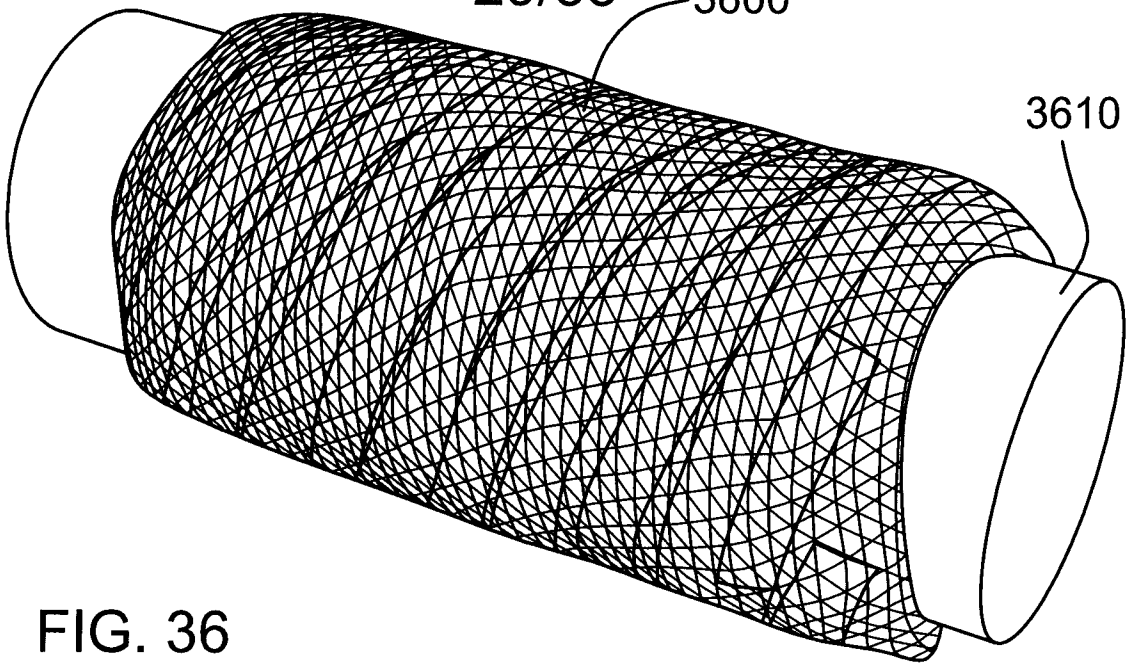


FIG. 36

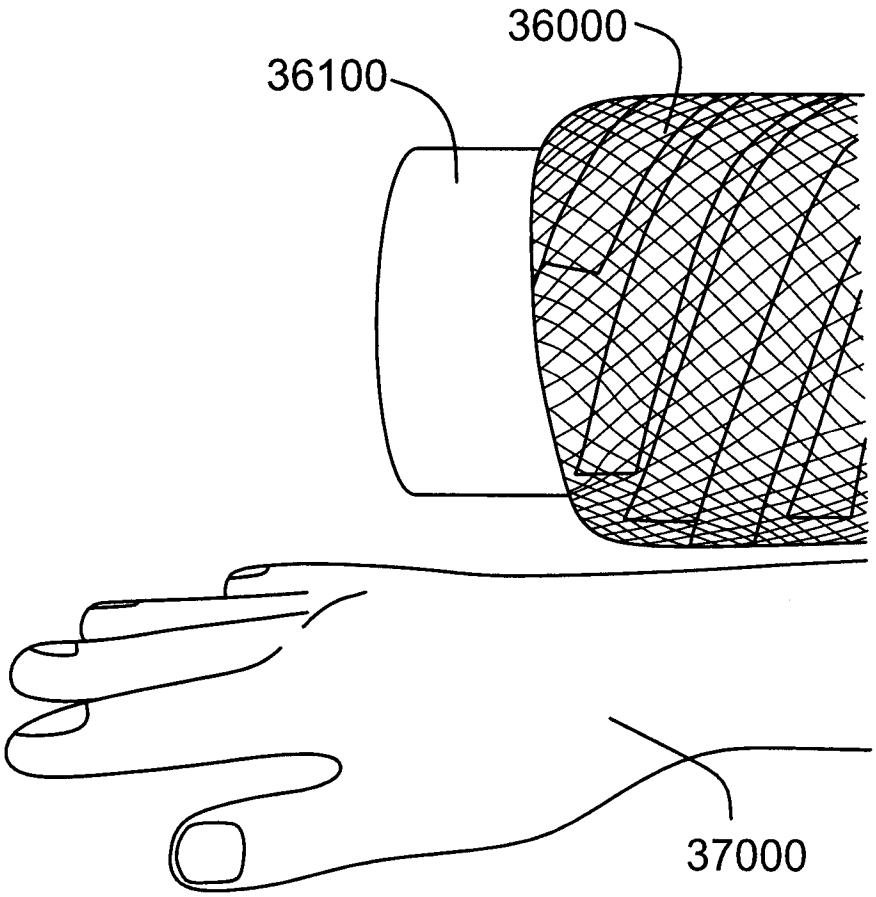


FIG. 37

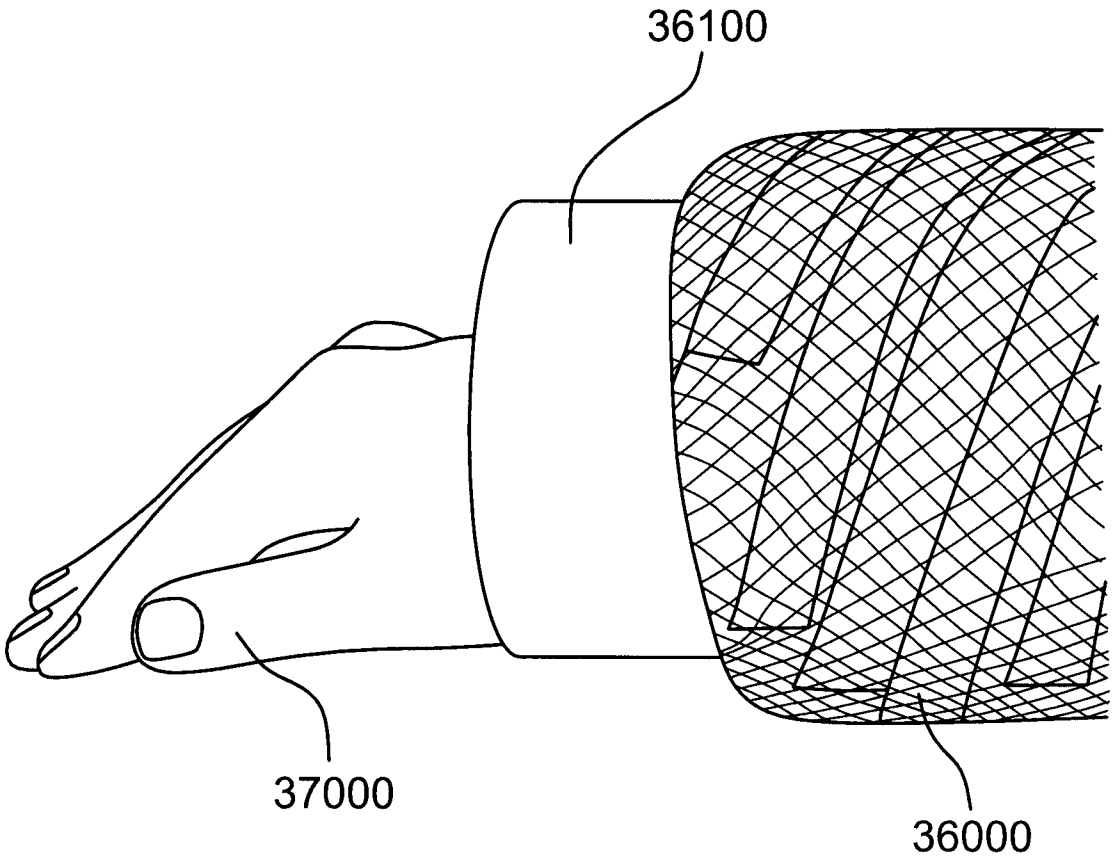
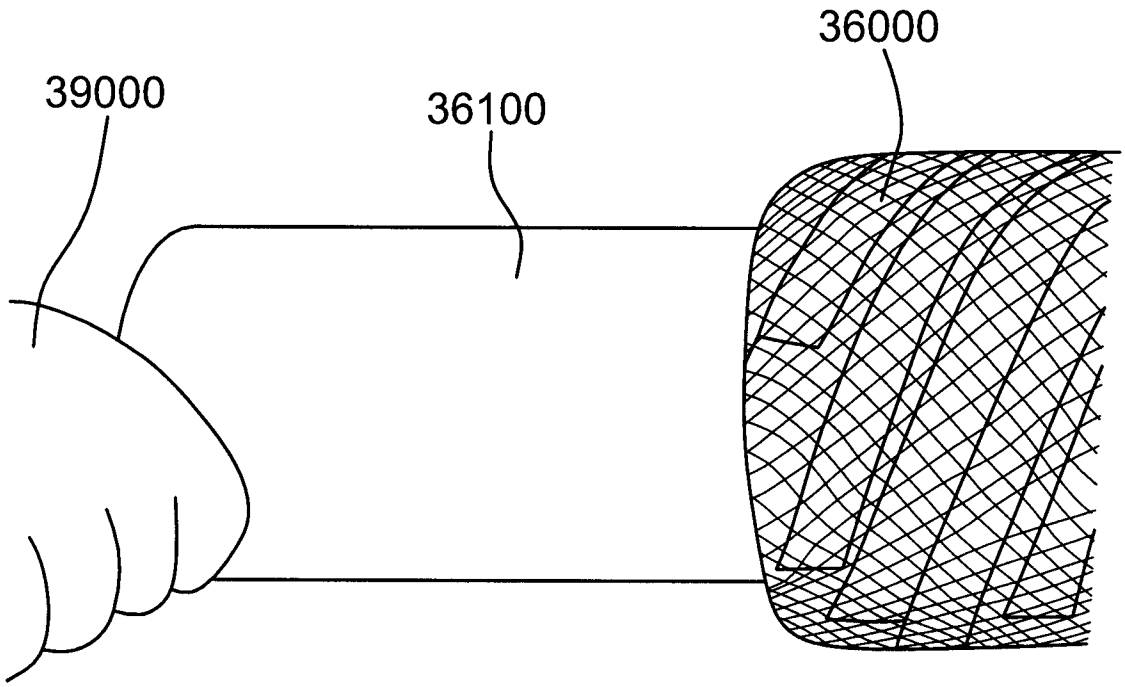


FIG. 38



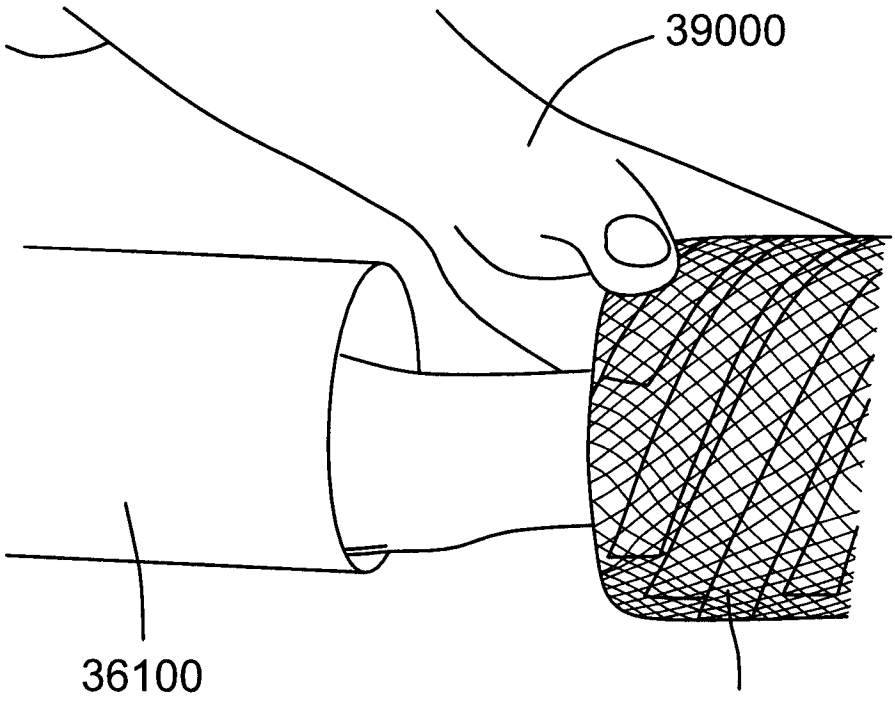


FIG. 39

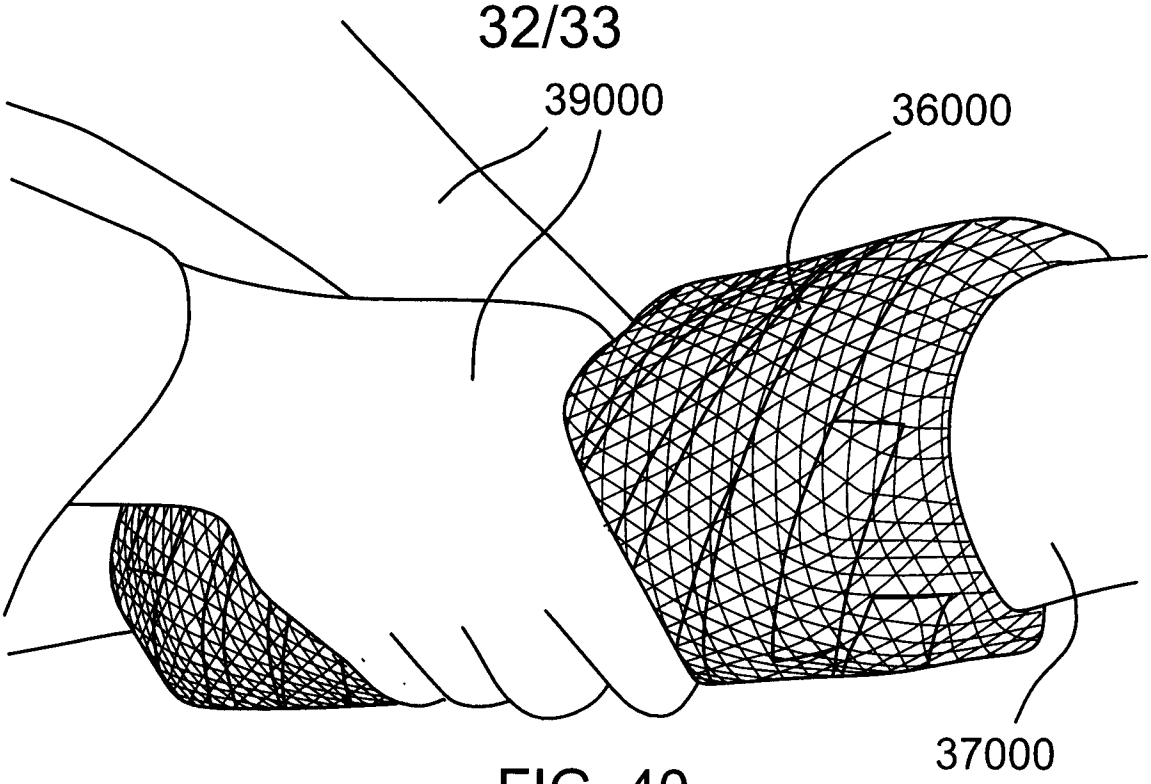


FIG. 40

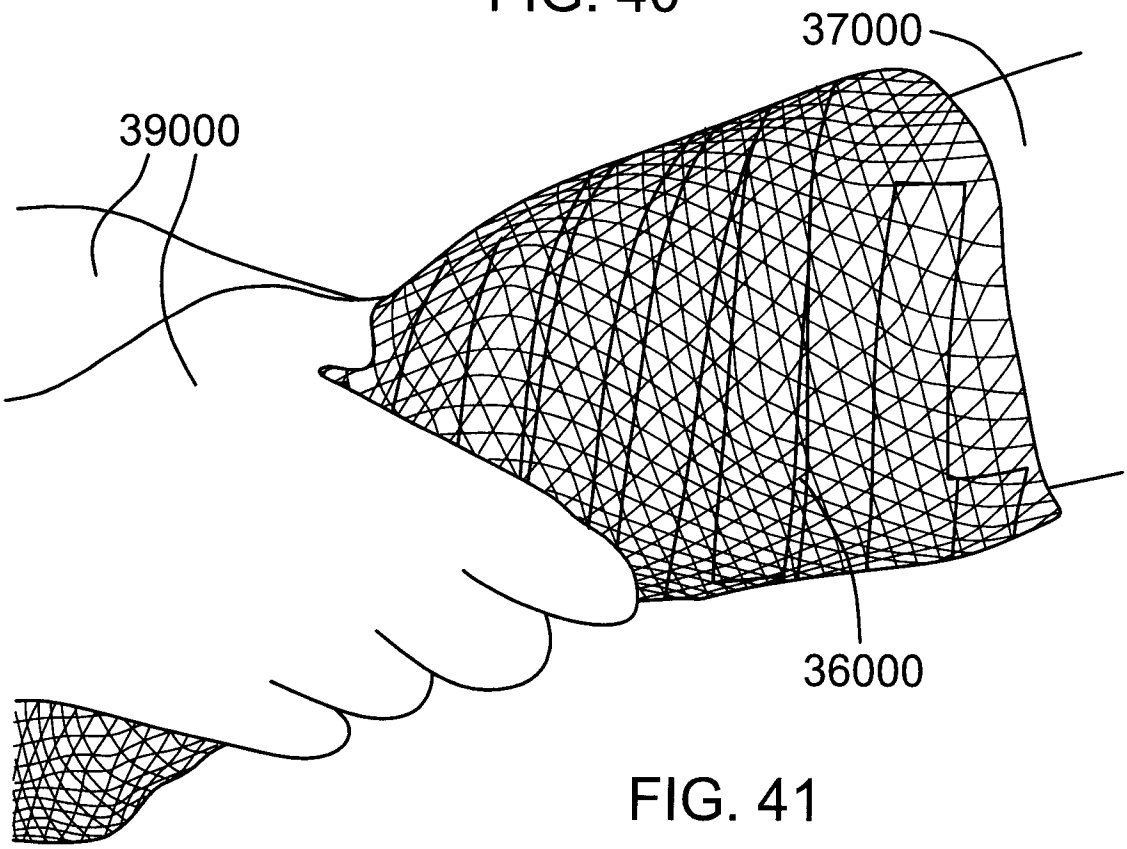


FIG. 41

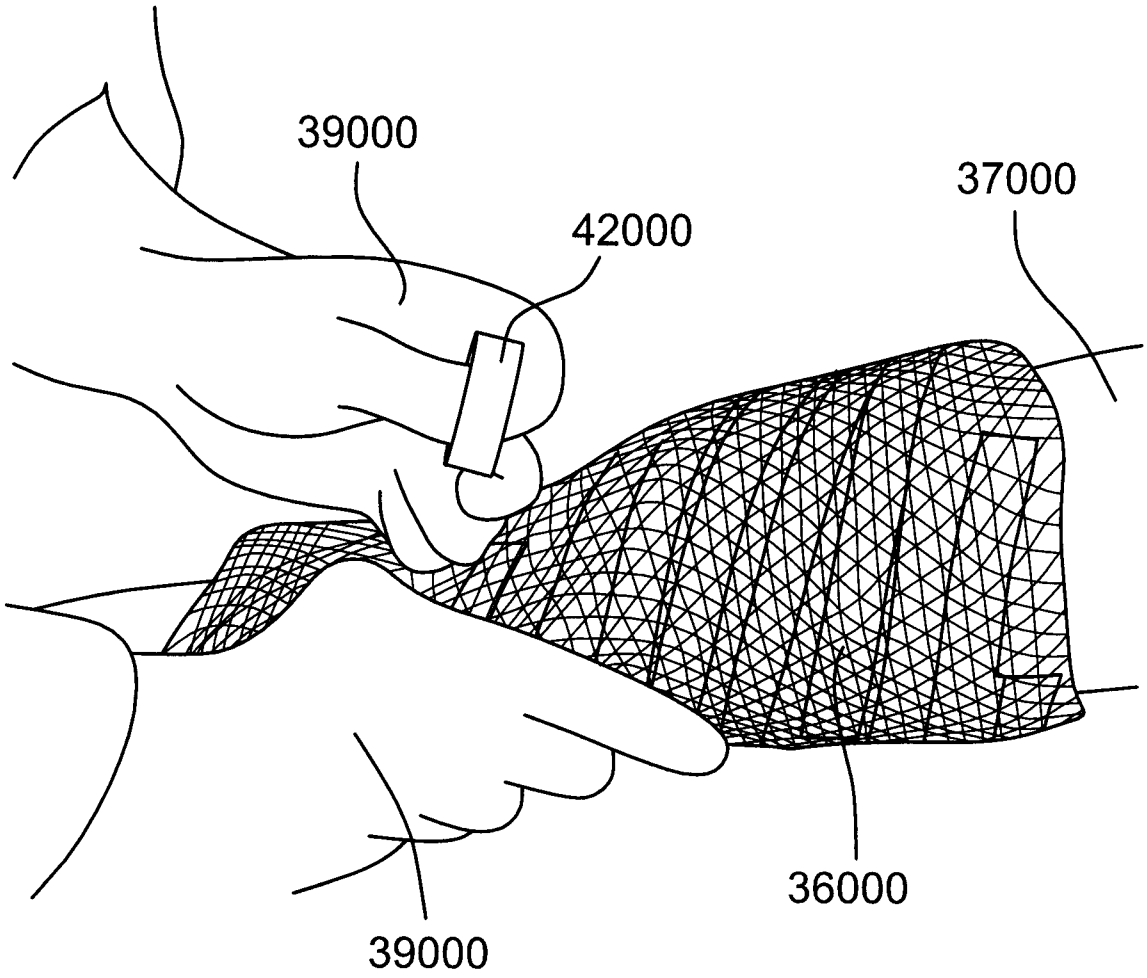


FIG. 42

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2018/051668

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***B32B 3/26*** (2006.01) , ***A61F 13/04*** (2006.01) , ***A61F 5/01*** (2006.01) , ***B32B 3/30*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B32B (2006.01); A61F (2006.01)

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

QUESTEL-ORBIT (FAMPAT); GOOGLE PATENTS; STN (CAPLUS, DWPI, FULLTEXT PATENT DB); CANADIAN PATENT DATABASE; Keywords: wrap, cast, seam, joint, buffer, helicoidal, helix, spiral, flexible, liner, venting, air circulation, aeration, breathable, orthopedic, surgical, sleeve

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7,250,034 B2; BARBERIO; 31 July 2007 (31-07-2007) Whole document	
A	US 2011/0152735 A1; BARBERIO; 23 June 2011 (23-06-2011) Whole document	
A	US 2014/0052041 A1; BARBERIO; 20 February 2014 (20-02-2014) Whole document	

☐ 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
"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 21 February 2019 (21-02-2019)	Date of mailing of the international search report 28 March 2019 (28-03-2019)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer David Chamberlain (819) 639-8437

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2018/051668

Patent Document Cited in Search Report	Publication Date	Publication Family Member(s)	Publication Date
US7250034B2	31 July 2007(31-07-2007)	US2004230148A1	18 November 2004(18-11-2004)
		AT552808T	15 April 2012(15-04-2012)
		AU2004202023A1	02 December 2004(02-12-2004)
		AU2004202023B2	03 February 2011(03-02-2011)
		CA2467154A1	13 November 2004(13-11-2004)
		CA2467154C	10 September 2013(10-09-2013)
		EP1477147A2	17 November 2004(17-11-2004)
		EP1477147A3	02 March 2005(02-03-2005)
		EP1477147B1	11 April 2012(11-04-2012)
		JP2005040583A	17 February 2005(17-02-2005)
		JP4673576B2	20 April 2011(20-04-2011)
US2011152735A1	23 June 2011(23-06-2011)	US8777883B2	15 July 2014(15-07-2014)
		AU2008204680A1	17 July 2008(17-07-2008)
		AU2008204680B2	04 April 2013(04-04-2013)
		CA2689160A1	17 July 2008(17-07-2008)
		CA2689160C	17 May 2016(17-05-2016)
		EP2107899A1	14 October 2009(14-10-2009)
		EP2107899A4	28 December 2011(28-12-2011)
		EP2107899B1	11 June 2014(11-06-2014)
		US2014343471A1	20 November 2014(20-11-2014)
		US9615957B2	11 April 2017(11-04-2017)
		WO2008083477A1	17 July 2008(17-07-2008)
US2014052041A1	20 February 2014(20-02-2014)	US9554944B2	31 January 2017(31-01-2017)
		AU2014282932A1	21 January 2016(21-01-2016)
		CA2916144A1	24 December 2014(24-12-2014)
		EP2985013A2	17 February 2016(17-02-2016)
		EP2985013A3	23 March 2016(23-03-2016)
		EP2985013B1	11 April 2018(11-04-2018)
		EP3010463A1	27 April 2016(27-04-2016)
		EP3010463A4	03 May 2017(03-05-2017)
		JP2016537047A	01 December 2016(01-12-2016)
		WO2014203049A1	24 December 2014(24-12-2014)