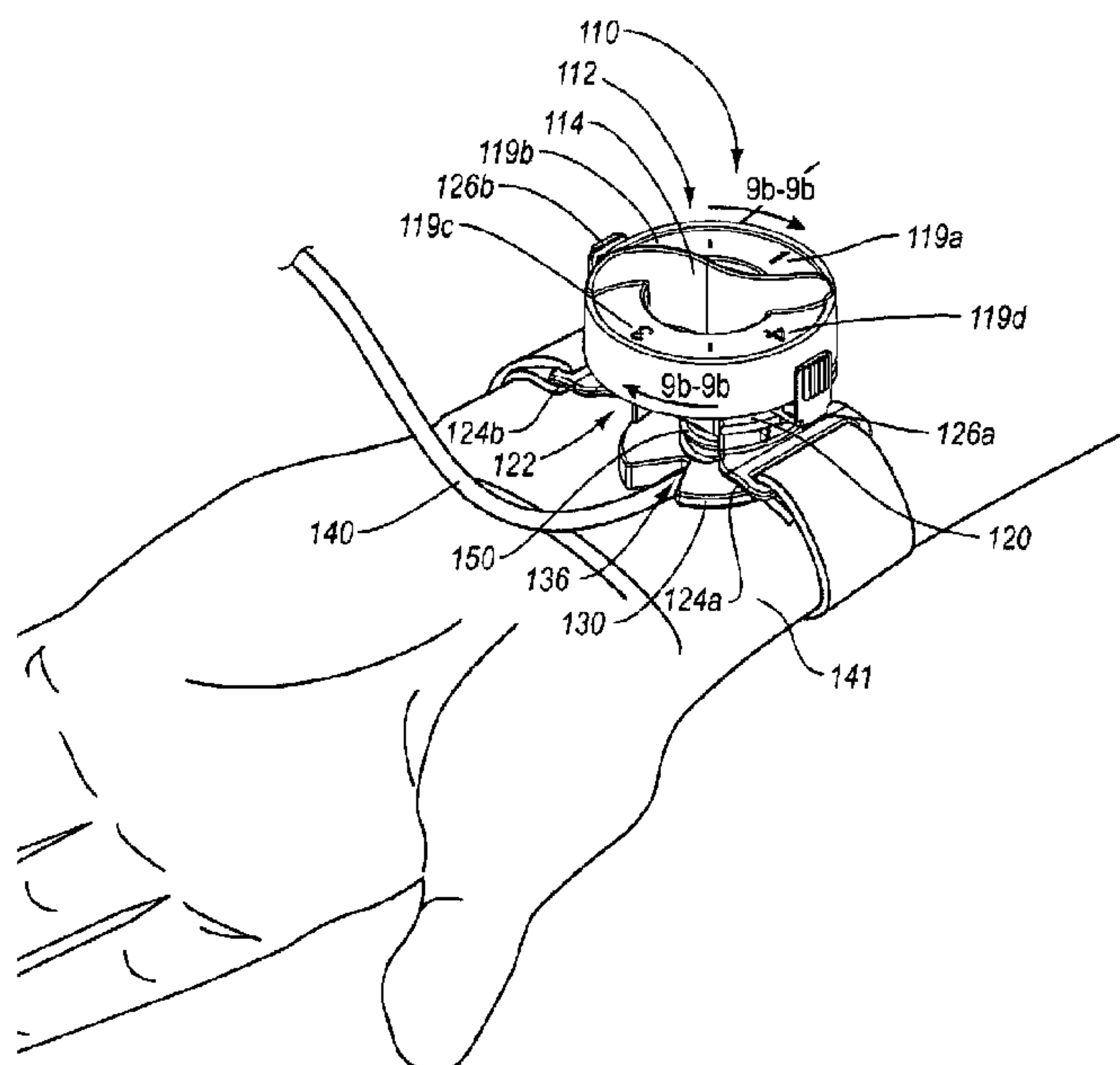




(86) Date de dépôt PCT/PCT Filing Date: 2009/05/05
(87) Date publication PCT/PCT Publication Date: 2009/12/17
(45) Date de délivrance/Issue Date: 2017/06/27
(85) Entrée phase nationale/National Entry: 2010/11/01
(86) N° demande PCT/PCT Application No.: US 2009/042868
(87) N° publication PCT/PCT Publication No.: 2009/151824
(30) Priorités/Priorities: 2008/05/06 (US61/050,907);
2009/01/06 (US12/349,405); 2009/05/04 (US12/435,227)

(51) Cl.Int./Int.Cl. *A61B 17/132* (2006.01)
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(54) Titre : DISPOSITIF DE COMPRESSION DE L'ARTERE RADIALE
(54) Title: RADIAL ARTERY COMPRESSION DEVICE



(57) **Abrégé/Abstract:**

A radial artery compression device configured to be releasably secured by a strap or band to the underside of a wrist of a patient and to provide adjustable and consistent compression pressure in the area of a radial artery access site to achieve hemostasis either during or after a medical procedure such as a percutaneous coronary procedure. The radial artery compression device includes a body configured to engage and secure a knob while allowing the knob to rotate with respect to the body. Rotation of the knob can cause a threaded shaft to move. The threaded shaft mechanically couples the knob to a disk-shaped compression pad. The compression pad can include one or more notches adapted to at least partially surround a sheath and/or a catheter inserted into the radial artery at the access site.



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

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
17 December 2009 (17.12.2009)(10) International Publication Number
WO 2009/151824 A1(51) International Patent Classification:
A61B 17/132 (2006.01)62232 (US). **MCARTHUR, Gregory, R.** [US/US]; 8990 Shady Meadow Drive, Sandy, Utah 84093 (US).(21) International Application Number:
PCT/US2009/042868(74) Agent: **BENSON, Ryan, D.**; Stoel Rives LLP, 201 So. Main Street, Suite 1100, One Utah Center, Salt Lake City, UT 84111 (US).(22) International Filing Date:
5 May 2009 (05.05.2009)(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, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

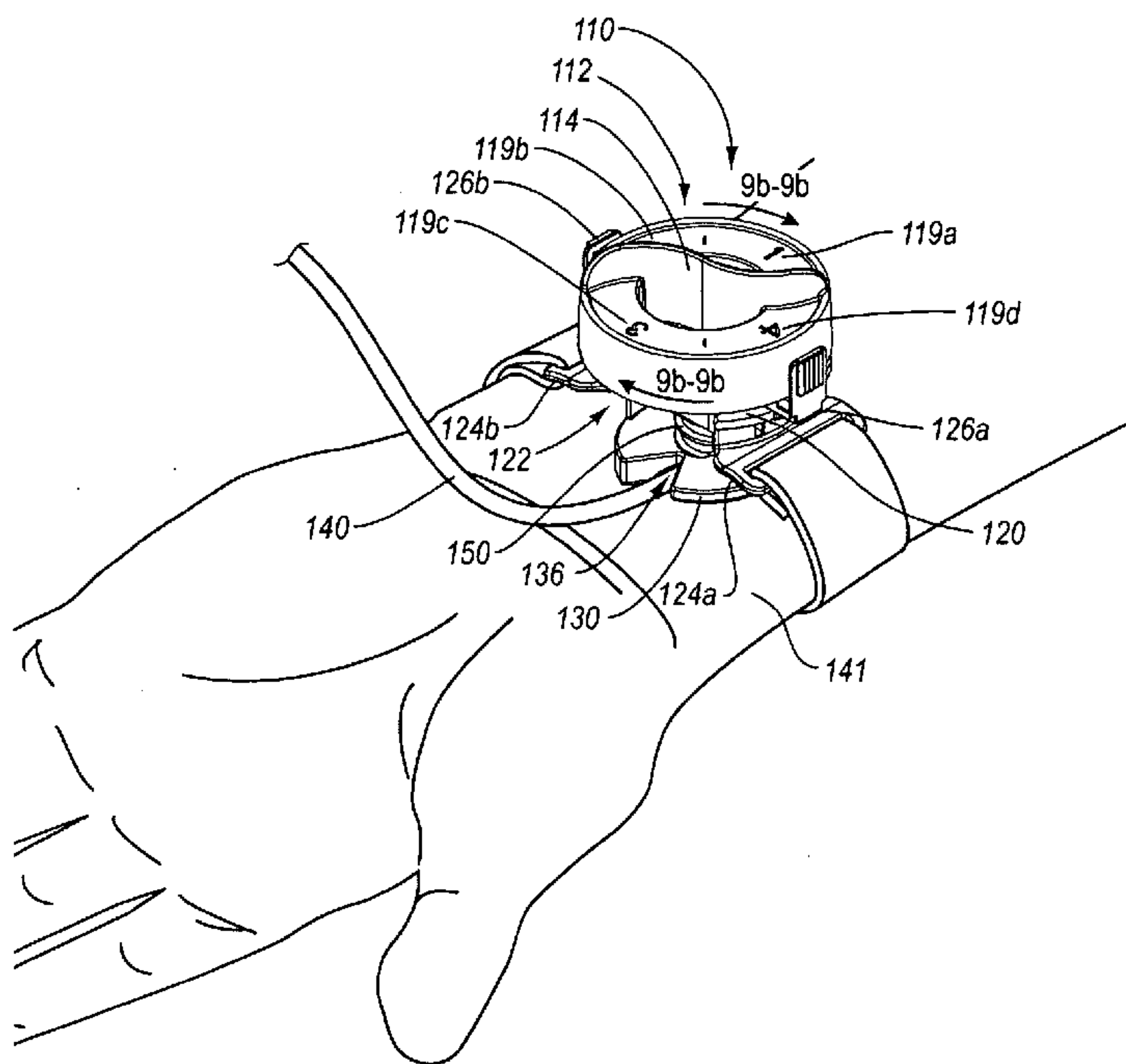
(30) Priority Data:
61/050,907 6 May 2008 (06.05.2008) US
12/349,405 6 January 2009 (06.01.2009) US
12/435,227 4 May 2009 (04.05.2009) US(71) Applicant (*for all designated States except US*): **MERIT MEDICAL SYSTEMS, INC.** [US/US]; 1600 West Merit Parkway, South Jordan, Utah 84095 (US).

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[Continued on next page]

(54) Title: RADIAL ARTERY COMPRESSION DEVICE

**FIG. 9B**

(57) Abstract: A radial artery compression device configured to be releasably secured by a strap or band to the underside of a wrist of a patient and to provide adjustable and consistent compression pressure in the area of a radial artery access site to achieve hemostasis either during or after a medical procedure such as a percutaneous coronary procedure. The radial artery compression device includes a body configured to engage and secure a knob while allowing the knob to rotate with respect to the body. Rotation of the knob can cause a threaded shaft to move. The threaded shaft mechanically couples the knob to a disk-shaped compression pad. The compression pad can include one or more notches adapted to at least partially surround a sheath and/or a catheter inserted into the radial artery at the access site.

WO 2009/151824 A1



OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, —
MR, NE, SN, TD, TG).

*before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))*

Published:

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

RADIAL ARTERY COMPRESSION DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present disclosure relates to a radial artery compression device. In more particular, the present disclosure relates to a radial artery compression device configured to provide an adjustable level of compression pressure on the radial artery to achieve hemostasis at, or in the area of, a vascular access site.

Relevant Technology

[0002] Medical advancements have resulted in the ability to diagnose and treat coronary artery disease using vascular delivery apparatus and techniques. One advantage of coronary procedures utilizing vascular delivery is that a practitioner can access a desired position within the patient's body without administering general anesthetic or requiring highly invasive surgery. During a typical procedure, a sheath having a haemostatic valve is utilized to access a peripheral artery utilizing the administration of a local anesthetic at the vascular access site. A pre-shaped catheter is then introduced into the patient's vasculature through the sheath. The catheter can then be advanced to the ostium of the relevant coronary artery or to another desired location within the patient. The catheter enables delivery of medical instruments, medicines or fluids such as radiography contrast medium, angioplasty wires, balloons, and stents. During or after completion of the procedure, the sheath and catheter are removed and hemostasis can be achieved by manual compression, suturing the access site, or by utilizing another direct repair procedure.

[0003] Often these percutaneous coronary diagnostic and interventional procedures are accomplished through the radial artery of a patient. Radial artery access has the potential advantages of reduced access site complications, rapid patient mobilization, and reduced costs. The relatively superficial position of the distal radial artery enables direct application of compression to the artery to achieve and maintain hemostasis during a procedure. Additionally the radial artery allows quick and direct closure at the catheter access site as soon as the arterial catheter has been removed at the end of the procedure.

[0004] As with any arterial puncture, achieving hemostasis during and/or after a procedure can be challenging. Typically the access site, or opening, in the artery is created utilizing a micropuncture apparatus, dilator or can even be formed utilizing a

single straight incision to form a slit in the artery. The pulsatile nature of arterial blood flow may present challenges to achieving hemostasis at the access site. As a result of this and other factors, during the course of the procedure, blood may leak through the access site and around the outside diameter of the sheath or catheter. Existing devices are not adapted to provide desired and/or adjustable compression to the radial artery at the vascular access site during the course of a procedure.

[0005] When the procedure has been completed, typically the catheter is removed and the practitioner or medical professional will apply pressure at the vascular access site to achieve hemostasis and effectuate closure of the vascular access site. One technique for achieving hemostasis is to apply pressure at, or at a point slightly upstream, of the vascular access site. Typically, continuous pressure is necessary to stop bleeding and achieve hemostasis at the access site. While the applied pressure should remain relatively constant, there are advantages to applying a higher level of compression pressure at the beginning of the compression period and then reducing the level of compression pressure after a determined amount of time has elapsed. By gradually reducing the compression pressurization during the compression period, while continually maintaining at least a threshold level of compression, blood can begin to flow through the artery at a reduced pressure, providing nutrient rich blood to the tissue downstream from the access site. Blood flowing through the artery can then hasten clotting to enable hemostasis without application of ongoing compression. Not only can this provide improved closure, but also can improve the relative comfort of the patient.

[0006] Compression is typically applied to an access site by a nurse or other practitioner by manually holding a dressing at the access site. Although employing a practitioner to provide compression permits the gradual reduction of pressurization at the access site, it can also be a costly use of practitioner time. Alternative existing radial artery compression techniques which do not require the ongoing manual application of pressure by the practitioner may employ tape or a compression bandage at the vascular access site. These devices and techniques, while allowing the practitioner to attend to other matters, can render it difficult or impractical to adjust the compression pressure while maintaining continuous pressure. As a result, the tape or compression bandages may end up being positioned around the access site without being loosened or adjusted until they are removed. Additionally, the

compression provided by such techniques can be poorly applied, insufficient to provide proper pressurization and/or may be poorly tailored for the exigencies of the particular procedure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Fig. 1 is a front perspective view of a radial artery compression device.

[0008] Fig. 2 is an partial exploded component view of a radial artery compression device.

[0009] Fig. 3 is a bottom view of a compression pad of the radial artery compression device of Fig. 1.

[0010] Fig. 4A is a cross-sectional side view of a radial artery compression device illustrating the compression pad in a fully retracted position.

[0011] Fig. 4B is a cross-sectional side view of a radial artery compression device illustrating the compression pad in an extended configuration.

[0012] Fig. 5 is a perspective view of a radial artery compression device positioned on the underside of a patient's wrist such that the device can provide compression to the radial artery.

[0013] Fig. 6 is a front perspective view of an alternative embodiment of a radial artery compression device.

[0014] Fig. 7 is a partial exploded component view of the radial artery compression device of Fig. 6.

[0015] Fig. 8 is a perspective view of an improved radial artery compression device according to one aspect of the present invention.

[0016] Fig. 9A is a perspective view a radial artery compression device of Fig. 8 illustrating use of the device on a patient.

[0017] Fig. 9B is a perspective view of a radial artery compression device illustrating the manner in which the radial artery compression device can secure a catheter within a patient's radial artery according to one aspect of the present invention.

[0018] Fig. 9C is a perspective view of a radial artery compression device of Fig. 8 illustrating retraction of a compression pad of the radial artery compression device.

[0019] Fig. 10 is an exploded view of a radial artery compression device of Fig. 8 according to one aspect of the present invention.

[0020] Fig. 11A is side view of a radial compression device of Fig. 8 illustrating the compression pad in an extended position according to one aspect of the present invention.

[0021] Fig. 11B is a side view of a radial compression device of Fig. 11A illustrating the compression pad in the retracted position according to one aspect of the present invention.

[0022] Fig. 12 is a bottom perspective view of a radial artery compression device of Fig. 8 illustrating the ratcheting mechanism of the radial artery compression device according to one aspect of the present invention.

[0023] Fig. 13A is a cross-sectional view of a radial artery compression device of Fig. 8 illustrating the compression pad in an extended position according to one aspect of the present invention.

[0024] Fig. 13B is a cross-sectional view of a radial artery compression device of Fig. 13A illustrating the compression pad in a retracted position according to one aspect of the present invention.

[0025] Fig. 14 is a cross-sectional view of a radial artery compression device illustrating the manner in which the compression pad secures the catheter within the radial artery of a patient according to one aspect of the present invention.

[0026] Fig. 15 is a top perspective view of a radial artery compression device according to one aspect of the present invention.

BRIEF SUMMARY OF THE INVENTION

[0027] The present invention relates to a radial artery compression device configured to be releasably secured by a strap or band to the underside of a wrist of a patient to provide continuous and adjustable compression in the area of a radial artery access site. The radial artery access site can be an opening formed utilizing a micropuncture apparatus, a dilator, an incision, or other percutaneous access device or procedure which allows insertion of a sheath and/or a catheter into the radial artery. The radial artery compression device can be configured to provide compression pressure in the area of the radial artery access site to achieve hemostasis. The radial artery compression device of the present invention is effective for achieving hemostasis at the access site during and after a medical procedure such as a vascular delivery procedure.

[0028] According to one embodiment of the present invention, the radial artery compression device is adapted to allow a user to provide varying degrees of pressurization against a patient's radial artery in order to maintain a desired degree of hemostasis at a percutaneous catheter access site. The radial artery compression device includes a rotatable member and a compression pad. The rotatable member allows a practitioner to actuate the compression pad to provide an increased or decreased amount of pressurization against a patient's radial artery.

[0029] According to one embodiment, the radial artery compression device includes a body configured to engage and secure a knob while allowing the knob to rotate with respect to the body of the radial artery compression device. As the knob is rotated, female threads of the knob engage a threaded shaft and cause the threaded shaft to move. The threaded shaft can be coupled to a compression pad formed of rigid material and shaped like a disk. As the shaft moves, the compression pad is either extended away from the body of the device or retracted toward the body of the device, depending on the direction the knob is rotated. According to another aspect of the present invention, the compression pad can include one or more notches adapted to at least partially surround a sheath and/or a catheter inserted into the radial artery at the access site. The compression pad can also include a step on the surface, or can otherwise be configured, to at least partially contour to a portion of a sheath and/or a catheter within the radial artery during a procedure. The radial artery compression device can further comprise a band coupled to the body and configured to secure the body to the underside of a wrist of a patient in the area of the radial artery.

[0030] According to another embodiment, the threaded shaft is coupled to the knob, and rotates as the knob is rotated. The shaft mates with threads on the compression pad. As the shaft rotates, the compression pad is either extended away from the body of the device or retracted toward the body of the device, depending on the direction the knob is rotated.

[0031] According to one aspect of the present invention, the radial artery compression device can be secured to a patient's wrist utilizing a strap, wrist band or other mechanism. Upon actuation of the rotatable member, the compression pad can be extended away from a body of the radial artery compression device. When the compression pad is extended away from the body of the radial artery

compression device an increased amount of pressurization is provided against the radial artery. In the event that a catheter is positioned within the radial artery, the configuration of the surface of the compression pad secures the wall of the radial artery against the outside diameter of the catheter positioned therein. In this manner, the radial artery compression device can maintain hemostasis of the radial artery relative to the catheter. In other words, a practitioner can actuate the radial artery compression device to secure a catheter within a patient's radial artery while providing a desired degree of hemostasis at the percutaneous access site. As a result, the radial artery compression device allows the practitioner to turn his/her attention to other aspects of the procedure being done.

[0032] Once the practitioner has substantially completed a procedure and is ready to remove the catheter from the patient's radial artery, the practitioner can easily retract the compression pad relative to the body of the radial artery compression device. Retraction of the compression pad relative to the body of the radial artery compression device removes the compression pressurization which helps to maintain the catheter within the patient's radial artery. As a result, the practitioner can remove the catheter from within the patient's radial artery.

[0033] The configuration of the radial artery compression device allows the practitioner to actuate the rotatable member utilizing a single hand, thus freeing the other hand of the practitioner to perform other aspects of a procedure. For example, the practitioner can hold a catheter within a percutaneous access site in the patient's wrist while actuating the rotatable member to extend the compression pad and secure the catheter within the patient's radial artery. Alternatively, the practitioner can slowly deactuate the rotatable member of the radial artery compression device in order to withdraw the compression pad relative to the body of the radial artery compression device and remove the catheter from the patient's wrist.

[0034] According to one aspect of the present invention, the radial artery compression device includes a threaded shaft which is secured to the rotatable member. The threaded shaft threadably engages the body of the radial artery compression device such that actuation of the threaded shaft results in a first amount of movement of the threaded shaft. A secondary shaft is provided in threaded communication with the threaded shaft which is secured to the rotatable member. In this manner, a compound threading action is provided upon rotation of the rotatable

member. In other words, when the rotatable member is rotated by the user, a first amount of axial displacement is provided by the threaded shaft. A second amount of axial displacement is provided in addition to the first amount of axial displacement by the secondary threaded shaft. In this manner, a desired degree of rotation of the rotatable member provides an increased amount of axial displacement of the compression pad relative to the body of the radial artery compression device.

[0035] According to another aspect of the present invention, a body of the radial artery compression device provides a structure upon which the other components of the radial artery compression device are secured. A rotatable member is provided on the upward facing portion of the body and the compression pad is located on the downward facing portion of the body of the radial artery compression device. The rotatable member includes a threaded shaft which is threaded through the body of the radial artery compression device. The body of the radial artery compression device includes a threaded aperture which threadably engages the threaded shaft of the rotatable member. In this manner, rotation of the rotatable member and the cooperative engagement of the thread shaft of the rotatable member and the threaded aperture of the body results in axial displacement of both the rotatable member and the threaded shaft. A secondary threaded shaft is provided in connection with the compression pad. As a result, when a user rotates the rotatable member, the threaded interaction between the threaded shaft of the rotatable member and the threaded shaft of the compression pad results in axial displacement of both the compression pad and the secondary threaded shaft relative to the rotatable member. As a result, a compounding effect is effectuated in which rotation of the rotatable member provides a greater amount of axial displacement than would be provided by cooperative engagement of the primary threaded shaft with the threaded aperture of the body of the radial artery compression device.

[0036] According to one aspect of the present invention, a threaded shaft is formed of rigid material and is disposed through the body of the radial artery compression device. The threaded shaft is positioned between the rotatable member and the compression pad of the radial artery compression device. The threaded shaft threadably engages the body allowing movement of the rotatable member relative to the body. A second shaft formed of rigid material is also provided. The second shaft is positioned between the rotatable member and the

compression pad. The second shaft threadably engages the first shaft such that the threaded engagement between the first shaft and the second shaft results in movement of the compression pad with respect to the body as the rotatable member is rotated relative to the body. As a result, rotation of the rotatable member in a first direction is configured to increase the amount of compression applied to the radial artery by the compression pad. The rotation of the rotatable member in a second direction is adapted to decrease the amount of compression applied to the radial artery by the compression pad.

[0037] According to one aspect of the present invention, the configuration of the rotatable member and compression pad is such that inadvertent rotational movement of the compression pad is prevented. For example, in one embodiment the first threaded shaft and the second threaded shaft engage one another such that the axial movement of the compression pad relative to the body of the radial artery compression device does not result in rotational movement of the compression pad. In another embodiment, body engagement posts are secured relative to the compression pad to minimize or prevent rotational movement of the compression pad relative to the body of the radial artery compression device.

[0038] Minimizing rotational movement of the compression pad can be desirable for a variety of reasons. For example, the compression pad can include a notch or step which is desired to be aligned with the radial artery or catheter. The compression pad can provide a desired curvature which conforms to the outside diameter of the catheter and/or the structure of the radial artery. By controlling rotational movement of the compression pad, the desired alignment of the features of the compression pad can be maintained without additional user attention or manipulation. Additionally, the first and second sides of the contact surface of the compression pad can be adapted to conform to the physiological features of a patient's wrist to provide a desired amount of contact between the compression pad and the patient's wrist when the desired rotational alignment of the compression pad is maintained. As a result, maintaining the rotational alignment of the compression pad of the radial artery compression device throughout the course of the procedure, despite rotation of the rotatable member during the procedure, can be important to maintain desired operability of the radial artery compression device.

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[0039] According to another aspect of the present invention, the radial artery compression device includes ratchet engagement members. The ratchet engagement members permit rotation of the rotatable member in a first direction without additional manipulation by the user. However, the ratchet engagement members prevent rotation of the rotatable member in a second direction without first releasing the ratchet engagement members relative to the rotatable member. For example, in one embodiment, the user is allowed to rotate the rotatable member in a clockwise direction to extend the compression pad and thus apply an increased degree of compression on the radial artery. However, the user is not allowed to rotate the rotatable member in a counter-clockwise direction to retract the compression pad and result in a lesser amount of compression being applied to the radial artery. As a result, inadvertent or undesired releasing of the pressurization provided by the compression pad relative to the patient's wrist, radial artery, or catheter is controlled, thus ensuring desired compression on the patient's wrist during the course of the procedure. When the user desires to lessen the amount of pressurization on the patient's radial artery or to remove a catheter from the patient's artery, the user first disengages the ratchet mechanism to allow rotation of the rotatable member in the second rotational direction.

[0040] According to one embodiment of the present invention, the ratchet mechanism is positioned on an interior diameter of the rotatable member. According to another embodiment of the present invention, the ratchet engagement or disengagement members are buttons positioned on one or both sides of the rotatable member which are depressed by the user to release the engagement of the ratchet. According to yet another embodiment, the ratchet engagement member includes one or more ramps which permit rotation of the rotatable member in a first position while preventing or minimizing rotation of the rotatable member in a second direction.

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[0040a] According to some aspects of the present invention, there is provided a radial artery compression device, the radial artery compression device adapted to allow a user to provide varying degrees of pressurization against a patient's radial artery to maintain a desired degree of hemostasis at a percutaneous access site, the radial artery compression device comprising: a knob configured to be grasped by a user and rotated; a body configured to engage the knob such that the knob can be rotated relative to the body; a compression pad comprising: a first contact surface; a second contact surface, wherein the elevation of the first contact surface is different from the elevation of the second contact surface; and a step on the surface of the compression pad to be positioned adjacent the wrist of the patient, the step configured to enable the compression pad to at least partially contour to a portion of a device within the radial artery during a medical procedure; wherein the step forms a curved contact surface disposed between the first contact surface and the second contact surface; a threaded shaft formed of rigid material and disposed through the body, the threaded shaft being positioned between the knob and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the knob is rotated relative to the body; a band to secure the body to the underside of a wrist of a patient in the area of the radial artery, such that the compression pad can be positioned adjacent the wrist of the patient wherein the user rotates the knob to selectively move the compression pad between a first position and at least a second position to provide varying degrees of pressurization to the wrist of a patient, wherein when the compression pad is in the first position, the compression pad is positioned adjacent the body and applies a lesser degree of pressurization against the wrist of the patient and when the compression pad is in the second position, the compression pad is positioned a given amount of displacement from the body and provides a greater amount of pressurization against the patient's wrist; one or more ratchet engagement members operably coupled to the knob, wherein the ratchet engagement members are configured to permit rotation of the knob in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the knob in a second direction; and a ratchet mechanism coupled with the

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knob, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the knob in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the knob in the second direction.

- 5 **[0040b]** According to some aspects of the present invention, there is provided use of a radial artery compression device for applying compression pressure at an access site of a radial artery of a patient, wherein the radial artery compression device comprises: a knob configured to be grasped by a user and rotated, a body configured to engage the knob such that the knob can be rotated relative to the body,
- 10 a compression pad comprising: a first contact surface; a second contact surface, wherein the elevation of the first contact surface is different from the elevation of the second contact surface; and a step on the surface of the compression pad to be positioned adjacent the wrist of the patient, the step configured to enable the compression pad to at least partially contour to a portion of a device within the radial
- 15 artery during a medical procedure; wherein the step forms a curved contact surface disposed between the first contact surface and the second contact surface, a threaded shaft formed of rigid material and disposed through the body and between the knob and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the knob is rotated relative to the body,
- 20 a band to secure the body to the underside of a wrist of the patient in the area of the radial artery, such that the compression pad is positioned adjacent the wrist of the patient, one or more ratchet engagement members operably coupled to the knob, wherein the ratchet engagement members are configured to permit rotation of the knob in a first direction without manipulation of the ratchet engagement members by
- 25 a user, and wherein the ratchet engagement members are configured to prevent rotation of the knob in a second direction, and a ratchet mechanism coupled with the knob, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the knob in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members
- 30 permits rotation of the knob in the second direction; wherein the radial artery

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compression device is for securing to a wrist of the patient, the compression pad of the radial artery compression device being positioned adjacent the access site of the radial artery of the patient; and wherein the knob of the radial artery compression device is for rotating relative to the body to increase compression pressure applied by
5 the compression pad at the access site.

[0040c] According to some aspects of the present invention, there is provided a radial artery compression device, comprising: means for rotating a plurality of threads, the rotating means configured to be grasped by a user and rotated; means for compressing a radial artery of a patient at an access site of the radial artery, the
10 compressing means configured to be displaced longitudinally along an axis of rotation of the rotating means as the rotating means is rotated to adjust the level of compression pressure applied to the radial artery of the patient; means for supporting the rotating means and the compressing means; means for securing the supporting means to the underside of a wrist of a patient in the area of the radial artery, such
15 that the compressing means is positioned adjacent the wrist of the patient; one or more ratchet engagement members operably coupled to the rotating means, wherein the ratchet engagement members are configured to permit rotation of the rotating means in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent
20 rotation of the rotating means in a second direction; and a ratchet mechanism coupled with the rotating means, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotating means in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the rotating means in the second
25 direction; wherein rotation of the rotating means causes a compounding effect in which rotation of the rotating means provides a greater amount of displacement between the compressing means and the supporting means than the displacement provided between the rotating means and the supporting means.

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[0040d] According to some aspects of the present invention, there is provided a radial artery compression device, the radial artery compression device adapted to allow a user to provide varying degrees of pressurization against a patient's radial artery to maintain a desired degree of hemostasis at a percutaneous access site, the radial artery compression device comprising: a body; a rotatable member positioned adjacent the body such that the rotatable member can be rotated relative to the body; a compression pad operably coupled to the rotatable member; a threaded shaft formed of rigid material and disposed through the body, the threaded shaft being positioned between the body and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the rotatable member is rotated relative to the body; a securement member adapted to secure the position of the body relative to the portion of a patient's wrist corresponding with the radial artery, such that rotation of the rotatable member in a first direction is adapted to increase the amount of compression applied to the radial artery by the compression pad, and rotation of the rotatable member in a second direction is adapted to decrease the amount of compression applied by the radial artery to the compression pad; a viewing window for allowing visualization of the access site, the viewing window positioned within a central void of the rotatable member; one or more ratchet engagement members operably coupled to the rotatable member, wherein the ratchet engagement members are configured to permit rotation of the rotatable member in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the rotatable member in a second direction; and a ratchet mechanism coupled with the rotatable member, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotatable member in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the rotatable member in the second direction.

[0040e] According to some aspects of the present invention, there is provided a radial artery compression device comprising: a body; a rotatable member positioned

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adjacent the body such that the rotatable member can be rotated relative to the body;
a compression pad; a threaded shaft formed of rigid material and disposed through
the body, the threaded shaft being positioned between the body and the compression
pad, the threaded shaft configured to move the compression pad with respect to the
5 body as the rotatable member is rotated relative to the body; one or more ratchet
engagement members operably coupled to the rotatable member, wherein the ratchet
engagement members are configured to permit rotation of the rotatable member in a
first direction without manipulation of the ratchet engagement members by a user,
and wherein the ratchet engagement members are configured to prevent rotation of
10 the rotatable member in a second direction; and a ratchet mechanism coupled with
the rotatable member, wherein engagement of the ratchet mechanism with the
ratchet engagement members prevents rotation of the rotatable member in the
second direction and wherein disengagement of the ratchet mechanism from the
ratchet engagement members permits rotation of the rotatable member in the second
15 direction.

[0040f] According to some aspects of the present invention, there is provided a
radial artery compression device, the radial artery compression device adapted to
allow a user to provide varying degrees of pressurization against a patient's radial
artery to maintain a desired degree of hemostasis at a percutaneous access site, the
20 radial artery compression device comprising: a body; a rotatable member positioned
adjacent the body such that the rotatable member can be rotated relative to the body;
a compression pad operably linked to the rotatable member; a first shaft being
positioned between the rotatable member and the compression pad, the first shaft
threadably engaging the body to move the rotatable member relative to the body; and
25 a second shaft being positioned between the rotatable member and the compression
pad, wherein engagement between the first shaft and the second shaft causes a
compounding of the amount of compression provided by the compression pad; one or
more ratchet engagement members operably coupled to the rotatable member,
wherein the ratchet engagement members are configured to permit rotation of the
30 rotatable member in a first direction without manipulation of the ratchet engagement

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members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the rotatable member in a second direction; and a ratchet mechanism coupled with the rotatable member, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotatable member in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the rotatable member in the second direction; wherein the rotation of the rotatable member results in axial movement of the compression pad towards or away from the body; wherein the rotation of the rotatable member results in axial movement of the compression pad towards or away from the body; and wherein the compounding of the amount of compression results in a greater amount of axial movement of the compression pad relative to the body pursuant to a predetermined amount of rotation of the rotatable member than the amount of axial movement of the rotatable member relative to the body pursuant to the predetermined amount of rotation of the rotatable member.

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DETAILED DESCRIPTION

[0041] Percutaneous coronary diagnostic and interventional procedures can be performed through a catheter introduced into the radial artery. A sheath with a hemostatic valve is inserted into an opening, or access site, into the radial artery. A pre-shaped catheter can then be passed through the sheath to the ostium of the relevant coronary artery or other position within the patient's body. The catheter

enables delivery of instruments and fluids such as contrast medium, angioplasty wires, balloons, and stents. During the procedure, maintaining hemostasis at the access site is desirable to reduce the patient's loss of blood, allow for desired performance during the procedure and limit risk of infection. After completion of the procedure, the sheath and catheter are removed and the flow of blood through the access site is stopped.

[0042] As with any arterial puncture, achieving hemostasis during and after a procedure can be challenging. During the procedure, blood may leak around the sheath or catheter through the opening. Typically the access site, or opening, in the artery is created utilizing a micropuncture device, a dilator, or a single straight incision to form a slit. The access site may not conform closely to the tubular-shaped sheath and catheter. Moreover, the arterial walls include a layer of smooth muscle cells that expand and contract in conjunction with the rhythm of the heart to complement the pumping of the heart and move blood throughout the body. The expanding and contracting of the radial artery can present challenges to achieving hemostasis at the access site during a procedure. Additionally, the nature of vascular catheter access can make it difficult to achieve hemostasis when the catheter is positioned within the radial artery. This is because the practitioner is providing pressurization on the radial artery when the catheter is positioned within the artery. After the procedure has been completed and the catheter has been removed, the size of the catheter access bore, and movement of the patient's arm and/or wrist may cause stretching and contraction of the tissue surrounding the access site and can prevent clotting and thereby delay hemostasis.

[0043] The present invention is directed to a radial artery compression device that can be releasably secured to the underside of a wrist of a patient and provide adjustable compression pressurization in the area of a radial artery access site. The radial artery compression device is configured to provide consistent and adjustable compression pressure in the area of the radial artery access site to achieve hemostasis. The radial artery compression device disclosed is adapted to achieve hemostasis at the access site both during and after the completion of a percutaneous coronary procedure.

[0044] According to one embodiment, the radial artery compression device includes a body configured to engage and secure a knob while allowing the knob to

rotate with respect to the body. As the knob is rotated, female threads of the knob engage a threaded shaft and cause the threaded shaft to move. The threaded shaft can be formed of rigid material and coupled to a compression pad. The compression pad can be formed of rigid or flexible material and shaped like a disk. The compression pad can be advanced such that the pad is extended away from the body of the device to provide additional compression. The compression pad can also be retracted toward the body of the device to provide a lesser amount of compression or to remove compression entirely.

[0045] According to another aspect of the present invention, the compression pad can include one or more notches positioned on the outer periphery of the compression pad. The notches can be adapted to at least partially conform to and/or at least partially surround a sheath and/or a catheter inserted into the radial artery at the access site. The compression pad can also include a step on the surface, or otherwise be configured, to at least partially conform to a portion of a sheath and/or a catheter within the radial artery during a procedure. The radial artery compression device can further comprise a band coupled to the body and configured to secure the body to the underside of a wrist of a patient in the area of the radial artery.

[0046] According to another embodiment, the threaded shaft is coupled to the knob, and rotates as the knob is rotated. The shaft mates with female threads on the compression pad. As the shaft rotates, the compression pad is either extended away from the body of the device or retracted toward the body of the device, depending on the direction the knob and shaft are rotated.

[0047] Fig. 1 is a perspective view of a radial artery compression device 2. Fig. 2 is an exploded view of radial artery compression device 2 of Fig. 1. Radial artery compression device 2 comprises a knob 4, a body 6, a compression pad 8, a threaded shaft 10, and a wrist strap 12. Radial artery compression device 2 is configured to be strapped to a wrist of a patient utilizing wrist strap 12. Radial artery compression device 2 is strapped to the wrist of the patient in a manner that positions body 6 on the underside of the patient's wrist with compression pad 8 positioned adjacent the patient's wrist. Threaded shaft 10 is disposed through body 6 to mechanically couple compression pad 8 and knob 4. As knob 4 is rotated, threads 5 (see Figures 4A and 4B) on an inside diameter of knob 4 engage threads 11 of threaded shaft 10 and cause threaded shaft 10 to move relative to body 6.

Compression pad 8 is coupled to threaded shaft 10 such that as threaded shaft 10 is rotated by interaction with knob 4, compression pad 8 is displaced relative to body 6. Depending on the rotational direction knob 4 is rotated, compression pad 8 moves further from body 6 or closer to body 6. In this manner, additional compression can be applied to or removed from a radial artery of a patient when radial artery compression device 2 is properly secured to the patient's wrist. Moreover, the compression pressurization can be increased or decreased as desired without removing radial artery compression device 2 from the wrist of the patient.

[0048] Body 6 can be configured to support knob 4, threaded shaft 10, compression pad 8, and wrist strap 12. Body 6 includes an opening 19 through which threaded shaft 10 can be disposed. Knob 4 is configured to engage threads at one end of threaded shaft 10 while threaded shaft 10 is disposed through opening 19. Knob 4 is positioned on the outward facing extent of body 6. The outward facing extent of body 6 is configured to face away from a wrist of a patient when radial artery compression device 2 is secured to the wrist of the patient. Compression pad 8 couples to the other end of threaded shaft 10 which is positioned on the opposing side of body 6 such that compression pad 8 is positioned adjacent to the wrist of the patient when radial artery compression device 2 is secured to the wrist of the patient.

[0049] Body 6 includes a recess 22 on the underside of body 6 to receive compression pad 8 when compression pad 8 is in a retracted position adjacent body 6. Body 6 can further comprise rings 24 to enable coupling of wrist strap 12 to body 6. In one illustrative embodiment, wrist strap 12 comprises a two-piece band, similar to a two-piece watch band. In one embodiment, radial artery compression device 2 is secured to the patient utilizing Velcro straps. To reduce potential discomfort to a patient, body 6 can also be configured to at least partially contour to the underside of a wrist of the patient so as to abut the patient's wrist in a comfortable and ergonomic manner.

[0050] In the illustrated embodiment, body 6 comprises an aperture 18 configured to secure knob 4 in a fixed position along the axis of rotation of knob 4. Aperture 18 receives and secures a collar 16 of knob 4 such that knob 4 can freely rotate with respect to body 6 about the axis of rotation of knob 4, while limiting displacement longitudinally along the axis of rotation. Due to the fact that body 6 secures knob 4 from longitudinal displacement along the axis of rotation, compression pad 8 and

threaded shaft 10 are displaced relative to body 6 along the axis of rotation of knob 4 as knob 4 rotates. In this manner the level of compression pressure can be adjustably increased or decreased by rotation of knob 4 when radial artery compression device 2 is secured to the wrist of a patient.

[0051] Knob 4 can include threads (see e.g. Figure 4A and 4B) configured to engage threaded shaft 10. As knob 4 rotates, the threads of knob 4 displace threaded shaft 10 longitudinally along the axis of rotation of knob 4. Knob 4 can further include a finger grip portion 14 which provides an ergonomic surface facilitating grasping and manipulation of knob 4 allowing a user to simply and efficiently rotate knob 4 relative to body 6. As previously discussed, knob 4 can further comprise a collar 16 which facilitates the rotation of knob 4 relative to body 6. Collar 16 can also be configured to be secured by body 6 to restrict unintended displacement of knob 4 relative to body 6. Body 6 is configured to engage at least a portion of knob 4 in a manner that allows knob 4 to freely rotate about the axis of rotation of threaded shaft 10 without being displaced longitudinally or otherwise being removed from body 6.

[0052] Figure 2 depicts an exploded view of radial artery compression device 2. In the illustrated embodiment, collar 16 of knob 4 and aperture 18 of body 6 are illustrated. Collar 16 can be received into a side opening of aperture 18 provided on the lateral extent of body 6. Body 6 is designed such that the upper surface of collar 16 is in contact with the downward facing surface of aperture 18. In this manner, in the event that upward forces are exerted on knob 6, interaction between the upper surface of collar 16 and downward facing surface of aperture 18 will retain the position of knob 4 relative to body 6. Additionally, in the event that downward forces are exerted on knob 6, the bottom surface of collar 16 is engaged by the upward facing surface of aperture 18. In this manner, the position of knob 4 relative to body 6 is maintained. Prior to the threads of knob 4 engaging threaded shaft 10, knob 4 may be movable in a lateral direction with respect to body 6. However, once the threads of knob 4 engage threaded shaft 10 lateral movement of knob 4 is restricted due to securement of threaded shaft 10 by body 6.

[0053] Threaded shaft 10 is disposed through opening 19 of body 6 providing a linkage between knob 4 and compression pad 8. Threaded shaft 10 can be formed of a rigid, semi-rigid, or flexible material, such as for example plastic, wood, metal or

other suitable materials. Threaded shaft 10 includes threads 11 on at least a portion of threaded shaft 10. Threads 11 provide cooperative engagement with threads on body 6 and/or knob 6 to enable longitudinal displacement of threaded shaft 10. Opening 19 is configured to secure threaded shaft 10, restricting movement of threaded shaft 10 in a lateral direction while allowing threaded shaft 10 to move longitudinally. As knob 4 is rotated, threaded shaft 10 can move longitudinally through body 6 to extend compression pad 8 away from body 6 or retract compression pad 8 closer to body 6. Longitudinal movement of threaded shaft 10 adjusts the pressure applied by compression pad 8 to the wrist and/or radial artery of a patient when radial artery compression device 2 is secured to the underside of a wrist of the patient.

[0054] Knob 4 is an example of means for rotating a plurality of threads. A compression pad is an example of means for compressing a radial artery of a patient. A compression pad coupled to a threaded shaft is another example of means for compressing a radial artery of a patient. A body is an example of a means for supporting a rotating means and a compressing means. A band is an example of means for securing a supporting means to a wrist of a patient. A notch in a compression pad is an example of means for at least partially surrounding a device inserted into a radial artery of a patient. A step on a surface of a compression pad configured to be positioned adjacent a wrist of a patient is an example of means for at least partially contouring to a device inserted into a radial artery of a patient.

[0055] Fig. 3 is a bottom perspective view of a compression pad 8 of the radial artery compression device 2 of Fig. 1. The surface of body 6 can be configured to partially contour to the underside of a wrist of a patient. The bottom view of Fig. 3 also depicts the surface of compression pad 8 configured to be positioned over, or in the area of, the radial artery on the underside of the wrist of the patient. In the illustrated embodiment, compression pad 8 is coupled to threaded shaft 10. Accordingly, longitudinal movement of threaded shaft 10 results in movement of compression pad 8 relative to body 6. Compression pad 8 includes a curved step 20, a first contact surface 21 and a second contact surface 23. First contact surface 21 has a first elevation and second contact surface 23 has a second elevation that is different from the elevation of first contact surface 23. Curved step 20 provides a transition from first contact surface 21 to second contact surface 23. In the

illustrated embodiment, curved step 20 has a radius that approximates the outer diameter of illustrative catheters and/or sheaths that can be positioned in the radial artery.

[0056] The profile of first contact surface 21, second contact surface 23 and curved step 20 provides a desired contact with the contours of a patient's wrist. The lower elevation of first contact surface 21 is adapted to conform to the generally raised profile of the center of a patient's wrist. The higher elevation of the second contact surface 23 is adapted to conform to the generally depressed or sloped shape of the portion of the patient's wrist positioned laterally to the radial artery. Curved step 20 enables compression pad 8 to at least partially contour to a portion of a sheath or catheter inserted into the radial artery of a patient. The ability to contour to a sheath or catheter inserted into the radial artery allows radial artery compression device 2 to be positioned such that compression pad 8 can apply compression pressure during a medical procedure. The juxtaposition of first contact surface 21, second contact surface 23 and curved step 20 not only conform to the physiological features of a patient's wrist, but also provide reliable and slip free engagement of the radial artery and surrounding tissues during potentially prolonged use of the device. Utilizing radial artery compression device 2 during a procedure to apply compression pressure can facilitate safe and reliable hemostasis at the access site of the radial artery.

[0057] In the illustrated embodiment compression pad 8 is substantially disc-shaped. Compression pad 8 can further comprise a notch 26 formed in the outer perimeter of the compression pad 8. Notch 26 is configured to at least partially contour to a sheath or catheter inserted into the radial artery at an access site. By contouring to an inserted sheath or catheter, notch 26 facilitates application of pressure at an access site during a medical procedure. Compression pad 8 can be positioned upstream to the access site and notch 26 can be positioned to partially surround an inserted sheath or catheter to enable application of compression pressure and thereby facilitate hemostasis at the access site.

[0058] Fig. 4A is a cross-sectional side view of radial artery compression device 2 depicting a configuration in which compression pad 8 is fully retracted toward body 6. In the illustrated embodiment of Fig. 4A, a practitioner rotates knob 4 in a clockwise direction, as indicated by directional arrow 4A-4A, to retract compression pad 8 and

threaded shaft 10 toward body 6. When fully retracted, compression pad 8 is received into recess 22 of body 6. In the fully retracted position shown in Fig. 4A, compression pad 8 can be completely contained within recess 22, and thus minimize compression pressure to an access site. Accordingly, a practitioner may opt to secure radial artery compression device 2 to the wrist of a patient while compression pad 8 is in the fully retracted position so that initially no compression pressure is applied to the access site.

[0059] Fig. 4B is a cross-sectional side view of radial artery compression device 2 in which compression pad 8 is extended away from body 6. In the illustrated embodiment, knob 4 is rotated in a counterclockwise direction, illustrated by directional arrow 4B-4B, to move the threaded shaft 10 and compression pad 8 away from body 6. When radial artery compression device 2 is secured to the underside of a wrist of a patient, counterclockwise rotation of knob 4 moves compression pad 8 toward the wrist of the patient and provides the ability to apply incrementally increasing amounts of pressure at the radial artery compression site. When radial artery compression device 2 is properly positioned over the radial artery, the compression pressure is applied to the radial artery. Knob 4 can continue to be rotated in a counterclockwise direction to increase the amount of compression pressurization around the access site to achieve a desired level of hemostasis. Similarly knob 4 can be rotated clockwise to decrease the amount of compression pressurization. In this manner, a practitioner can adjust the amount of pressure to achieve a desired level of hemostasis at the access site while maintaining relative comfort of the patient.

[0060] Fig. 5 is a perspective view of a radial artery compression device 2 positioned on the underside of a patient's wrist over the radial artery. Wrist strap 12 secures body 6 to the wrist of the patient. Compression pad 8 of radial artery compression device 2 is positioned in the area of the radial artery of the patient, which is on the underside of the patient's wrist slightly off center toward the thumb side of wrist. In the illustrated embodiment, a catheter 30 is inserted into the radial artery at an access site 32. Compression pad 8 is positioned over the radial artery in the area of access site 32. Notch 26 of compression pad 8 can be positioned adjacent to and partially surrounding catheter 30. In this manner, compression can be applied in the area of access site 32 during the medical procedure to facilitate

hemostasis at access site 32. A practitioner can rotate knob 4 counterclockwise to increase the level of pressure to achieve hemostasis. The practitioner can also rotate knob 4 in a clockwise direction to decrease compression pressurization as needed to maintain relative comfort of the patient.

[0061] After the medical procedure is complete, radial artery compression device 2 enables a practitioner to remove catheter 30 from the radial artery of the patient without removing radial artery compression device 2 from the wrist of the patient. The practitioner can rotate knob 4 to a desired clockwise displacement to sufficiently reduce compression pressurization to allow removal of catheter 30 from access site 32. After catheter 30 is completely withdrawn from access site 32, radial artery compression device 2 remains advantageously positioned to allow quick and efficient application of compression to access site 32. The practitioner can quickly rotate knob 4 to increase compression pressure applied by compression pad 8 and quickly achieve a desired level of hemostasis. Because radial artery compression device 2 enables rapid application of compression, blood loss of the patient is reduced, risks of transfer of blood-borne diseases is reduced, and closure of the access site can begin immediately. Additionally, the practitioner can apply continued pressurization in a hands free manner allowing the practitioner to attend to other aspects of the procedure until an adjustment of pressurization is to be effectuated. In this manner, radial artery compression device 2 can be utilized both during and after a medical procedure to apply compression pressure to achieve hemostasis.

[0062] A similar process can be utilized to remove a sheath from the radial artery after a catheter has been properly inserted. Traditionally, a sheath is first inserted into the radial artery at the access site and then a catheter is inserted through the sheath to perform the percutaneous diagnostic or interventional medical procedure. The practitioner can use radial artery compression device 2 to achieve hemostasis once the sheath is inserted. The catheter can then be inserted through the sheath. In some instances the sheath is removed after the catheter is inserted. Radial artery compression device 2 allows the practitioner to briefly reduce compression pressure at the access site to allow the sheath to be removed. After the sheath is removed, the practitioner can rapidly increase compression pressure using radial artery compression device 2. By enabling rapid increase of compression pressure, radial artery compression device 2 allows the practitioner to quickly halt blood flow around

the catheter and through the access site to thereby achieve hemostasis at the access site.

[0063] Fig. 6 is a front perspective view of another embodiment of a radial artery compression device 52. The illustrated embodiment, radial artery compression device 52 comprises a knob 54, a body 56, a compression pad 58, a threaded shaft 60 (see Figure 7), and a wrist strap 62. In the illustrated embodiment, body 56 includes a retainment bracket 68, as discussed in greater detail below. Wrist strap 62 can secure radial artery compression device 52 to a wrist of a patient in a manner that positions body 56 on the underside of the wrist of the patient. The threaded shaft 60 is disposed through body 56 to mechanically couple compression pad 58 and knob 54. Threaded shaft 60 (see Figure 7) can be integrated with knob 54, such that as knob 54 is rotated cooperative engagement with threads associated with compression pad 58 cause compression pad 58 to move relative to body 56. Depending on the direction knob 54 is rotated, compression pad 58 will extend away from body 56 or retract towards body 56. In this manner, compression pressure can be applied to the radial artery of a patient when radial artery compression device 52 is properly secured to and positioned on the patient's wrist. Moreover, the compression pressure can be increased or decreased as desired without removing radial artery compression device 52 from the wrist of the patient.

[0064] Fig. 7 is an exploded view of the radial artery compression device 52 of Fig. 6. In the illustrated embodiment, threaded shaft 60 can be coupled to knob 54, as depicted in Fig. 7. As knob 54 is rotated with respect to body 56, threaded shaft 60 is also rotated. Compression pad 58 includes a threaded opening 78. Threads 80 of threaded opening are configured to engage threads 61 of threaded shaft 60. As threaded shaft 60 is rotated, threads 61 of threaded shaft 60 engage the threads of threaded opening 78 and thereby bias compression pad 58 in a longitudinal direction along the axis of rotation of threaded shaft 60. In the illustrated embodiment, as knob 54 and threaded shaft 60 are rotated clockwise, compression pad 58 is retracted toward body 56. As knob 54 and threaded shaft 60 are rotated counterclockwise compression pad 58 is extended away from body 56.

[0065] The exploded view of Fig. 7 also depicts retainment bracket 68 of body 56. Retainment bracket 68 is configured to receive and secure at least a portion of knob 54 while allowing knob 54 to rotate with respect to body 56. Retainment bracket 68

is configured to engage a collar 66 of knob 54. Retainment bracket 68 pivots to allow threaded shaft 60 to be inserted through opening 67 of body 56. The positioning of threaded shaft 60 through opening 67 allows retainment bracket 68 to bias back into position such that retainment bracket 68 engages collar 66 of knob 54. Retainment bracket 68 pivots to engage collar 66 thus securing knob 54 in a fixed position relative to body 56 along the axis of rotation of knob 54. Knob 54 is free to rotate with respect to body 6 about the axis of rotation, while minimizing unintentional displacement longitudinally along the axis of rotation that would cause unintentional releasing of knob 54.

[0066] Body 56 includes a recess 72. Recess 72 is configured to receive compression pad 58 when compression pad 58 is fully retracted relative to body 56. Body 56 can be configured to contour to at least a portion of the underside of a wrist of a patient. Threaded shaft 60 is configured to be disposed through an opening 67 disposed through the middle of body 56. Threaded shaft 60 extends from knob 54 at its proximal extent distally through opening 67 of body 56. In the illustrated embodiment, the length of threaded shaft 60 is designed such that the proximal tip of threaded shaft 60 does not extend beyond the distal extent of recess 72. As a result, little or no contact is adapted to occur between compression pad 58 and a wrist of a patient when compression pad 58 is at its proximal most extent. Because threaded shaft 60 is integrally coupled to knob 54, threaded shaft 60 does not move longitudinally relative to body 56 as knob 54 is rotated. Rather, threaded shaft 60 causes compression pad 58 to move relative to body 56 as threaded shaft 60 is rotated. Threaded opening 78 of compression pad 58 is configured to enable compression pad 58 to extend beyond recess 72 permitting the application of pressure to the patient's wrist when radial artery compression device 52 is properly secured to and positioned on the wrist of a patient.

[0067] Compression pad 58 can further comprise a step 70 on the surface of compression pad 58 that is configured to be positioned proximal to a wrist of a patient. Step 70 enables compression pad 58 to at least partially contour to a portion of a sheath or catheter inserted into an access site of a radial artery of a patient and thereby enable application of compression pressure during a medical procedure to facilitate hemostasis at the access site. In the illustrated embodiment, compression pad 58 can further comprise two notches 76a and 76b positioned on opposing sides

of compression pad 58. Notches 76a and 76b are configured to at least partially surround the access site of a catheter inserted into the radial artery. The configuration of notches 76 on opposing sides of compression pad 58 allows compression pad 58 to be rotated one half of a rotation to reposition step 70 relative to body 56. A half rotation may allow compression pad 58 to be repositioned with respect to the portion of the sheath or catheter inserted into the radial artery. As a result in the event that a practitioner is unable to achieve hemostasis when compression pad 58 is in a first rotational position, the practitioner can quickly reorient compression pad 58 relative to the catheter and radial artery of the patient and apply compression pressure in an attempt to achieve hemostasis. Moreover, with notches 76 positioned on opposing sides of compression pad 58, radial artery compression device 52 can easily be adapted to apply compression pressure on either the left wrist or the right wrist of a patient by simply rotating compression pad 58 to achieve a desired positioning of step 70.

[0068] A knob coupled to a threaded shaft, as depicted in Fig. 7, is an example of means for rotating a plurality of threads. A compression pad as depicted in Fig. 7 is an example of means for compressing a radial artery of a patient. A body with a retainment bracket is an example of means for supporting a rotating means and a compressing means.

[0069] Fig. 8 is a perspective view of a radial artery compression device 110 according to one embodiment of the present invention. Radial artery compression device 110 is adapted to allow a user to provide varying degrees of pressurization against a patient's radial artery or other position in a patient's vasculature to maintain a desired degree of hemostasis at a percutaneous access site. In the illustrated embodiment, radial artery compression device 110 comprises a rotatable member 112, a body 120, wrist straps securement members 124a, b, a compression pad 130, and a threaded shaft 150.

[0070] Body 120 is adapted to provide a framework upon which the other components of the radial artery compression device 110 can be positioned. In the illustrated embodiment rotatable member 112 and compression pad 130 are positioned on alternative sides of body 120. Compression pad 130 is positioned on the underside of body 120 such as to be positioned adjacent a patient's skin or other desired target of a pressurization procedure. Rotatable member 112 is positioned on

the upper side of body 120. The positioning of rotatable member 112 relative to body 120 allows a practitioner to rotate rotatable member 112 in a desired manner so as to allow for proper actuation of radial artery compression device 110.

[0071] In the illustrated embodiment, rotatable member 112 is adapted to allow a practitioner to actuate or deactuate radial artery compression device 110. Additionally, rotatable member 112 allows a practitioner to incrementally increase or decrease the amount of pressurization provided by compression pad 130 throughout the course of a procedure. Rotatable member 112 comprises a handle member 114, a sidewall 116, a central void 117, an upper face 118, and indicia 119a-d. In the illustrated embodiment, a handle member 114 is provided to allow a user to grasp rotatable member 112 and to rotate rotatable member 112 in a desired manner. Handle member 114 has an arcuate S-curve type shape which provides an ergonomic and desired grip. The shape of handle member 114 allows a user to place a thumb and index finger on alternative sides of handle member 114 to twist rotatable member 112 in either a clockwise or counter-clockwise rotational direction. In this manner, an ergonomic and easy to grasp configuration is provided by handle member 114.

[0072] Central void 117 forms a circular recessed region in the center of rotatable member 112. Central void 117 is intersected by the arcuate configuration of handle member 114. In other words, handle member 114 extends from one lateral side of central void 117 to the opposing lateral side of central void 117. In this manner, a recess is provided relative to upper face 118 of rotatable member 112. Handle member 114 can extend from an elevation which extends above upper face 118 to a position within central void 117 which extends below upper face 118. The resultant hemispherical type voids on either lateral side of handle member 114 created by the juxtaposition of central void 117 and handle member 114 can receive the finger or thumb to grasp handle member 114 and cause rotation of rotatable member 112.

[0073] Upper face 118 in sidewall 116 forms the outer periphery of rotatable member 112. Sidewall 116 extends a determined amount in an upward direction such that a user can grasp the outer facing surface of sidewall 116 and rotate rotatable member 112. Additionally, sidewall 116 provides a thickness or overall elevational dimension to the body of rotatable member 112. Upper face 118 is positioned so as to face away from the body 120 of radial artery compression device

110. Upper face 118 includes a plurality of indicia 119a-d which provide the user an indicator of the rotational position of rotatable member 112. This allows a user to ascertain and perceive not only the current rotational position of rotatable member 112 but to ascertain the current rotational position relative to other rotational positions of rotatable member 112.

[0074] In the illustrated embodiment, the configuration of rotatable member 112 is such that a single rotation of rotatable member 112 causes extension of compression pad 130 through a range of at least half of the total possible axial movement of compression pad 130. As a result, when the user rotates rotatable member 112, a single rotation of rotatable member 112 will cause a substantial amount of movement of compression pad 130. Similarly, a single full rotation of rotatable member 112 results in a substantial pressurization increase by compression pad 130 on the radial artery or other physiological feature of a patient. As a result, when a first indicia is moved from one rotational position to a second rotational position, a user can ascertain the approximate amount of extension of compression pad 130 relative to body 120.

[0075] In the illustrated embodiment indicia 119a is a numeric indicia "1", indicia 119b is a numeric indicia "2", indicia 119c is a numeric indicia "3" (see Fig. 9B), and indicia 119d is a numeric indicia "4". In the illustrated embodiment indicia 119a is adjacent to a ratchet engagement member 126a and indicia 119d is adjacent to a ratchet engagement member 126b. When rotatable member 112 is rotated such that indicia 119a is positioned adjacent to ratchet engagement member 126b instead of being positioned adjacent to ratchet engagement member 126a, a practitioner can perceive that compression pad 130 has been extended a predetermined amount and a desired amount of pressurization is provided against a patient's wrist or other physiological feature. According to one embodiment of the present invention, a single rotation of rotatable member 112 results in a complete and full extension of compression pad 130 relative to body 120. In other words, a single rotation of rotatable member 112 moves compression pad 130 from a position in which compression pad 130 is fully retracted to a position of in which compression pad 130 is fully extended.

[0076] Wrist strap securement members 124a, b are integrally coupled to body 120 of radial artery compression device 110. Wrist strap securement members

124a, b are positioned on opposing lateral sides of body 120. Wrist strap securement members 124a, b include a loop or central bore which permits the threading of a strap, or other securement member which can be placed around a patient's wrist to secure radial artery compression device 110 relative to the wrist or other physiological feature of a patient.

[0077] Ratchet engagement members 126a, b are also positioned on opposing sides of body 120. Ratchet engagement members 126a, b project from the underside of rotatable member 112 and extend in an upward direction adjacent the sidewall 116 of rotatable member 112. Ratchet engagement members 126a, b are adapted to be grasped by the user and pushed inward in the direction of one another. Actuation of ratchet engagement members 126a, b disengages a ratchet mechanism associated with rotatable member 112 allowing rotation of rotatable member 112 in both a first direction and a second direction. In one embodiment, a user releases rotatable member 112 by biasing ratchet engagement member 126a toward ratchet engagement member 126b and by biasing ratchet engagement member 126b in the direction of ratchet engagement member 126a. Biasing ratchet engagement members 126a, b in the direction of one another effectively reduces the spatial distance between ratchet engagement member 126a and ratchet engagement member 126b. In this manner, an internal ratchet component which engages a component of rotatable member 112 is released allowing movement of rotatable member 112 in one or both of a clockwise and counter-clockwise direction.

[0078] According to one aspect of the present invention, the practitioner is allowed to rotate rotatable member 112 in a first rotational direction to extend compression pad 130 without actuating ratchet engagement members 126a, b. The ratchet mechanism associated with radial artery compression device 110 prevents rotation of rotatable member 112 in a second direction effectively securing compression pad 130 in a desired extended position. In this manner, during the course of a procedure a desired amount of compression can be consistently provided by radial artery compression device 110 without requiring the ongoing attention of the practitioner. Additionally, the practitioner can simply and quickly change the amount of compression provided by the radial artery compression device 110 by simple actuation of rotatable member 112.

[0079] In the event the practitioner desires to retract compression pad 130 relative to body 120 or otherwise lessen the amount of compression provided by radial artery compression device 110 relative to the patient, the user simply compresses ratchet engagement members 126a, b relative to one another. When ratchet engagement members 126a, b are compressed, the engagement of rotatable member 112 is released and rotation of rotatable member 112 in a reverse direction is permitted. Rotation of rotatable member 112 in a reverse direction allows retraction of compression pad 130 relative to body 120.

[0080] In the illustrated embodiment, a threaded shaft 150 is depicted. Threaded shaft 150 is actuated by rotation of rotatable member 112. When a user rotates rotatable member 112, threaded shaft 150 engages threaded members or other components of radial artery compression device 110 causing axial movement of compression pad 130 relative to body 120. For example, when rotatable member 112 is rotated in a first direction, the threaded shaft can engage a threaded member of body 120 resulting in extension of compression pad 130 relative to body 120. In other words, when rotatable member 112 is rotated in a first direction, compression pad 130 moves away from body 120. When rotatable member 112 is rotated in a second direction, the cooperative engagement of threaded shaft 150 with the threaded component of body 120 results in retraction of compression pad 130 relative to body 120. In other words, the distance between compression pad 130 and body 120 is decreased when rotatable member 112 is rotated in a second direction.

[0081] Compression pad 130 includes a first portion 132, a second portion 134, a notch 136, and a step 138. First portion 132 is positioned on one lateral side of step 138. Second portion 134 is position on the opposing side of compression pad 130. Notch 136 provides a cutout in the otherwise circular radius of compression pad 130. Notch 136 provides a pie shaped or angular cutout which is wider at the radius of compression pad 130 and gradually narrows to a point as the notch approaches the middle of compression pad 130. The configuration of notch 136 is such that the point of notch 136 is aligned with step 138. Step 138 runs from one lateral side of compression pad 130 to the opposing lateral side of compression pad 130.

[0082] In the illustrated embodiment, compression pad 130 includes a first portion 132 and a second portion 134. First portion 132 has a different elevation than

second portion 134. For example, in the illustrated embodiment first portion 132 has a higher elevation such that the sidewall of compression pad 130 associated with first portion 132 has a minimal height. In contrast, second portion 134 has a lower elevation such that the sidewall of compression pad 130 associated with second portion 134 has a greater height than the sidewall of compression pad associated with first portion 132. Additionally, the distance between the contact surface of second portion 134 is further away from the upper surface of compression pad 130 than that of first portion 132.

[0083] The different elevational positions of first portion 132 and second portion 134 is adapted to conform to the physiological features on the underside of a patient's wrist. For example, the outside of a patient's wrist is somewhat depressed from the more central portion of a patient's wrist. As a result, the different elevational surfaces of compression pad 130 provided by first portion 132 and section portion 134 provide a better overall contact with the portions of the patient's wrist on either side of the patient's radial artery.

[0084] Step 138 provides a transition from first portion 132 to second portion 134. According to one embodiment of the present invention, step 138 has a curvilinear, arcuate, or radial dimension which can more closely approximate the outside diameter of a catheter which may be positioned within a patient's radial artery. Notch 136 provides desired compression around a percutaneous catheter access point such that the catheter is maintained in desired hemostasis within the patient's radial artery.

[0085] Fig. 9A is a perspective of radial artery compression device 110 of Fig. 8 according to one embodiment of the present invention. In the illustrated embodiment, radial artery compression device 110 has been secured to a patient's wrist 141. A wrist strap 142 circumscribes a patient's wrist 141 and is secured to wrist strap securement members 124a, b. Additionally, radial artery compression device 110 is secured to the underside of patient's wrist 142. Radial artery compression device 110 is positioned such that compression pad 130 is adapted to be in contact with a lateral side of patient's wrist 141. Radial artery compression device 110 is positioned on the lateral side of patient's wrist 141 adjacent patient's thumb 146. This is due to the fact that the radial artery is positioned laterally within

the patient's wrist on the same lateral side of the patient's wrist 141 as the patient's thumb 146.

[0086] In the illustrated embodiment, compression pad 130 is positioned such that it is in a retracted position relative to body 120. As a result, a minimal amount of compression is provided on the patient's wrist. A catheter 140 is positioned within the patient's radial artery. Compression pad 130 is positioned over catheter 140 such that notch 136 accommodates the portion of catheter 140 extending from patient's wrist 141. The juxtaposition of compression 130 relative to catheter 140 provides a desired amount of compression at the radial artery access site in which catheter 140 is entering the patient's radial artery. As will be appreciated by those skilled in the art, catheter 140 will typically be threaded from the thumb side of the patient's wrist and extend upward into the patient's arm. Additionally, notch 136 will be positioned on the hand side of the radial artery compression device 110. In the illustrated embodiment, a practitioner is holding catheter 140 to maintain the position of catheter 140 within the patient's radial artery prior to full actuation of radial artery compression device 110. In other words, in the illustrated embodiment radial artery compression device 110 has been secured to the patient's wrist, however rotatable member 112 has not yet been fully actuated. While radial artery compression device 110 has been secured to the patient's wrist, compression pad 130 has not been extended to a position to secure catheter 140 within the patient's radial artery. Once the radial artery compression device 110 has been secured to the patient's wrist 141 utilizing wrist strap 142, the practitioner can actuate rotatable member 112. Actuation of rotatable member 112 allows the practitioner to effectuate desired axial movement of compression pad 130 so as to cause desired compression of catheter 140 within the patient's radial artery.

[0087] The configuration of radial artery compression device 110 allows a practitioner to actuate rotatable member 112 utilizing a single hand. As a result, the practitioner can hold catheter 140 in one hand to maintain the desired position of the catheter 140 within the patient's radial artery while simultaneously actuating rotatable member 112 with the practitioner's other hand. As a result, radial artery compression device 110 allows for a single handed actuation and securement of a catheter within a patient's vasculature while permitting desired and often advantageous use of the practitioner's other hand in other aspects of the procedure.

[0088] Fig. 9B is a perspective view of the radial artery compression device 110 of Fig. 9A. In the illustrated embodiment, rotational arrows 9b-9b are illustrated. Rotational arrows 9b-9b are indicative of a clockwise rotational direction of rotatable member 112. Rotation of rotatable member 112 in the clockwise rotational position as indicated by rotational arrow 9b-9b causes extension of compression pad 130 from within recess 122 of body 120. Recess 122 is adapted to accommodate compression pad 130 when compression pad 130 is in a fully retracted position.

[0089] Catheter 140 is positioned within a percutaneous access site allowing the threading of catheter 140 into the patient's radial artery. As previously discussed, catheter 140 will typically be threaded into the patient's artery from the hand side of the wrist and extend in the direction of the elbow of the patient. Once a practitioner has threaded catheter 140 to a desired position within the patient's radial artery, the practitioner can grasp a handle member 114 or other portion of rotatable member 112 and rotate rotatable member 112 in a clockwise rotational direction. As the practitioner rotates rotatable member 112 in a clockwise rotational direction, threads of threaded shaft 150 cooperatively engage other components of radial artery compression device 110 resulting in axial movement of compression pad 130. As the practitioner continues to rotate rotatable member 112, compression pad 130 moves from within recess 122 of body 120 such that the distance between compression pad 130 and body 120 begins to increase. As a result, compression pad 130 begins to exert increasing pressure on the patient's wrist 141. The portion of catheter 140 positioned within the patient's wrist is contacted by step 138 (see Fig. 8) on the underside of compression pad 130. In particular, due to the threading of catheter 140 beneath compression pad 130, pressure begins to be exerted on both the radial artery and in particular on the portion of the radial artery in which catheter 140 is positioned. In this manner, when a desired degree of compression is provided by compression pad 130, the configuration of compression pad 130 effectively seals catheter 140 within the radial artery of the patient. Additionally, the flow of blood from the percutaneous access site is stopped. As a result, radial artery compression device 110 provides a consistent and desired degree of compression on the percutaneous access site in the patient's wrist without requiring ongoing attention or manual compression by the practitioner. In other words, once the practitioner has fully actuated rotatable member 112, compression

pad 130 will hold catheter 140 in place within the patient's vasculature while also minimizing or preventing bleeding at the catheter access site. This allows the practitioner to turn her/his attention to other aspects of the procedure to be performed.

[0090] In the illustrated embodiment, ratchet engagement members 126a, b, have not been depressed. As a result, rotational movement in a counter-clockwise direction, or a direction opposite to the rotational arrows 9b-9b is prevented. As a result, inadvertent releasing of the pressure provided by compression pad 130 is prevented. In the illustrated embodiment, the cooperative interaction between threaded shaft 150, body 120, and rotatable member 112 results in little or no rotational movement of compression pad 130 pursuant to rotation of rotatable member 112. In other words, as the user rotates rotatable member 112, the rotational position of notch 136 remains unchanged. As a result, a user can align notch 136 with catheter 140 and step 138 (see Fig. 8) along the patient's radial artery. Once the components of compression pad 130 are properly aligned, the practitioner can actuate rotatable member 112 without the risk that compression pad 130, and in particular notch 136 and step 138 (see Fig. 8), will remain in their correct rotational orientation relative to catheter 140 as the practitioner rotates rotatable member 112. For example, a user may position a notch of compression pad 130 over catheter 140. Additionally, step 138 (see Fig. 8) of compression pad 130 may be aligned over the portion of the radial artery in which catheter 140 extends. As the user rotates rotatable member 112, the positioning of notch 136 relative to the other components of radial artery compression device 110 remain unchanged.

[0091] In the illustrated embodiment, notch 136 is positioned at a rotational position which is approximately half way between ratchet engagement members 126a, b. Additionally, notch 136 is positioned approximately half way between wrist strap securement members 124a, b. As the user begins to rotate rotatable member 112, the rotational position of notch 136 remains unchanged relative to the components of body 120. As a result, during rotation of rotatable member 112, notch 136 remains positioned approximately half way between ratchet members 126a, b and wrist strap securement members 124a, b. This facilitates desired alignment and operation of the components of radial artery compression device 110 throughout the course of the compression procedure.

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[0092] As will be appreciated by those skilled in the art, a variety of types and components of radial artery compression devices can be provided without departing from the scope of the present invention. For example, according to one embodiment of the present invention, a rotatable member which rotates in a counter-clockwise direction to actuate the compression pad is utilized. According to another embodiment of the present invention, a handle component, knob, or other actuation member having a configuration which is different than the rotatable member is utilized. According to another embodiment of the present invention, the compression pad is actuated utilizing a motion other than rotation. According to another embodiment of the present invention, actuation or reverse actuation of the rotatable member requires disengagement of a ratchet engagement member or other rotational securement component. In yet another embodiment, a compression pad has a contact surface or configuration that is different from that depicted in Figs. 8-9B. For example, according to one embodiment of the present invention, the compression pad may have a soft or pliable component. In another embodiment, the compression pad may not include a notch portion. In yet another embodiment, the contact surface of the compression pad may have a somewhat flat or curved configuration rather than having first and second elevational components.

[0093] Fig. 9C is a perspective view of the radial artery compression device of Fig. 9A. In the illustrated embodiment, the practitioner is grasping ratchet engagement members 126a, b (see also Fig. 9B) by urging ratchet engagement members 126a, b (see also Fig. 9B) toward one another. In this manner, an internal ratchet member which prevents counter-clockwise rotational movement of rotatable member 112 is released. Once the ratchet engagement members 126a, b (see also Fig. 9B) are compressed, the practitioner can rotate rotatable member 112 in a counter-clockwise direction indicated by directional arrows 9c-9c. As the practitioner rotates rotatable member 112 in a counter-clockwise direction, compression pad 130 is retracted back in the direction of body 120. In other words, as rotatable member 112 is rotated in the counter-clockwise direction indicated by rotational arrows 9c-9c, the distance between body 120 and compression pad 130 lessens until compression pad 130 is fully retracted into a recess of body 120.

[0094] As the amount of force provided by compression pad 130 decreases, the securement of catheter 140 within the patient's wrist is lessened. Once the

compression provided by compression pad 130 is diminished to a desired extent, a practitioner can grasp catheter 140 and withdraw catheter 140 from within the patient's radial artery. In the illustrated embodiment, catheter 140 is depicted as having been withdrawn from access site 152 and from the patient's vasculature. Once the catheter tip 149 has been withdrawn from the patient's body, the practitioner can once again rotate rotatable member 112 in a clockwise direction and increase the pressurization provided by compression pad 130 on the access site 152. This provides a desired degree of hemostasis until the access site closes and heals sufficiently to prevent further bleeding of the access site subsequent to the procedure. As a result, radial artery compression device 110 can provide supplemental pressure at the catheter access point after the procedure has been completed rather than requiring a nurse, doctor, or patient from applying pressure until bleeding at the catheter access site has diminished or stopped. Additionally, the amount of pressure can be adjusted. For example, initially a greater amount of compression pressure can be provided. After an amount of time, the pressure provided by the radial artery compression device can be lessened.

[0095] Fig. 10 is a perspective exploded view of radial artery compression device 110 according to one embodiment of the present invention. In the illustrated embodiment, the threaded components of radial artery compression device 110 are depicted. Threaded shaft 150 is integrally coupled to compression pad 130. A rotatable member post 154 having threads 158 on the outside surface 156 of rotatable member post 154 is depicted. Rotatable member post 154 is integrally coupled to rotatable member 112. Additionally, a center aperture 164 of body 120 is depicted. Center aperture 164 also includes a plurality of threads 166. Center aperture 164 is adapted to engage threads 158 on the outside surface 156 of rotatable member post 154.

[0096] As a practitioner rotates rotatable member 112, threads 158 of rotatable member post 154 threadably engage threads 166 of center aperture 164. As a result, as rotatable member 112 is rotated, rotatable member 112 is axially displaced relative to body 120. Threaded shaft 150 includes threads 170 on the outside surface of threaded shaft 150. Threads 170 on the outside surface of threaded shaft 150 are adapted to engage threads positioned on the inside diameter of rotatable member post 154. The threaded engagement of threaded shaft 150 and rotatable

member post 154 results in displacement of compression pad 130 relative not only to body 120, but also to rotatable member 112 pursuant to rotation of rotatable member 112. The threaded engagement of threaded shaft 150, rotatable member post 154 and body 120 results in a compounding effect of the movement of compression pad 130 during rotation of rotatable member 112.

[0097] When rotatable member 112 is rotated, cooperative engagement between rotatable member post 154 and center aperture 164 results in displacement of rotatable member 112 relative to body 120. The engagement between threaded shaft 150 and rotatable member post 154 results in displacement of compression pad 130 relative to body 120. Additionally, the engagement of threaded shaft 150 and rotatable member post 154 results in an amount of displacement of compression pad 130 relative to rotatable member 112. According to one embodiment of the present invention, a first amount of displacement between compression pad 130 and body 120 results upon a first amount of rotation of rotatable member 112. A second amount of displacement which is different than the first amount of displacement occurs between compression pad 130 and rotatable member 112 upon the same amount of rotation of rotatable member 112.

[0098] The primary and secondary threaded engagement results in a compounding effect pursuant to which rotation of rotatable member 112 results in a greater amount of displacement between compression pad 130 and body 120 than the displacement provided between rotatable member 112 and body 120 pursuant to a given amount of rotation. For exemplary purposes, according to one embodiment of the present invention, when the rotatable member is rotated one-half rotation, a change in displacement between rotatable member 112 and body 120 of approximately one-quarter inch occurs. During the one-half rotation of rotatable member 112, a change of displacement between compression pad 130 and body 120 of approximately one-half inch occurs. In other words, compression pad 130 moves approximately twice as far relative to body 120 than rotatable member 112 moves relative to body 120 during the same amount of rotation of rotatable member 112.

[0099] In the illustrated embodiment, rotation of rotatable member 112 in a clockwise direction results in movement of rotatable member 112 in the direction of body 120. The same rotation of rotatable member 112 in the clockwise direction

results in a greater amount of displacement between compression pad 130 and body 120. In other words, rotation of rotatable member 112 in a clockwise direction results in downward movement of both handle member 114 and compression pad 130. Rotation of rotatable member 112 in a counter-clockwise direction results in retraction of compression pad 130 in the direction of body 120. Additionally, rotation of rotatable member 112 in a counter-clockwise direction results in a greater amount of displacement between body 120 and rotatable member 112. In other words, rotation of rotatable member 112 in a counter-clockwise direction results in upward movement of both compression pad 130 and rotatable member 112.

[00100] In the illustrated embodiment, rotatable member posts 160a, b are depicted. Rotatable member posts 160a, b include ramp surfaces 162a, b on their outward facing surfaces. Ramp surfaces 162a, b are adapted to engage ramp or notch members provided on the inside diameter of rotatable member 112. The alignment and orientation of ramp surfaces 162a, b allow rotation of rotatable member 112 in a first direction while preventing or minimizing rotation of rotatable member 112 in a second direction. When a user desires to rotate rotatable member 112 in the second direction, ramp surfaces 162a, b will inhibit such rotation. In order to effectuate rotation of rotatable member 112 in the reverse direction, the user simply grasps ratchet engagement members 126a, b and urges them in an inward direction. This results in inward lateral movement of rotatable member engagement posts 160a, b. The lateral movement of rotatable member engagement posts 160a, b causes disengagement of ramp surfaces 162a, b from the ratchet members on the inside diameter of rotatable member 112 permitting the rotational movement of rotatable member 112 in a second direction.

[00101] In the illustrated embodiment, the configuration of ramp surfaces 162a, b permits rotation of rotatable member 112 in a first direction without requiring the actuation of ratchet engagement members 126a, b. However, ramp surfaces 162a, b minimize or prevent the rotational movement of rotatable member 112 in a counter-clockwise direction absent, or in the absence of, actuation of ratchet engagement members 126a, b.

[00102] Body engagement posts 172a, b are provided in connection with compression pad 130. Body engagement posts 172a, b are integrally coupled or otherwise secured to compression pad 130. Body engagement posts 172a, b are

adapted to be threaded through lateral apertures 168a, b positioned through alternative sides of body 120 and on opposing sides of center aperture 164. Body engagement posts 172a, b maintain the rotational orientation of compression pad 170 relative to the other components of radial artery compression device 110 during rotation of rotatable member 112. In this manner, a desired alignment of compression pad 130, and in particular notch 136 and step 138 of compression pad 130, can be maintained notwithstanding the rotational position of rotatable member 112. Body engagement posts 172a, b include tabs 174a, b. Tabs 174a, b are sloped structures which permit the introduction of body engagement posts 172a, b through lateral apertures 168a, b during assembly. Additionally, tabs 174a, b include a shelf member which inhibits or prevents the accidental removal or passage of body engagement posts from their cooperative engagement with body 120.

[00103] Body engagement posts 172a, b also maintain the rotational orientation of threaded shaft 150. As a result, rotation of rotatable member post 154 pursuant to rotation of rotatable member 112 results in movement of threads 158 of rotatable member post 154 in relation to threads 170 of threaded shaft 150. Rotation of rotatable member post 154 results in axial movement of threaded shaft 150 and compression pad 130 relative to rotatable member post 154. As rotatable member 112 is rotated, rotatable member post 154 also rotates. During rotation of rotatable member post 154, the rotational orientation of body 120, threads 166 of center aperture 164, compression pad 130 and threads 170 of threaded shaft 150 remains fixed. As a result, threaded shaft 150, compression pad 130, rotatable member post 154 and rotatable member 112 are displaced axially relative to body 120 pursuant to rotation of rotatable member 112 and rotatable member post 154.

[00104] The juxtaposition of rotatable member post 154 relative to center aperture 164 and threaded shaft 150 relative to rotatable member post 154 also helps to minimize rotational forces which may urge compression pad 130 to a different rotational position other than the one desired. In the illustrated embodiment, recess 122 is illustrated. Recess 122 comprises a cutout or spaced gap type member on the underside of body 120. Recess 122 is sized to receive compression pad 130 when compression pad 130 is retracted to its position closest to body 120. In other words, when compression pad 130 is fully retracted relative to body 120, all or a portion of compression pad 130 is positioned within recess 122.

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[00105] In the illustrated embodiment, handle member 114 is provided in connection with rotatable member 112. The shape of handle member 114 allows a user to place a thumb and index finger on alternative sides of handle member 114 to twist rotatable member 112 in either a clockwise or counter-clockwise rotational direction. The arcuate configuration of handle member 114 creates a concave surface 177 and convex surface 178 on each lateral side of handle member 114

For example, the concave portion 177 of lateral side 176 of handle member 114 is on the opposing side of a convex portion on the other lateral side of the handle member 114. Similarly, the convex portion 178 on the lateral side 176 is on the opposing side of the concave portion of the opposing lateral side of the handle member 114. In this manner, an ergonomic and easy to grasp configuration is provided by handle member 114.

[00106] As will be appreciated by those skilled in the art, a variety of types and configurations of radial artery compression devices can be provided without departing from the scope of the present invention. For example, according to one embodiment of the present invention, a mechanism other than a ratchet engagement member is provided to secure the rotational position of the rotatable member. According to another embodiment of the present invention, a ratchet engagement member is provided only on one side of the rotatable member. According to another embodiment of the present invention, the rotational position of the compression pad is secured relative to the body utilizing a mechanism other than the body engagement post. According to another embodiment of the present invention, rotation of the rotatable member results in movement of the compression pad utilizing a single set of threads. According to yet another embodiment of the present invention, rotation of the rotatable member only results in movement of the compression pad relative to the body and does not cause movement of the rotatable member relative to the body.

[00107] Fig. 11A is a side view of radial artery compression device 110 of Fig. 8 according to one embodiment of the present invention. In the illustrated embodiment, compression pad 130 is illustrated in a fully extended position. When compression pad 130 is in a fully extended position, the displacement between compression pad 130 and body 120 is maximized. Additionally, when compression pad 130 is in a fully extended position, rotatable member 112 is positioned at a

displacement that is closer to body 120 than at any other rotational position of rotatable member 112.

[00108] Rotatable member engagement posts 160a, b are positioned in cooperative engagement with the inside diameter of rotatable member 112. When a user desires to rotate rotatable member 112 in a counter-clockwise direction to permit the retraction of compression pad 130, a user simply depresses ratchet engagement members 126a, b toward one another. Depressing of ratchet engagement members 126a, b results in manipulation of a portion of body 120 coextensive with rotatable member engagement posts 160a, b. As a result, the cooperative engagement provided in connection with ramp surfaces 162a, b (see Fig. 10) is broken permitting rotational movement of rotatable member 112 in a counter-clockwise direction.

[00109] In the illustrated embodiment, the juxtaposition of threaded shaft 150 relative to rotatable member post 154 is depicted. Threads 170 of threaded shaft 150 are cooperatively engaged with threads that are positioned on the inside diameter of rotatable member post 154. As a result, when rotatable member 112 is rotated, rotation of rotatable member post 154 results in axial movement of compression pad 130 due to the interaction between threads 170 of threaded shaft 150 and the threads on the inside diameter of rotatable member post 154. Additionally, the engagement between threads 158 on the outside surface 156 of rotatable member post 154 results in movement of rotatable member post 154 relative to body 120. Threads 158 of rotatable member post 154 cooperatively engage threads 166 of center aperture 164 (see Fig. 10). As a result, movement of compression pad 130 results not only from the engagement of threaded shaft 150 with rotatable member post 154, but also the cooperative engagement of rotatable member post 154 with body 120. The engagement of the components of threaded shaft 150, rotatable member post 154 and center aperture 164 cause a compounding of the axial displacement of compression pad such that a given amount of axial displacement of rotatable member 112 relative to body 120 results in a greater amount of axial displacement of compression pad 130 relative to body 120 than would be provided by a single threaded interaction.

[00110] Compression pad 130 includes a first portion 132 and a second portion 134. First portion 132 is positioned on one side of step 138 and second portion 134

is positioned on the opposing side of step 138. First portion 132 includes an interior surface 180a and a contact surface 182a. Second portion 134 includes an interior surface 180b and a contact surface 182b. Additionally, first portion 132 includes a sidewall 184a and second portion 134 includes a sidewall 184b. In the illustrated embodiment, the displacement between interior surface 180a and contact surface 182a has a smaller amount of displacement than the displacement between interior surface 180b and contact surface 182b of second portion 134. In other words, sidewall 184a of first portion 132 is smaller or has a smaller height than the height of sidewall 184b of second portion 134. The differing heights of sidewall 184a and 184b are adapted such that the elevation of contact surface 182a of first portion 132 is different from the elevation of contact surface 182b of second portion 134.

[00111] The differing elevations of contact surface 182a and 182b allows the contact surfaces of compression pad 130 to conform to a patient's wrist. As a result, contact surface 182b of second portion 134 can be positioned on the outside of the patient's wrist while contact surface 182a of first portion 132 can be positioned toward the inner part of the patient's wrist. In this manner, a consistent and desired amount of contact between most or all of compression pad 130 can be maintained relative to the patient's wrist, notwithstanding the elevational changes and the physiological features of a typical patient's wrist.

[00112] Step 138 is adapted to be positioned over the patient's artery. Step 138 includes a contact surface 186 which runs along the length of step 138. In the illustrated embodiment, contact surface 186 has a curvilinear or arcuate configuration which is adapted to somewhat conform to the curvilinear outside diameter of a typical catheter or to the rounded configuration of the outside diameter of the patient's radial artery. In this manner, when a catheter is positioned within the patient's radial artery, a desired cooperative contact can sandwich the outside diameter of the patient's radial artery between the catheter and the patient's body tissues as a result of the compression provided by the contact surface 186 of step 138.

[00113] In the illustrated embodiment, when compression pad 130 is positioned at its fully extended position, a maximum amount of displacement between contact surface 182a and contact surface 182b is provided relative to the underside of recess 122. In other words, when compression pad 130 is in its fully extended

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position, contact surfaces 182a and 182b are also positioned at their furthest displacement relative to body 120. As a result, when compression pad 130 is at a fully extended position a maximum amount of compression can be provided when radial artery compression device 110 is secured to a patient's wrist.

[00114] As will be appreciated by those skilled in the art, a variety of types and configurations of radial artery compression devices can be provided without departing from the scope of the present invention. For example, according to one embodiment of the present invention, the extension of the compression pad is the result not only of the rotation of the rotatable member, but also of other operating components of the radial artery compression device. According to another embodiment of the present invention, the extension of the compression pad is only one of two or more components that are utilized to exert pressure on a patient's radial artery or other physiological feature. According to another embodiment of the present invention, the compression pad has a first rigid component and a second flexible component which cooperatively engage the patient's radial artery or catheter. According to yet another embodiment of the present invention, the shape, configuration or material properties of the relief surface or contact surfaces of the compression pad can vary.

[00115] Fig. 11B is a side view of the radial artery compression device 110 illustrating compression pad 130 in a fully retracted position. In the illustrated embodiment, when compression pad 130 is in a fully retracted position, rotatable member 112 is positioned at a maximum amount of axial displacement relative to body 120. When compression pad 130 is in a fully retracted position, compression pad 130 is fully or partially retracted within recess 122. In the illustrated embodiment, it can be seen that when compression pad 130 is in a fully retracted position, body engagement posts 172a, b extend above the upper surface of body 120.

[00116] As will be appreciated by those skilled in the art, to move compression pad 130 from the fully extended position depicted in Fig. 11A, to the fully retracted position depicted in Fig. 11B, the user rotates rotatable member 112 in a counter-clockwise direction. To rotate the rotatable member 112 in a counter-clockwise direction, the user actuates ratchet engagement members 126a, b disengaging rotatable member engagement posts 160a, b relative to rotatable member 112 and

permitting rotation of rotatable member in a counter-clockwise direction. As the user rotates rotatable member 112 in a counter-clockwise direction, compression pad 130 is retracted in the direction of body 120. The configuration of rotatable member 112 and the other components of radial artery compression 110 device allows for varying amounts of displacement between compression pad 130 and body 120. In this manner, varying degrees of compression can be provided by radial artery compression device 110, depending on the particular requirements of the procedure being performed and/or how tightly radial artery compression device 110 is secured relative to the patient. Additionally, the practitioner can rotate rotatable member 112 to incrementally change the degree of extension of compression pad 130 throughout the course of the procedure to adjust the amount of compression provided by radial artery compression device 110.

[00117] In the illustrated embodiment, interior surfaces 180a, b are positioned directly adjacent or in contact with body 120. Additionally, all or a part of sidewalls 184a, b are retracted within recess 122. As will be appreciated by those skilled in the art, compression pad 130 can be fully retracted in recess 122 at the beginning of a procedure before compression pad 130 has been actuated. Similarly, compression pad 130 can be fully retracted into recess 122 at the end of a procedure after a catheter has been withdrawn from the patient. Compression pad 130 can also be retracted into recess 122 at any point during the course of the procedure when a practitioner desires to reposition the radial artery compression device or otherwise release pressure from the patient's vasculature.

[00118] In the illustrated embodiment, when compression pad 130 is retracted into recess 122, rotatable member post 154 has been rotated such that the bottom of rotatable member post 154 is fully retracted within body 120. Additionally, the portion of threaded shaft 150 positioned adjacent compression pad 130 has been fully retracted to within body 120. As a result, when compression pad 130 is fully retracted within body 120, the overall elevational profile from the top of handle member 114 to the bottom of compression pad 130 is at its smallest. Or in other words, the displacement between the top of handle member 114 and the bottom of compression pad 130 is at its smallest when compression pad 130 is fully retracted to within body 120. In contrast, when compression pad 130 is at its fully extended position, the displacement between the top of handle member 114 and the bottom of

compression pad 130 is at its greatest displacement. The relative change in displacement between the top of handle member 114 and the bottom of compression pad 130 at the different rotational positions of rotatable member 112 is a result of the compound movement of compression pad 130 relative to body 120 provided by the multiple threaded engagements between threaded shaft 150, rotatable member post 154, and center aperture 164 (see Fig. 10).

[00119] In the illustrated embodiment the underside of rotatable member 112 is configured to accommodate the top of body engagement post 172a, b. This permits the desired axial movement of body engagement post 172a, b as compression pad 130 moves in the direction of rotatable member 112 and in spite of the compounded axial displacement of compression pad 130 resulting from the cooperative engagement of threaded shaft 150, rotatable member post 154 and center aperture 164.

[00120] As will be appreciated by those skilled in the art, a variety of types and configurations of radial artery compression devices can be provided. According to one embodiment of the present invention, a single threaded engagement is provided between the components of the radial artery compression device. According to another embodiment of the present invention, four or more threaded engagements are provided in connection with the components of the radial artery compression device to provide further compounding of the axial movement of one or more components of the radial artery compression device. According to another embodiment of the present invention, the rotational position of the compression pad is maintained in place utilizing a mechanism other than body engagement post. According to yet another embodiment of the present invention, the body engagement post comprises a uniform outer wall around most or all of the outer circumference of the compression pad. According to yet another embodiment of the present invention, movement of the compression pad is provided in a linear fashion rather than a compounding fashion as depicted in Fig. 11B.

[00121] Fig. 12 is a bottom perspective view of the radial artery compression device of the present invention. In the illustrated embodiment, the internal configuration of the rotatable member 112 can be seen. Rotatable member 112 includes a recess 190 which is positioned on an inner diameter of sidewall 116.

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Recess 190 is adapted to accommodate rotatable member engagement post 160a, b (see Fig. 10).

[00122] Recess 190 is coextensive with an inside diameter of sidewall 192, ramps 194, and an interior wall 196. In the illustrated embodiment, the inside diameter of sidewall 192 includes a plurality of ramps 194. Ramps 194 are one example of a ratchet mechanism which are adapted to engage ramps surfaces 162a, b of rotatable member engagement post 160a, b (see Fig. 10). The configuration of ramps 194 permits rotational movement of rotatable member 112 in a first direction while controlling rotation of rotatable member 112 in a second direction. In other words, the practitioner can rotate rotatable member 112 in one direction without actuating ratchet engagement members 126a, b. To freely rotate rotatable member 112 in a second direction, the practitioner actuates ratchet engagement members 126a, b. For example, according to one embodiment of the present invention, the practitioner is allowed to rotate rotatable member 112 in a clockwise direction as depicted in Fig. 9B without actuating ratchet engagement members 126a, b. However, the practitioner actuates ratchet engagement members 126a, b in order to rotate rotatable member 112 in a second direction as depicted in Fig. 9C.

[00123] In the illustrated embodiment, rotatable member 112 includes a bottom contact surface 198. When rotatable member 112 is rotated such that compression pad 130 is fully extended, bottom contact surface 198 is positioned adjacent to and in contact with body 120. When the practitioner rotates rotatable member 112 in a second direction such that compression pad 130 is fully retracted into body 120 as depicted in Fig. 11B, a desired amount of displacement is provided between bottom contact surface 198 and body 120. In other words, when compression pad 130 is fully retracted, a greater amount of displacement is provided between compression pad 130 and body 120 than is provided between rotatable member 112 and body 120. When compression pad 130 is fully retracted, a greater amount of displacement is provided between rotatable member 112 and body 120 than is provided between compression pad 130 and body 120.

[00124] As will be appreciated by those skilled in the art, a variety of types and configurations of radial artery compression devices can be provided without departing from the scope of the present invention. For example, in one embodiment only the handle member of the radial artery compression device rotates.

In this embodiment, the sidewall remains fixed in its rotational orientation while interior components rotate pursuant to rotation or other actuation of a handle member, button or other actuation mechanism.

[00125] According to one aspect of the present invention, ramps 194 may be positioned on interior wall 196 so as to permit rotation of the handle member 114 in a first direction but to prevent rotation of the handle member 114 in a second direction. Rotatable member engagement post 160a, b (see Fig. 11B) are directed to engage ramps 194 which would be positioned on the interior wall 196 associated with handle member 114. According to another aspect of the present invention, actuation of ratchet engagement member 126a not only biases the portion of body 120 associated with rotatable member engagement posts 160a, b (see Fig. 11B), but causes the mechanical movement of the post pursuant to secondary mechanical members such as a spring, a leaf spring, biasing member or other actuatable components.

[00126] Fig. 13A is a side cutaway view of radial artery compression device 110 according to one embodiment of the present invention. In the illustrated embodiment, threads 166 of center aperture 164 are illustrated and compression pad 130 is shown in a fully extended position. When compression pad 130 is in a fully extended position, interior surfaces 180a, b are positioned a given amount of displacement from the underside of recess 122. In other words, a maximum amount of displacement between contact surfaces 182a, b and body 120 is provided when compression pad 130 is in a fully extended position. Additionally, only the upper portion of body engagement posts 172a, b are positioned within recess 190 of rotatable member 112.

[00127] When compression pad 130 is in a fully extended position, bottom contact surface 198 of rotatable member 112 is positioned in contact with body 120. Ramps 194 on the inside diameter of sidewall 192 cooperatively engage ramp surfaces of rotatable member engagement posts 160a, b. The cooperative engagement between the ramp surfaces of rotatable engagement posts 160a, b and ramps 194 permit rotation of rotatable member 112 until compression pad 130 is fully extended. Once compression pad 130 is in a partially or fully extended position, engagement between the ramp surfaces of rotatable engagement posts 160a, b and ramp 194

prevent or minimize rotation of rotatable member 112 in a rearward direction unless the practitioner depresses ratchet engagement members 126a, b.

[00128] As the practitioner rotates rotatable member 112, rotatable member post 154 is also rotated as a result of the integral coupling between rotatable member 112 and rotatable member post 154. As rotatable member post 154 is rotated, threads 158 of rotatable member post 154 engage threads 166 of center aperture 164. The threaded engagement between threads 158 and 166 displaces rotatable member 112 relative to body 120. Additionally, rotation of rotatable member 112 and rotatable member post 154 results in engagement of threads 170 by threads 200 on the inside diameter of rotatable member post 154. In this manner, rotation of rotatable member 112 provides interactive forces which result in the axial displacement of compression pad 130 relative to rotatable member 112. Axial displacement of rotatable member 112 relative to compression pad 130 is a result of the interaction between threads on the inside diameter of center aperture 164, threads on the outside diameter of rotatable member post 154, threads on the inside diameter of rotatable member post 154, and threads on the outside diameter of threaded shaft 150. The cooperative engagement of these threads results in a compounding of the axial movement of compression pad 130 relative to body 120.

[00129] In the illustrated embodiment, rotatable member post is positioned such that the portion of rotatable member post 154 adjacent rotatable member 112 has been substantially advanced into body 120. The bottom or distal most extent of rotatable member post 154 extends below body 120 such that the distal extent of rotatable member post extends below recess 122 and wrist strap securement members 124a, b. Threaded shaft 150 has been extended a given amount such that the portion of threaded shaft 150 which is positioned adjacent to compression pad 130 extends outside of rotatable member post 154. The cooperative engagement of threaded shaft 150, rotatable member post 154 and center aperture 164, results in compounding of the axial movement of compression pad 130 relative to body 120 when rotatable member 112 is rotated by a practitioner.

[00130] Fig. 13B illustrates radial artery compression device 110 in which compression pad 130 is in a fully retracted position. In the illustrated embodiment, when compression pad 130 is in a fully retracted position, contact surface 182a is aligned with the portion of wrist strap securement member 124a positioned adjacent

compression pad 130. In other words, the portion of compression pad 130 positioned adjacent wrist strap securement member 124a is fully retracted to within recess 122. Contact surface 182b is positioned adjacent wrist strap securement member 124b. Contact surface 182b extends a certain amount of displacement below wrist strap securement member 124b. This is due to the fact that contact surface 182b has a lower elevation than contact surface 182a. It will be appreciated that the configuration of the contact surfaces of compression pad 130 and the amount to which compression pad 130 is withdrawn into a recess of body 120 can vary depending on the size of the recess, the thickness of the compression pad, or other variables related to the components of the radial artery compression device that can be selected according to the particular requirements of a compression procedure to be performed.

[00131] In the illustrated embodiment, when compression pad 130 is fully retracted within recess 122, rotatable member 112 is positioned at its greatest displacement from body 120. Bottom contact surface 198 is positioned at a given amount of displacement from the portion of body 120 positioned opposite bottom contact surface 198. Body engagement posts 172a, b are fully retracted such that a substantial portion of body engagement posts 172a, b extend above body 120. When compression pad 130 is fully retracted to within body 120, the portion of body engagement posts 172a, b associated with tab 174a, b extend higher than rotatable member engagement posts 160a, b. As a result, a portion of body engagement posts 172a, b are positioned within recess 190.

[00132] In the illustrated embodiment, a substantial portion of rotatable post member 154 is positioned above body 120. Additionally, the bottom extremity of rotatable member post 154 is retracted such that it is positioned within body 120. Similarly, when compression pad 130 is fully retracted to within body 120, threaded shaft 150 is retracted to a position within body 120 such that the portion of threaded shaft 150 adjacent compression pad 130 has been retracted to within body 120 while the upper extremity of threaded shaft 150 extends above body 120. In the depicted configuration, the entire portion of threaded shaft 150 is positioned within rotatable member post 154. In other words, the upper extent of the threaded shaft 150 and the lower extent of the threaded shaft 150 are positioned such that substantially the entire length of the threaded shaft 150 is positioned within the inner cavity of the

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rotatable member post 154. Rotatable member post 154 is an example of a first threaded shaft. Threaded shaft 150 is an example of a secondary threaded shaft.

[00133] In the illustrated embodiment, rotatable member 112 has been displaced relative to body 120. In other words, a determined amount of displacement is provided between rotatable member 112 and body 120 when compression pad 130 is fully retracted to within body 120. As a result, only the bottom portion of inside diameter of sidewall 192 contacts ramp surfaces of rotatable member engagement post 160a, b. This is in contrast to the engagement of rotatable member engagement post 160a, b with substantially the entire length of the inside diameter of sidewall 192 when compression pad is fully extended as depicted in Fig. 13A.

[00134] As will be appreciated by those skilled in the art, of a variety of types and configurations of the internal components of the radial artery compression device can be utilized without departing from the scope of the present invention.

For example, according to one embodiment of the present invention, the threaded engagement between the components associated with the compression pad, the body, and the rotatable member can occur on the outside diameter of those components rather than internally or on an inside radius of the rotatable member. According to another embodiment of the present invention, the threaded shaft associated with the rotatable member can be placed on the inside diameter while the rotatable member associated with the compression pad can be positioned on the outside of the threaded member of the rotatable member.

[00135] Fig. 14 is a perspective view of a patient's radial artery 202 according to one aspect of the present invention. In the illustrated embodiment, a cross-section of the patient's wrist 141 is depicted. The cross-section of the patient's wrist shows the approximate position of a catheter threaded through radial artery 202 of the patient. Radial artery 202 has an outside diameter which is substantially circumferential in nature such that the portion of radial artery 202, which is positioned to be in contact with contact surface 186 of step 138, largely conforms to the arcuate configuration of contact surface 186 of step 138.

[00136] A catheter 140 is positioned within radial artery 202 of the patient. Compression provided by compression pad 130 ensures that a desired amount of pressure is provided on radial artery 202. As a result, the inner diameter of radial artery 202 is positioned directly adjacent to and in contact with the outside diameter

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of catheter 140. In this manner, the tissue surrounding radial artery 202 provides sufficient contact between the outside diameter of catheter 140 and in the inside diameter of radial artery 202 to provide a desired degree of hemostasis so as to prevent bleeding or the leakage of fluid at the radial artery access site.

[00137] In the illustrated embodiment, the alignment of notch 136 relative to catheter 140 is depicted. Notch 136 enables positioning of compression pad 130 such that the radial artery access site is positioned directly below threaded shaft 150. Aligning the radial artery access site directly below threaded shaft 150 allows the compressive or axial forces provided by threaded shaft 150 to be applied directly to the radial artery access site without interruption from catheter 140. In other words, compression pad 130 can apply pressure to the patient without catheter 140 being threaded underneath a contact surface of compression pad 130 on the outside radius of compression pad 130. In this manner, the catheter 140 can be threaded through notch 136 to a more central portion of compression pad 130 such that catheter 140 does not result in obstruction or tilting of compression pad 130. As a result, direct pressure can be applied to the radial artery catheter access site by the portion of compression pad 130 associated with threaded shaft 150.

[00138] Fig. 15 is a top perspective view of a radial artery compression device 110 according to one embodiment of the present invention. In the illustrated embodiment, rotatable member 112 of radial artery compression device 110 provides visual access to the access site 152 of catheter 140. In this manner, a practitioner can approximately visualize the juxtaposition of radial artery compression device 110 relative to access site 152.

[00139] In the depicted embodiment, rotatable member 112 includes a central void 117. Central void 117 comprises a recess portion adjacent handle member 114. Central void 117 is intersected by the arcuate configuration of handle member 114. In other words, handle member 114 extends from one lateral side of central void 117 to the opposing lateral side of central void 117. In this manner, a recess is provided relative to upper face 118 of rotatable member 112. Handle member 114 can extend from an elevation which extends above upper face 118 to a position within central void which extends below upper face 118. The resultant hemispherical type voids on either lateral side of handle member 114 created by the juxtaposition of central void

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117 and handle member 114 can receive the finger or thumb to grasp handle member 114 and cause rotation of rotatable member 112.

[00140] A floor surface 210 is provided in connection with central void 117. Floor surface 210 is transparent, translucent or otherwise less than opaque allowing a practitioner to see access site 152, catheter 140, or other objects or surfaces positioned on the underside of radial artery compression device 110. In this manner, a practitioner can ascertain the juxtaposition of radial artery compression device 110 relative to the patient's wrist, catheter 140, access site 152 or another object or surface. The practitioner can thus adjust the positioning of the compression pad or components of the compression pad relative to the access site 152. As will be appreciated by those skilled in the art, in order for a practitioner to be able to visualize the access site, other components of radial artery compression device may also be comprised of a clear, transparent, translucent or otherwise visually transductive material. For example, the compression pad, rotatable member post and any one or more components of the radial artery compression device 110 may be formed of a transparent or translucent material. According to another embodiment of the present invention a plurality of components or all of the components of the radial artery compression device are formed of a visually transductive material. Floor surface 210 is one example of a viewing window.

[00141] As will be appreciated by those skilled in the art, a variety of types and configurations of compression devices can be provided without departing from the scope of the present invention. For example, according to one embodiment of the present invention, a cavity or oversized recess can be provided in place of a notch on the compression pad to allow for clearance of the catheter from the bottom of the radial artery compression device. According to another embodiment of the present invention, the step has a shape other than an arcuate, radius, or circumferential contact surface which is adapted to provide a desired contact between the compression pad and the patient. According to another embodiment of the present invention, the radial artery compression device is a compression device utilized with a portion of the patient's body other than the radial artery. For example, in one embodiment of the present invention, the compression device comprises a femoral compression device which is sized and shaped to be positioned over and provide pressure to a patient's femoral artery. According to

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another embodiment of the present invention, the compression device is adapted to provide pressure both during the course of a procedure and upon completion of a procedure. According to yet another embodiment of the present invention, the compression device is adapted to be utilized with a plurality of compression pads which can be positioned on opposing sides of a patient's limb, adjacent multiple access sites, as desired by the practitioner, or as required by particular aspects of the procedure to be performed.

[00142] The present invention may be embodied in other specific forms without departing from its scope. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

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CLAIMS:

1. A radial artery compression device, the radial artery compression device adapted to allow a user to provide varying degrees of pressurization against a patient's radial artery to maintain a desired degree of hemostasis at a percutaneous
 5 access site, the radial artery compression device comprising:

a knob configured to be grasped by a user and rotated;

a body configured to engage the knob such that the knob can be rotated relative to the body;

a compression pad comprising:

10 a first contact surface;

a second contact surface, wherein the elevation of the first contact surface is different from the elevation of the second contact surface; and

a step on the surface of the compression pad to be positioned adjacent the wrist of the patient, the step configured to enable the compression pad to at least
 15 partially contour to a portion of a device within the radial artery during a medical procedure;

wherein the step forms a curved contact surface disposed between the first contact surface and the second contact surface;

a threaded shaft formed of rigid material and disposed through the
 20 body, the threaded shaft being positioned between the knob and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the knob is rotated relative to the body;

a band to secure the body to the underside of a wrist of a patient in the area of the radial artery, such that the compression pad can be positioned adjacent
 25 the wrist of the patient wherein the user rotates the knob to selectively move the

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compression pad between a first position and at least a second position to provide varying degrees of pressurization to the wrist of a patient, wherein when the compression pad is in the first position, the compression pad is positioned adjacent the body and applies a lesser degree of pressurization against the wrist of the patient
 5 and when the compression pad is in the second position, the compression pad is positioned a given amount of displacement from the body and provides a greater amount of pressurization against the patient's wrist;

one or more ratchet engagement members operably coupled to the knob, wherein the ratchet engagement members are configured to permit rotation of
 10 the knob in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the knob in a second direction; and

a ratchet mechanism coupled with the knob, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of
 15 the knob in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the knob in the second direction.

2. The radial artery compression device of claim 1, wherein the threaded shaft is integrated with the compression pad, and wherein the knob further comprises
 20 threads to engage threads on the threaded shaft such that rotation of the knob moves the shaft and the compression pad with respect to the body.

3. The radial artery compression device of claim 2, wherein clockwise rotation of the knob moves the shaft and the compression pad toward the body to a retracted position and counterclockwise rotation of the knob extends the shaft and
 25 compression pad away from the body and toward the wrist and radial artery of the patient.

4. The radial artery compression device of claim 1, wherein the threaded shaft is integrated with the knob, and wherein the compression pad further comprises

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threads to engage threads on the threaded shaft such that rotation of the knob causes rotation of the shaft and moves the compression pad with respect to the body.

5. The radial artery compression device of claim 4, wherein the body further comprises a pivotable retainment bracket configured to engage a portion of the knob to secure the knob at a fixed position with respect to the body while allowing the knob to be rotated relative to the body, the pivotable retainment bracket pivoting with respect to the body to allow the threaded shaft to be inserted through the body and the knob to be properly positioned to be secured by the retainment bracket.

6. The radial artery compression device of claim 1, wherein when the device is secured to the underside of the wrist of a patient, as the knob is rotated to cause the compression pad to extend away from the body and toward the wrist and radial artery of the patient, the compression pad gradually applies pressure to the radial artery of the patient.

7. The radial artery compression device of claim 6, wherein the compression pad is configured to apply pressure to the radial artery in a manner that prevents blood from flowing out through an opening in the radial artery to thereby achieve hemostasis at the opening.

8. The radial artery compression device of claim 7, wherein the compression pad is configured to apply pressure to the radial artery while a sheath is inserted through the opening to perform a medical procedure, wherein the pressure can be applied in a manner that prevents blood from flowing around the sheath and out the opening to thereby achieve hemostasis at the opening.

9. The radial artery compression device of claim 7, wherein the compression pad is configured to apply pressure to the radial artery while a catheter is inserted through the opening to perform a medical procedure, wherein the pressure can be applied in a manner that prevents blood from flowing around the catheter and out the opening to thereby achieve hemostasis at the opening.

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10. The radial artery compression device of claim 1, wherein the body is configured such that at least a portion of the body is contoured to at least a portion of the underside of the wrist of the patient.

11. The radial artery compression device of claim 1, wherein the knob
5 comprises a collar, and wherein the body engages the knob by engaging the collar of the knob.

12. The radial artery compression device of claim 11, wherein the body further comprises a pivotable retainment bracket to engage the collar of the knob.

13. The radial artery compression device of claim 1, wherein the
10 compression pad is a disk shaped.

14. The radial artery compression device of claim 13, wherein the compression pad further comprises at least one notch in the perimeter of the disk shape of the compression pad, the notch configured to at least partially surround a device inserted into the radial artery at an access site so as to facilitate application of
15 pressure to the radial artery at the access site and partially around the inserted device.

15. The radial artery compression device of claim 13, wherein the compression pad comprises a step on a surface of the compression pad to be positioned adjacent the wrist of the patient, the step configured to enable the
20 compression pad to at least partially contour to a portion of a device within the radial artery during a medical procedure.

16. The radial artery compression device of claim 1, wherein the body further comprises a recess configured to receive the compression pad when the compression pad is fully retracted toward the body.

25 17. Use of a radial artery compression device for applying compression pressure at an access site of a radial artery of a patient, wherein the radial artery compression device comprises:

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a knob configured to be grasped by a user and rotated,

a body configured to engage the knob such that the knob can be rotated relative to the body,

a compression pad comprising:

5 a first contact surface;

a second contact surface, wherein the elevation of the first contact surface is different from the elevation of the second contact surface; and

10 a step on the surface of the compression pad to be positioned adjacent the wrist of the patient, the step configured to enable the compression pad to at least partially contour to a portion of a device within the radial artery during a medical procedure;

wherein the step forms a curved contact surface disposed between the first contact surface and the second contact surface,

15 a threaded shaft formed of rigid material and disposed through the body and between the knob and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the knob is rotated relative to the body,

20 a band to secure the body to the underside of a wrist of the patient in the area of the radial artery, such that the compression pad is positioned adjacent the wrist of the patient,

one or more ratchet engagement members operably coupled to the knob, wherein the ratchet engagement members are configured to permit rotation of the knob in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent
25 rotation of the knob in a second direction, and

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a ratchet mechanism coupled with the knob, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the knob in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the knob in the
 5 second direction;

wherein the radial artery compression device is for securing to a wrist of the patient, the compression pad of the radial artery compression device being positioned adjacent the access site of the radial artery of the patient; and

wherein the knob of the radial artery compression device is for rotating
 10 relative to the body to increase compression pressure applied by the compression pad at the access site.

18. The use of claim 17, wherein the compression pad of the radial artery compression device includes at least one notch, and wherein the notch is for positioning to partially surround a device inserted into the radial artery via the access
 15 site.

19. The use of claim 17, wherein the step of the compression pad is for positioning to align with a portion of a device inserted into the radial artery via the access site.

20. A radial artery compression device, comprising:
 20 means for rotating a plurality of threads, the rotating means configured to be grasped by a user and rotated;

means for compressing a radial artery of a patient at an access site of the radial artery, the compressing means configured to be displaced longitudinally along an axis of rotation of the rotating means as the rotating means is rotated to
 25 adjust the level of compression pressure applied to the radial artery of the patient;

means for supporting the rotating means and the compressing means;

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means for securing the supporting means to the underside of a wrist of a patient in the area of the radial artery, such that the compressing means is positioned adjacent the wrist of the patient;

one or more ratchet engagement members operably coupled to the
 5 rotating means, wherein the ratchet engagement members are configured to permit rotation of the rotating means in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the rotating means in a second direction; and

a ratchet mechanism coupled with the rotating means, wherein
 10 engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotating means in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the rotating means in the second direction;

wherein rotation of the rotating means causes a compounding effect in
 15 which rotation of the rotating means provides a greater amount of displacement between the compressing means and the supporting means than the displacement provided between the rotating means and the supporting means.

21. The radial artery compression device of claim 20, wherein the compressing means includes means for at least partially surrounding a device
 20 inserted into the radial artery of the patient, wherein the surrounding means at least partially surrounds the device at the access site.

22. The radial artery compression device of claim 20, wherein the compressing means includes means for at least partially contouring to a device
 inserted into the radial artery of the patient, wherein the contouring means is
 25 configured to at least partially contour to a portion of the device within the radial artery when the compressing means is compressing a radial artery of the patient.

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23. A radial artery compression device, the radial artery compression device adapted to allow a user to provide varying degrees of pressurization against a patient's radial artery to maintain a desired degree of hemostasis at a percutaneous access site, the radial artery compression device comprising:

5 a body;

a rotatable member positioned adjacent the body such that the rotatable member can be rotated relative to the body;

a compression pad operably coupled to the rotatable member;

10 a threaded shaft formed of rigid material and disposed through the body, the threaded shaft being positioned between the body and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the rotatable member is rotated relative to the body;

15 a securement member adapted to secure the position of the body relative to the portion of a patient's wrist corresponding with the radial artery, such that rotation of the rotatable member in a first direction is adapted to increase the amount of compression applied to the radial artery by the compression pad, and rotation of the rotatable member in a second direction is adapted to decrease the amount of compression applied by the radial artery to the compression pad;

20 a viewing window for allowing visualization of the access site, the viewing window positioned within a central void of the rotatable member;

25 one or more ratchet engagement members operably coupled to the rotatable member, wherein the ratchet engagement members are configured to permit rotation of the rotatable member in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the rotatable member in a second direction; and

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a ratchet mechanism coupled with the rotatable member, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotatable member in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members
5 permits rotation of the rotatable member in the second direction.

24. The radial artery compression device of claim 23, further comprising a secondary threaded shaft that threadably engages the threaded shaft.

25. The radial artery compression device of claim 24, wherein the secondary threaded shaft is integrally coupled to the compression pad.

10 26. The radial artery compression device of claim 23, wherein the threaded shaft is securely coupled to the rotatable member such that rotation of the rotatable member causes rotation of the threaded shaft.

27. The radial artery compression device of claim 24, wherein the threaded shaft includes threads on the outside diameter of a wall of the threaded shaft and
15 threads on the inside diameter of a wall of the threaded shaft.

28. The radial artery compression device of claim 27, wherein the secondary threaded shaft engages the threads on the inside diameter of the wall of the threaded shaft.

29. The radial artery compression device of claim 27, wherein the threads
20 on the outside diameter of the wall of the threaded shaft threadably engage the body.

30. The radial artery compression device of claim 23, further comprising body engagement posts secured to the compression pad to secure the rotational orientation of the compression pad during rotation of the rotatable member.

31. A radial artery compression device comprising:

25 a body;

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a rotatable member positioned adjacent the body such that the rotatable member can be rotated relative to the body;

a compression pad;

5 a threaded shaft formed of rigid material and disposed through the body, the threaded shaft being positioned between the body and the compression pad, the threaded shaft configured to move the compression pad with respect to the body as the rotatable member is rotated relative to the body;

one or more ratchet engagement members operably coupled to the rotatable member, wherein the ratchet engagement members are configured to
10 permit rotation of the rotatable member in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the rotatable member in a second direction; and

a ratchet mechanism coupled with the rotatable member, wherein
15 engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotatable member in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the rotatable member in the second direction.

32. The radial artery compression device of claim 31, wherein the user
20 actuates the one or more ratchet engagement member to lessen the amount of compression provided by the compression pad.

33. The radial artery compression device of claim 31, wherein a user actuates the one or more ratchet engagement members to permit rotation of the rotatable member in the second direction.

25 34. A radial artery compression device, the radial artery compression device adapted to allow a user to provide varying degrees of pressurization against a

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patient's radial artery to maintain a desired degree of hemostasis at a percutaneous access site, the radial artery compression device comprising:

a body;

5 a rotatable member positioned adjacent the body such that the rotatable member can be rotated relative to the body;

a compression pad operably linked to the rotatable member;

a first shaft being positioned between the rotatable member and the compression pad, the first shaft threadably engaging the body to move the rotatable member relative to the body; and

10 a second shaft being positioned between the rotatable member and the compression pad, wherein engagement between the first shaft and the second shaft causes a compounding of the amount of compression provided by the compression pad;

15 one or more ratchet engagement members operably coupled to the rotatable member, wherein the ratchet engagement members are configured to permit rotation of the rotatable member in a first direction without manipulation of the ratchet engagement members by a user, and wherein the ratchet engagement members are configured to prevent rotation of the rotatable member in a second direction; and

20 a ratchet mechanism coupled with the rotatable member, wherein engagement of the ratchet mechanism with the ratchet engagement members prevents rotation of the rotatable member in the second direction and wherein disengagement of the ratchet mechanism from the ratchet engagement members permits rotation of the rotatable member in the second direction;

25 wherein the rotation of the rotatable member results in axial movement of the compression pad towards or away from the body;

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wherein the rotation of the rotatable member results in axial movement of the compression pad towards or away from the body; and

wherein the compounding of the amount of compression results in a greater amount of axial movement of the compression pad relative to the body pursuant to a predetermined amount of rotation of the rotatable member than the amount of axial movement of the rotatable member relative to the body pursuant to the predetermined amount of rotation of the rotatable member.

35. The radial artery compression device of claim 34, wherein threads one of the first shaft and the second shaft engage a threaded aperture positioned through the body.

36. The radial artery compression device of claim 34, further comprising a viewing window for allowing visualization of the access site, the viewing window positioned within a central void of the rotatable member.

37. The radial artery compression device of claim 1, wherein the knob can be rotated relative to the body while remaining secured at a fixed position with respect to the body.

38. The use of claim 17, wherein the knob can be rotated relative to the body while remaining secured at a fixed position with respect to the body.

39. The radial artery compression device of claim 20, wherein the supporting means is configured to engage the rotating means such that the rotating means can be rotated relative to the supporting means while remaining secured at a fixed position with respect to the supporting means and the supporting means is configured to receive the compressing means when the compressing means is displaced longitudinally toward the supporting means along the axis of rotation of the rotating means.

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40. The radial artery compression device of claim 23, wherein rotation of the rotatable member does not affect the rotational orientation of the compression pad.

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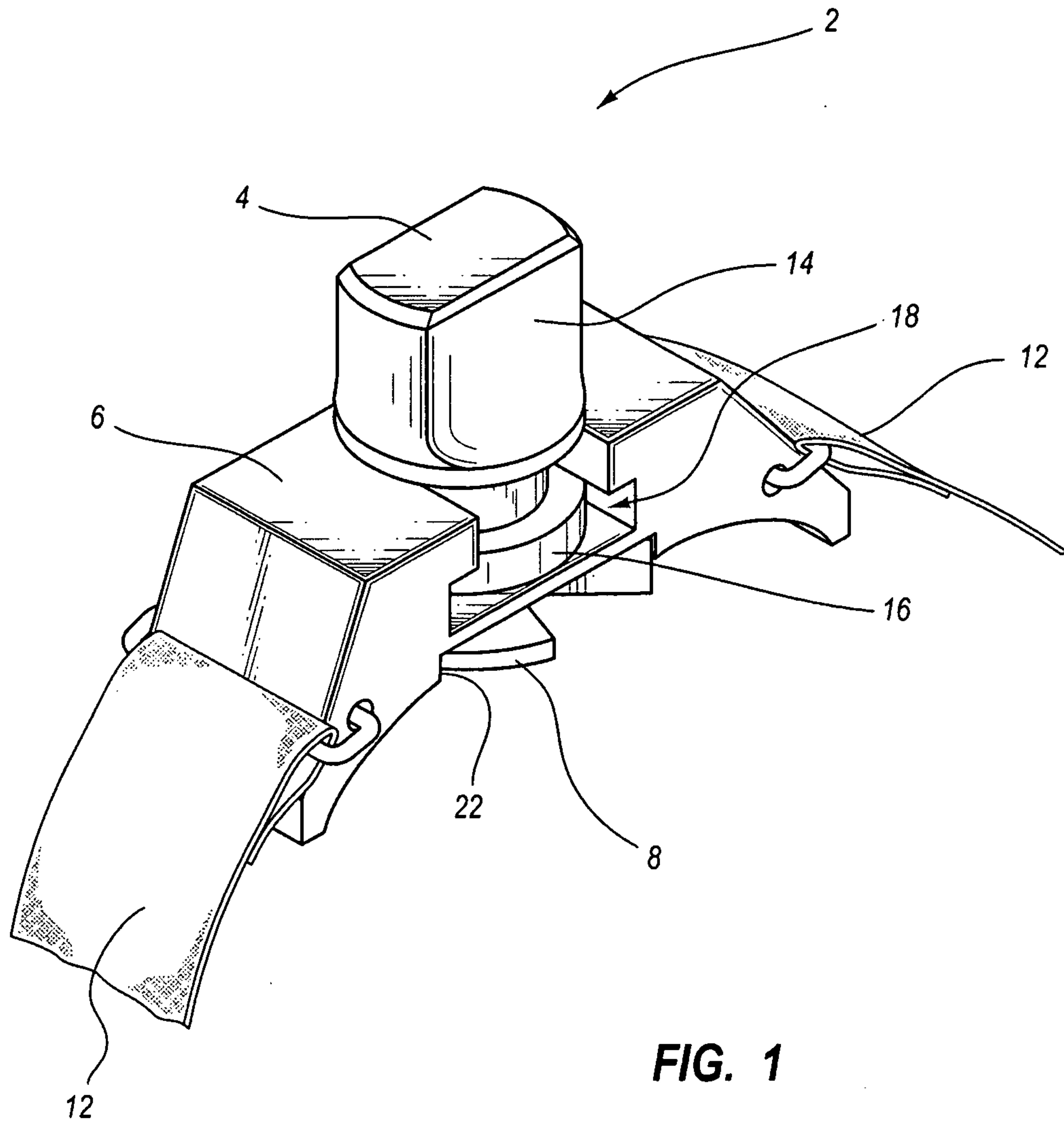


FIG. 1

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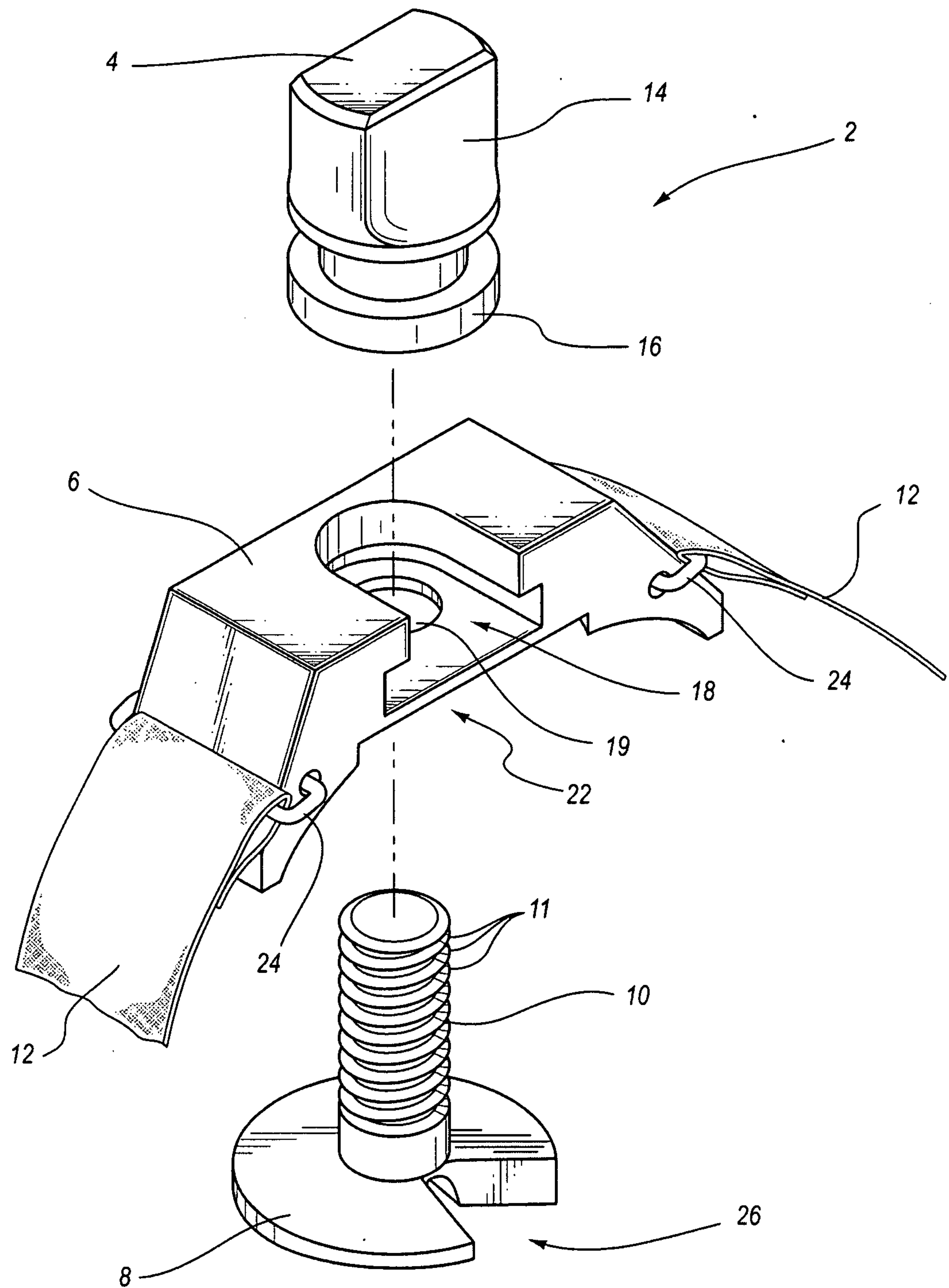
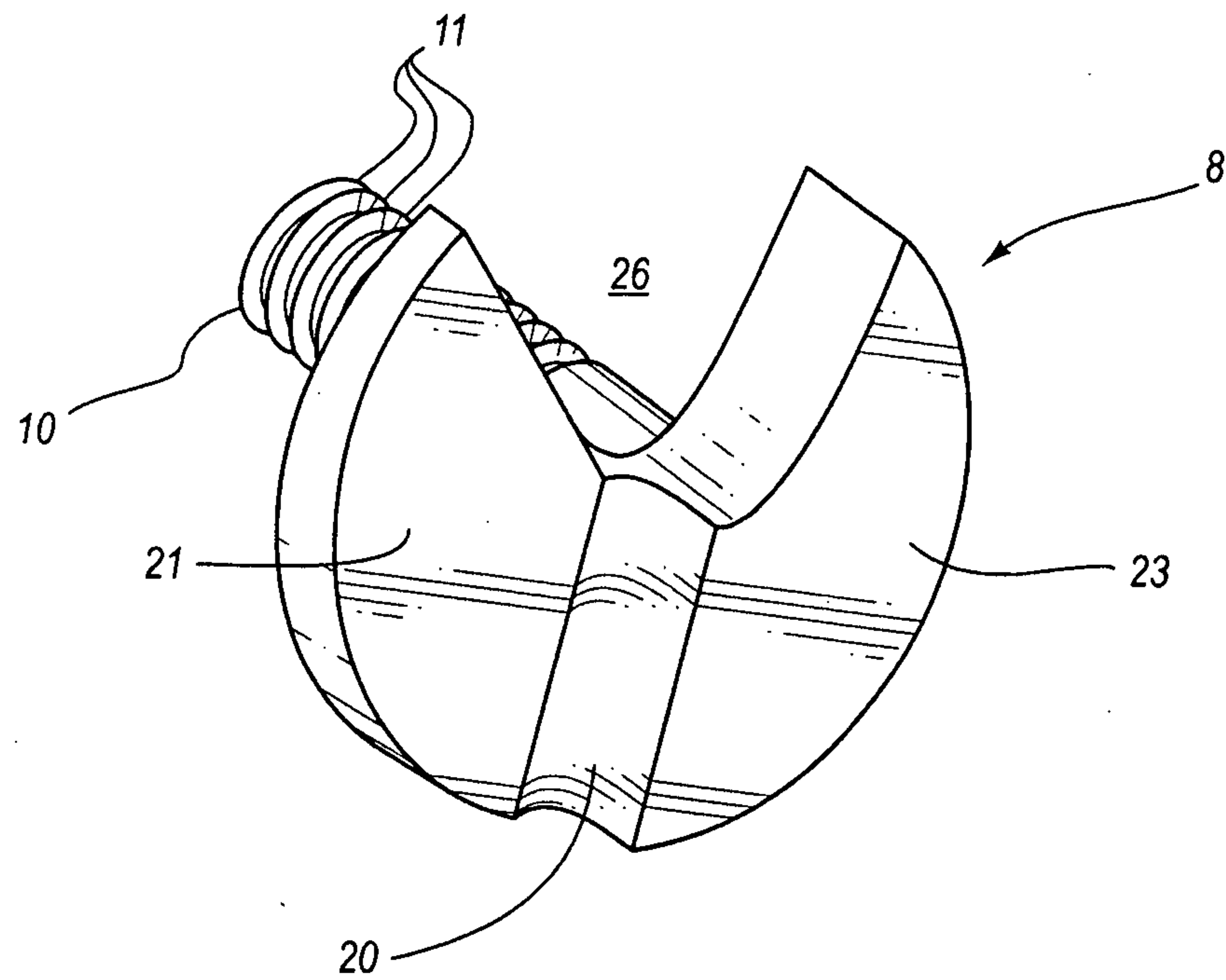
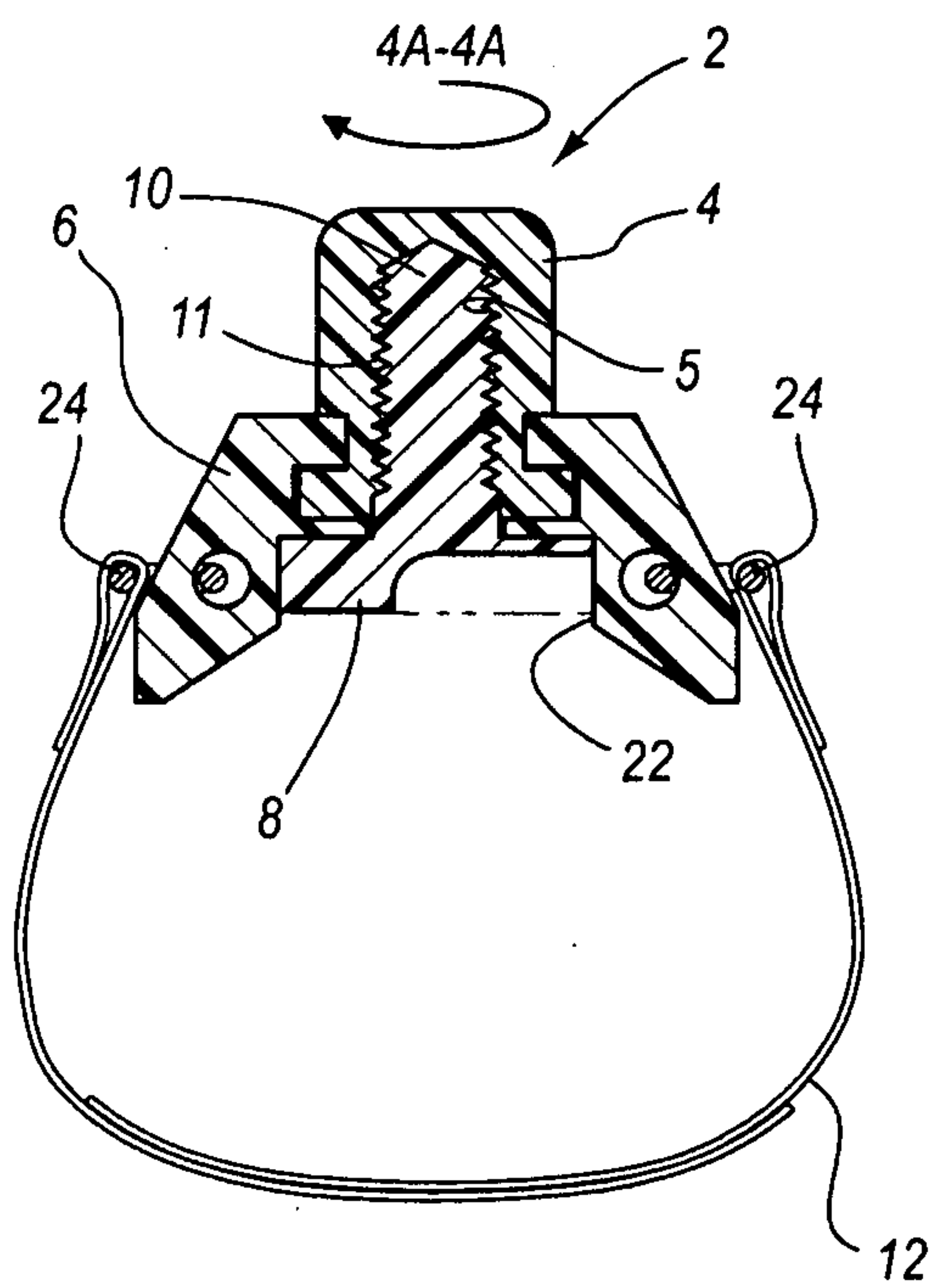
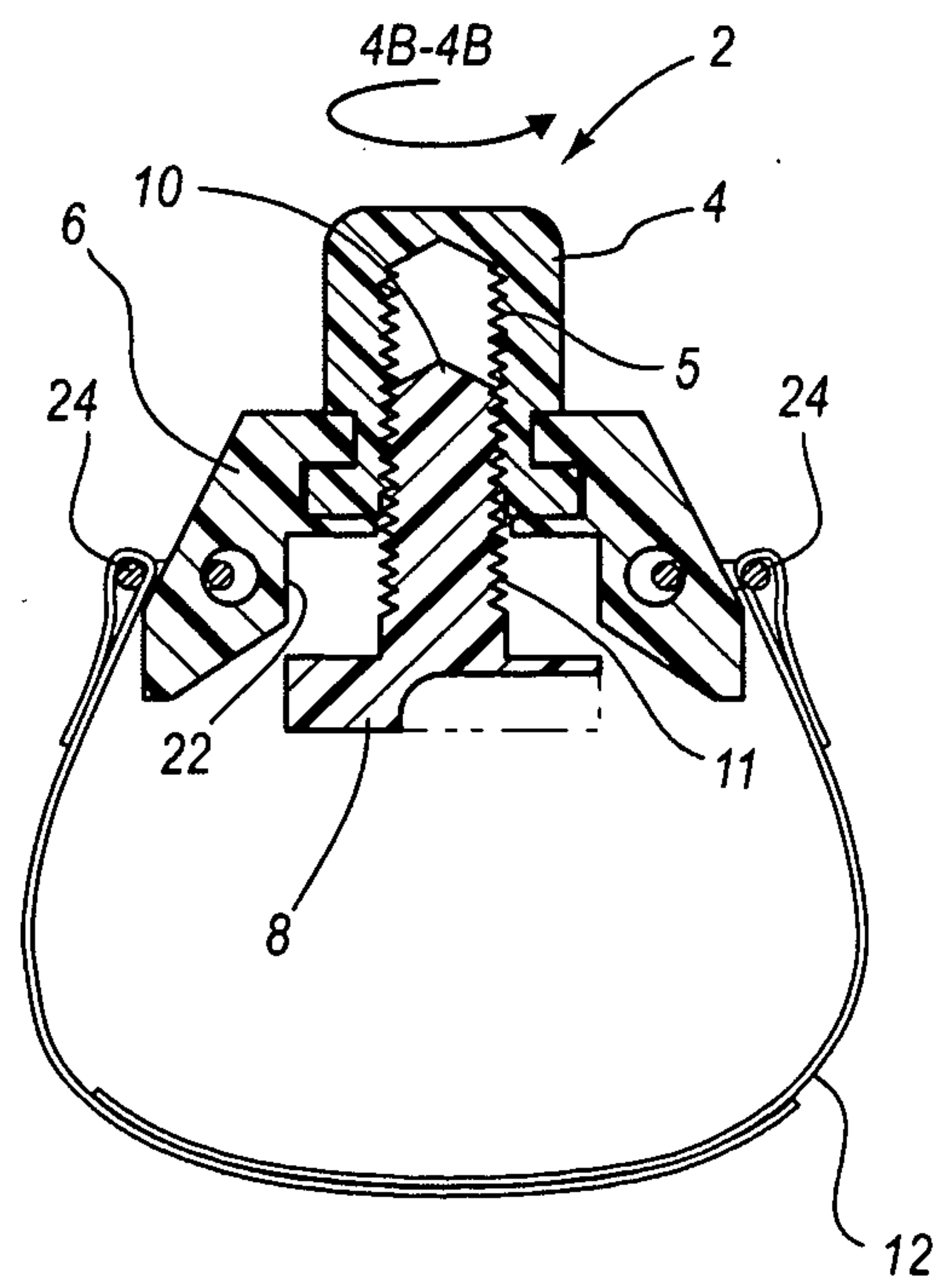
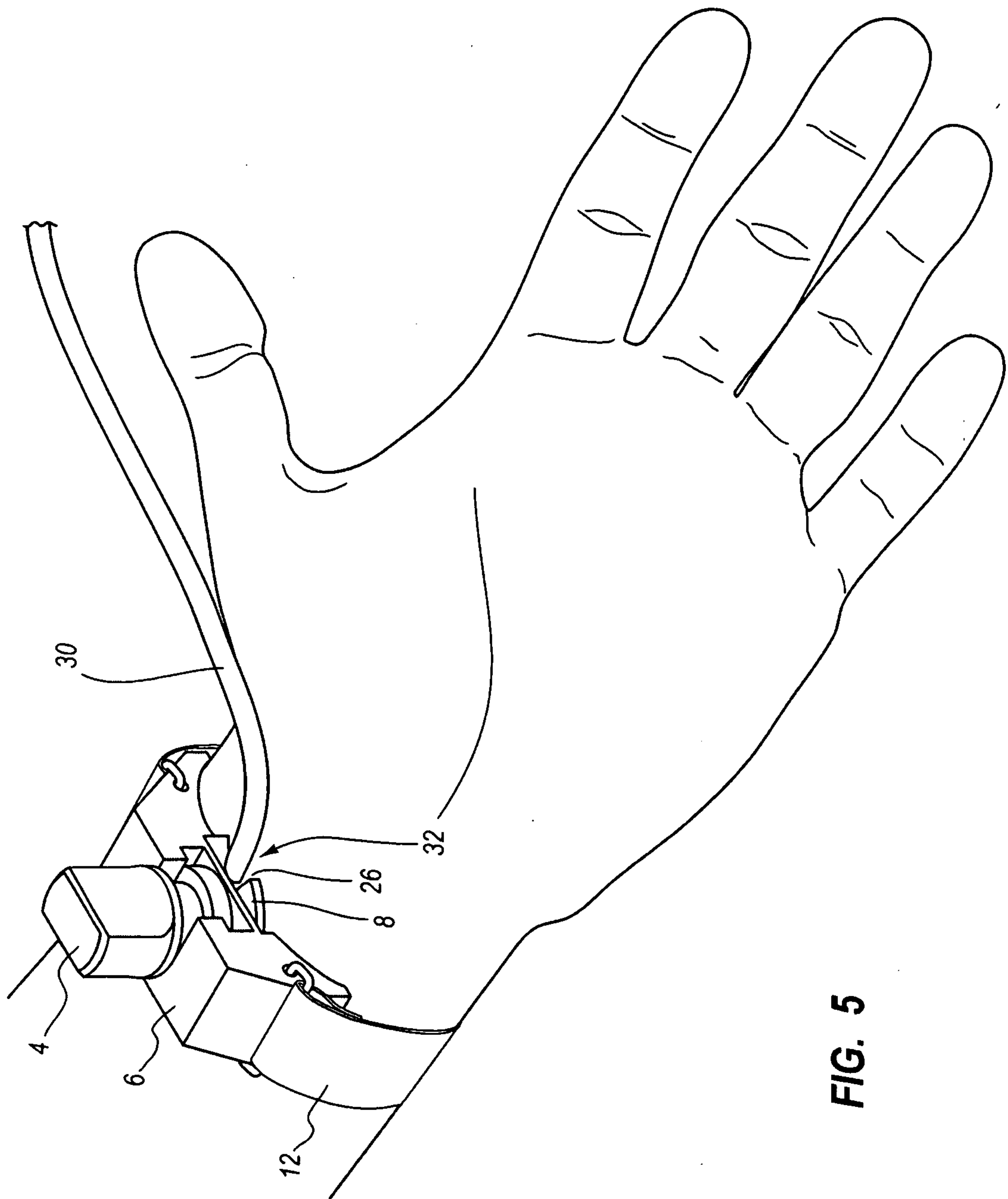


FIG. 2

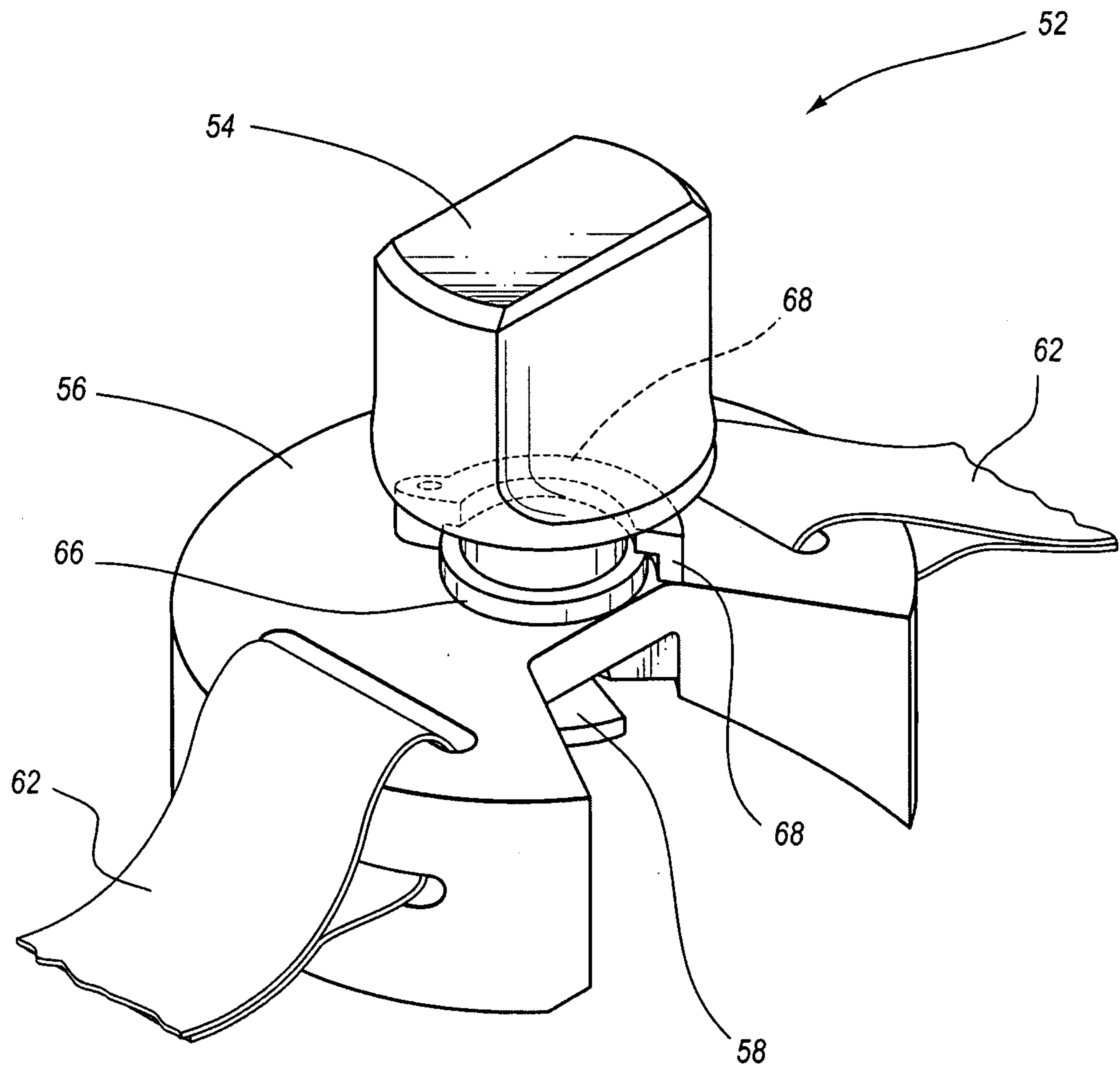
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**FIG. 3****FIG. 4A****FIG. 4B**

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**FIG. 6**

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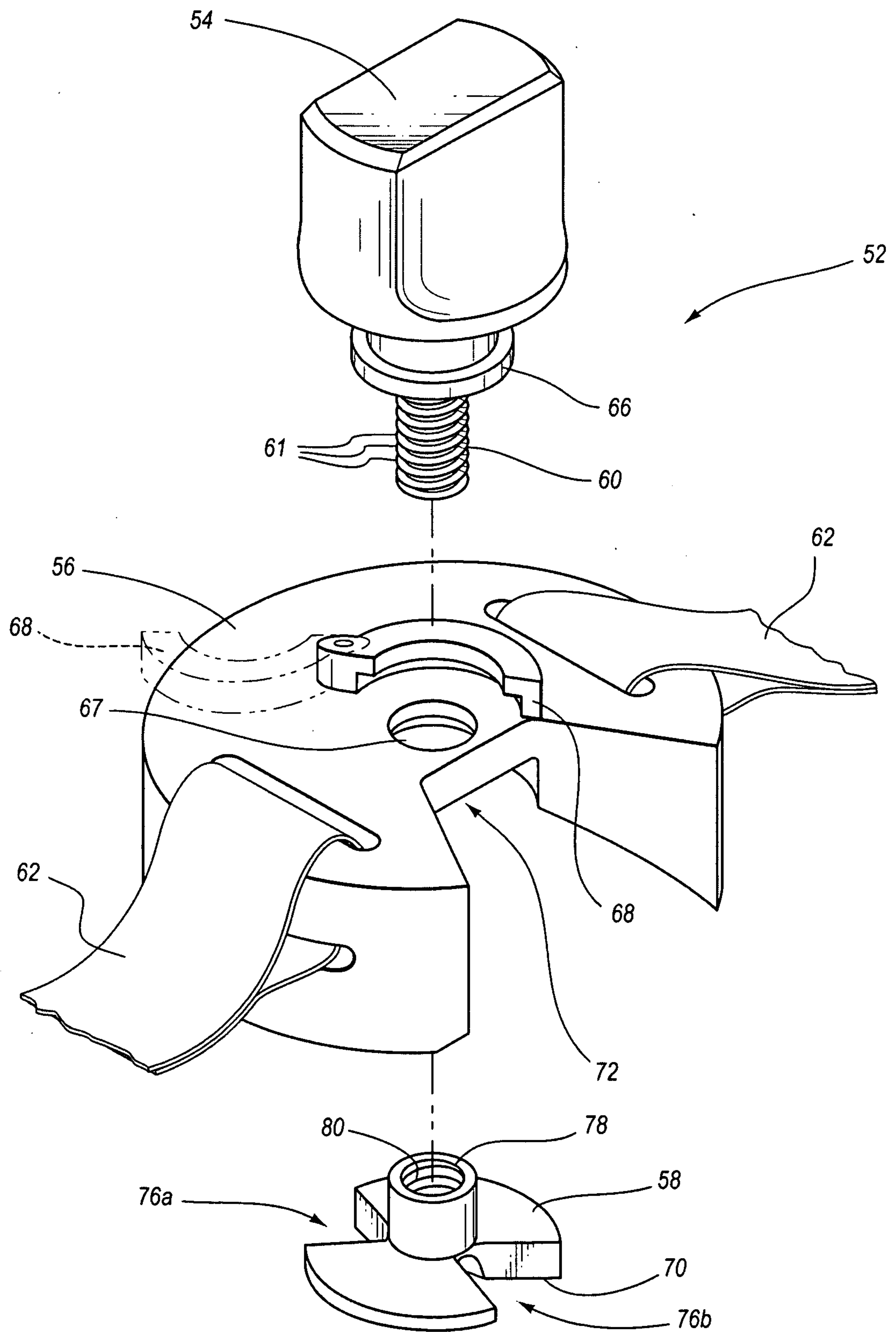
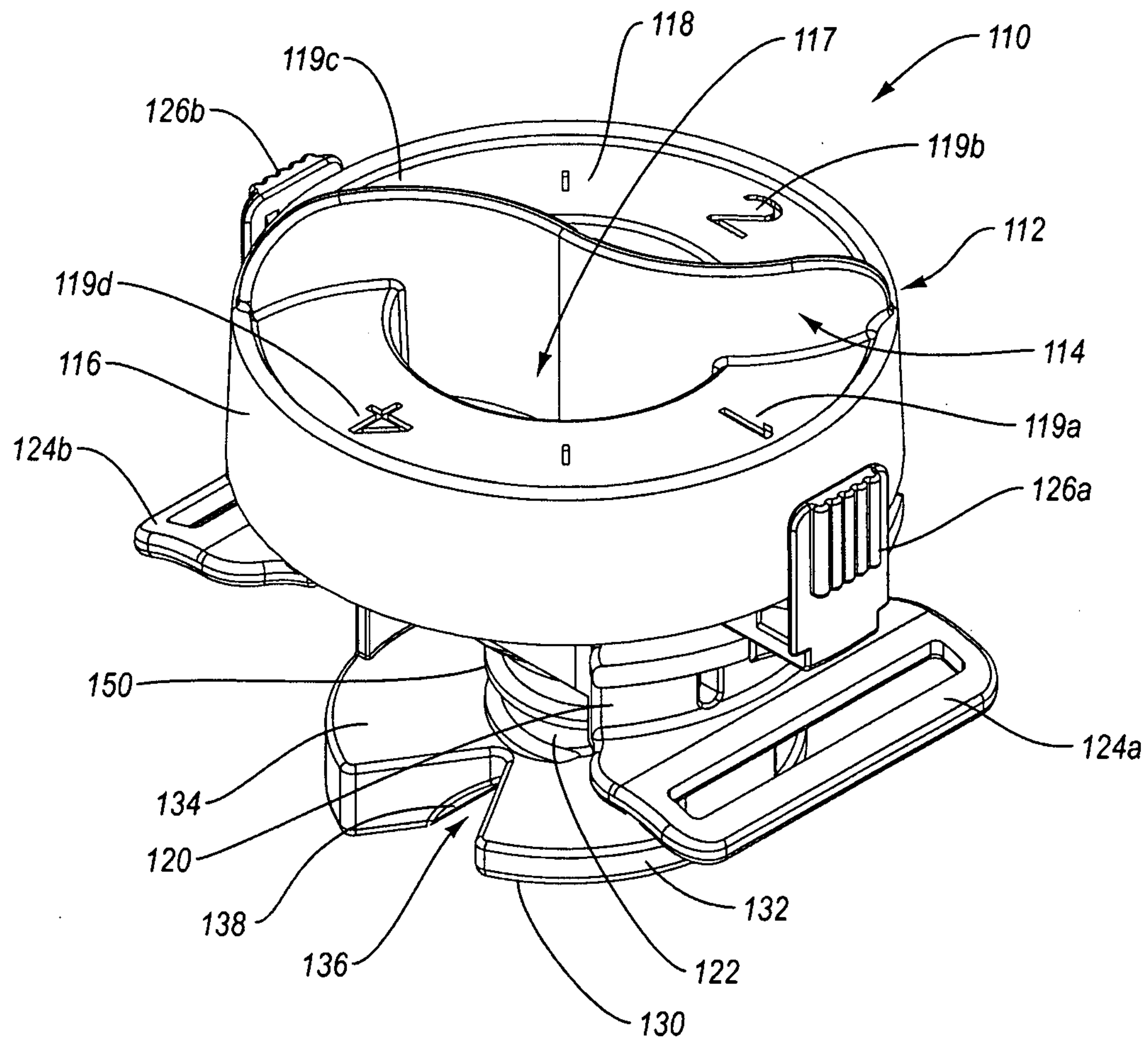
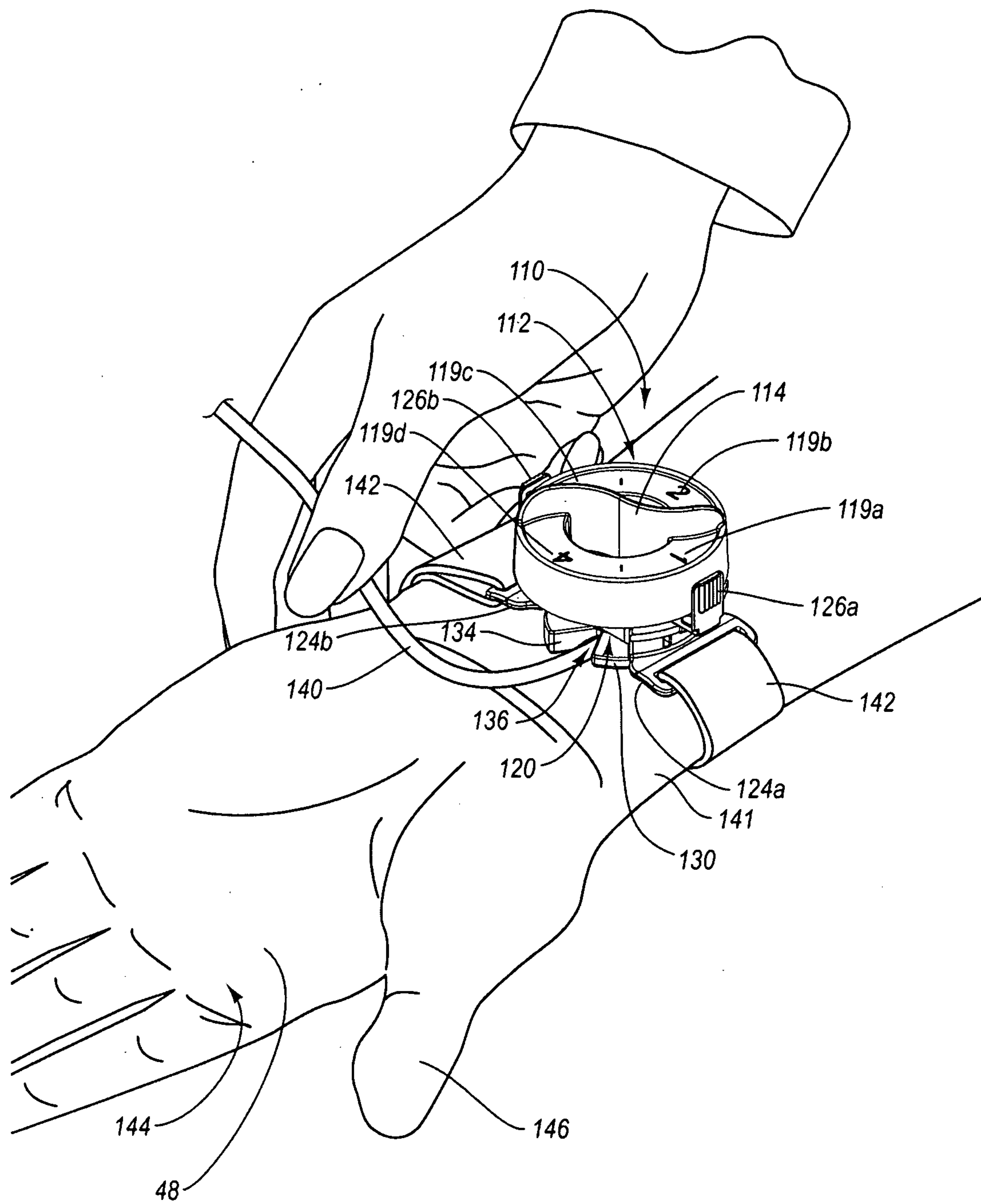


FIG. 7

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**FIG. 8**

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**FIG. 9A**

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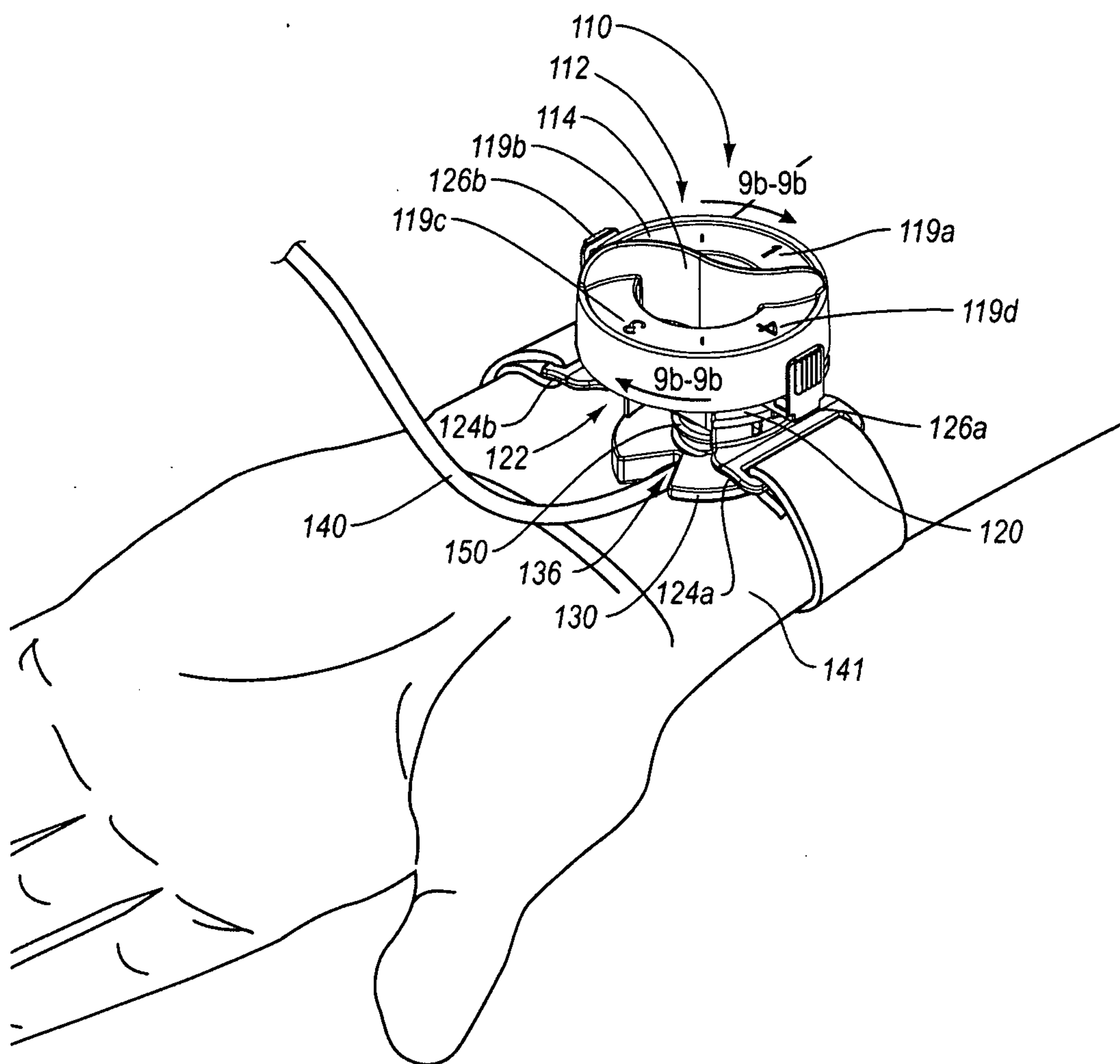


FIG. 9B

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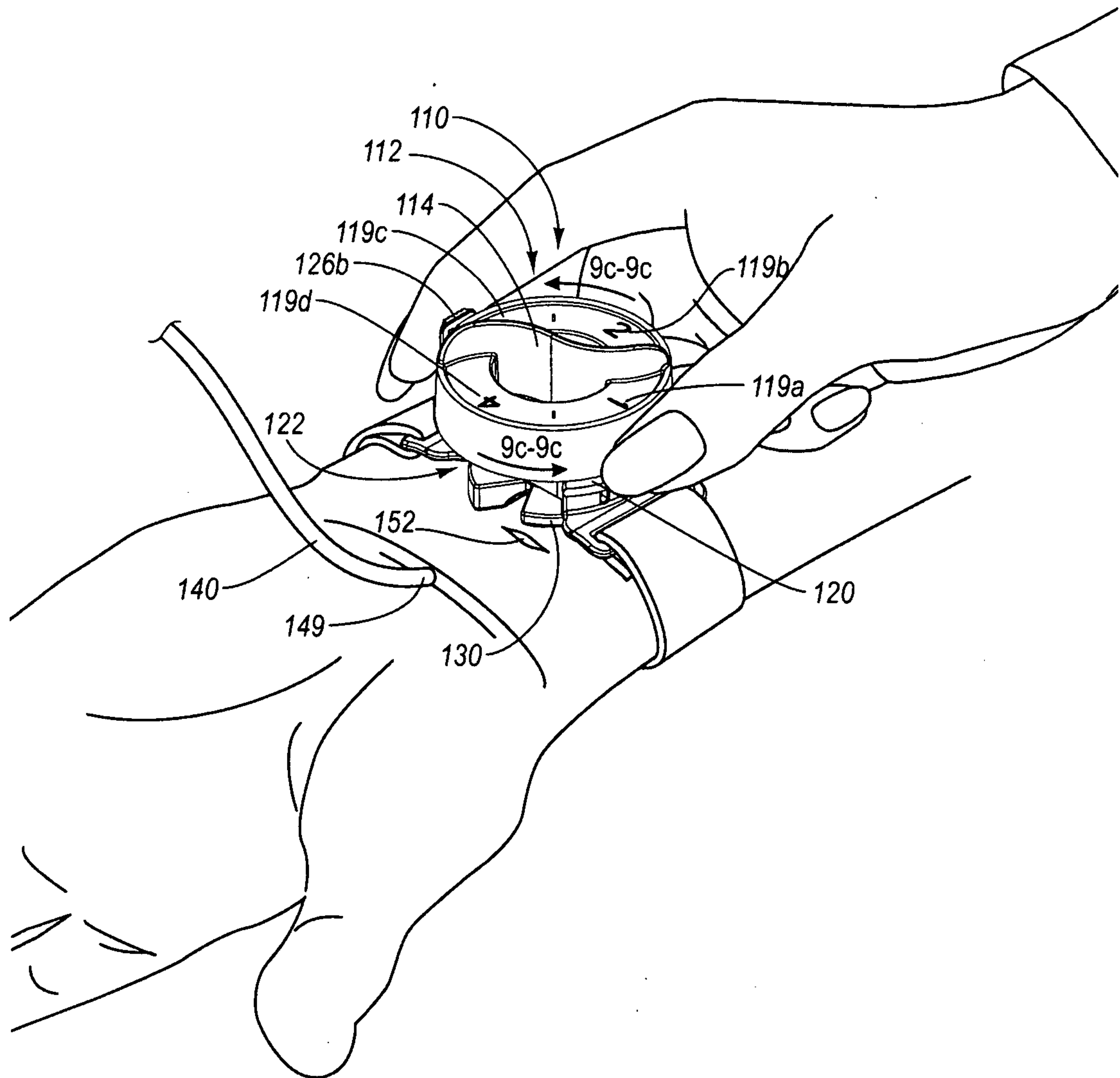


FIG. 9C

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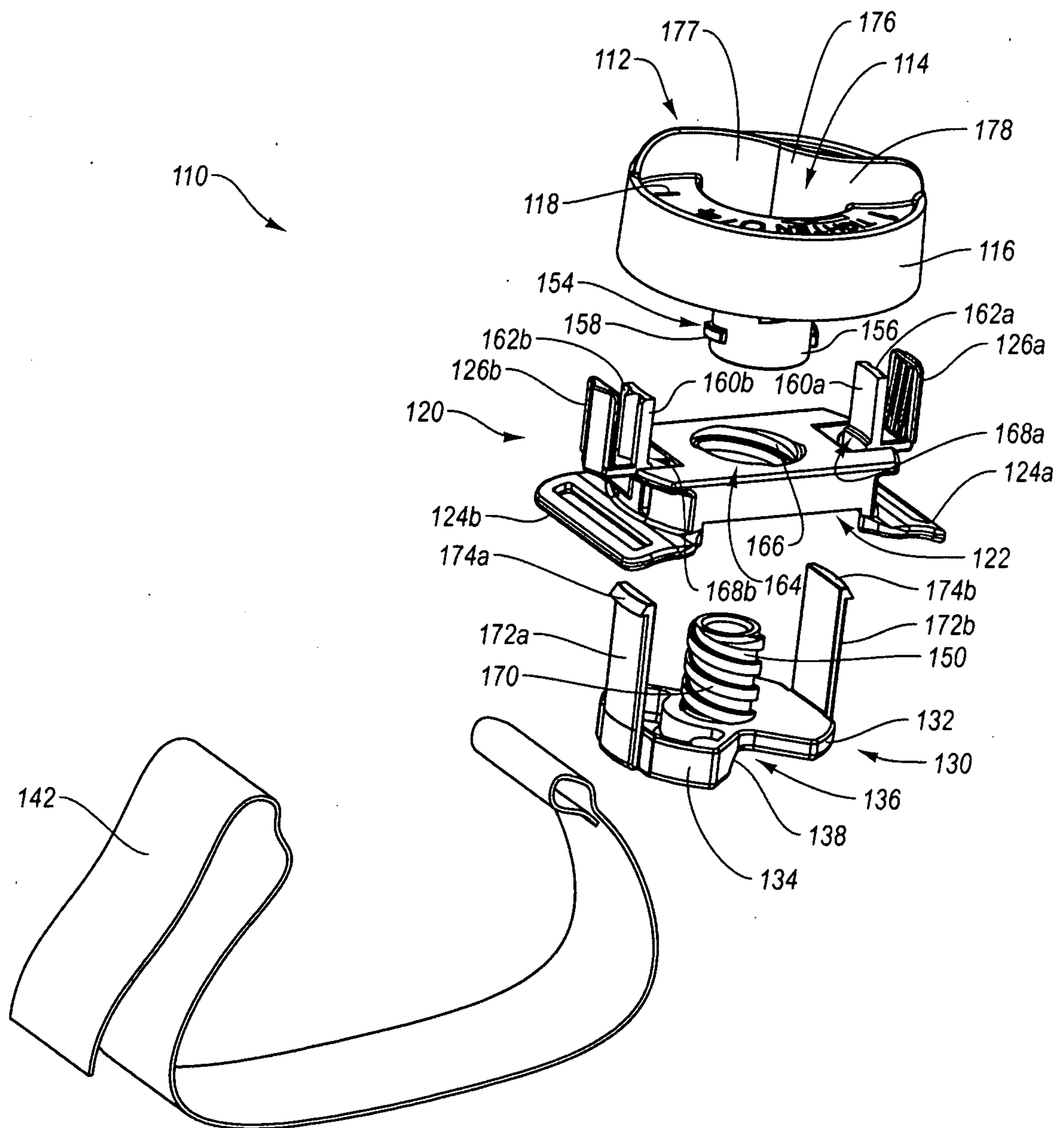


FIG. 10

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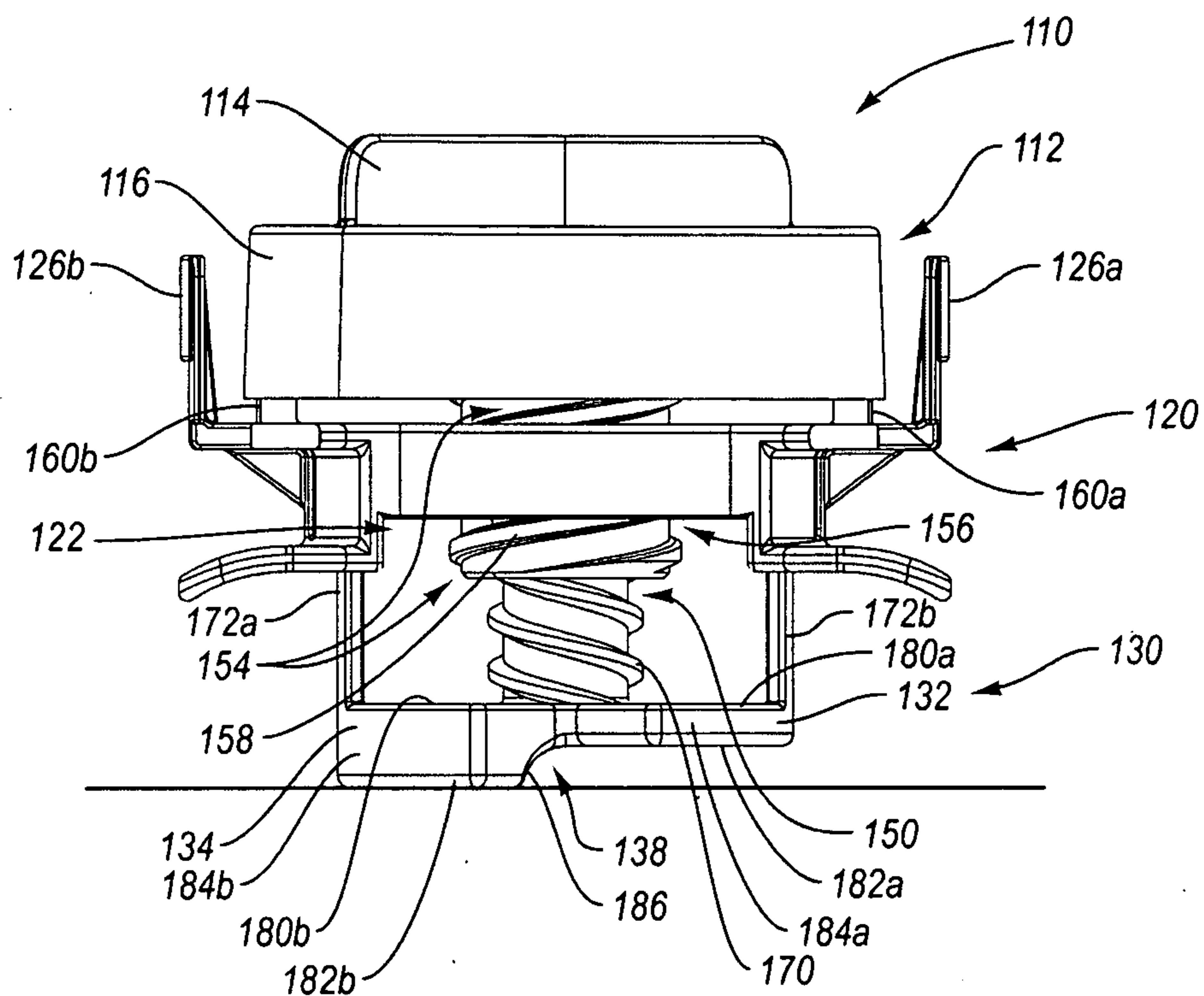


FIG. 11A

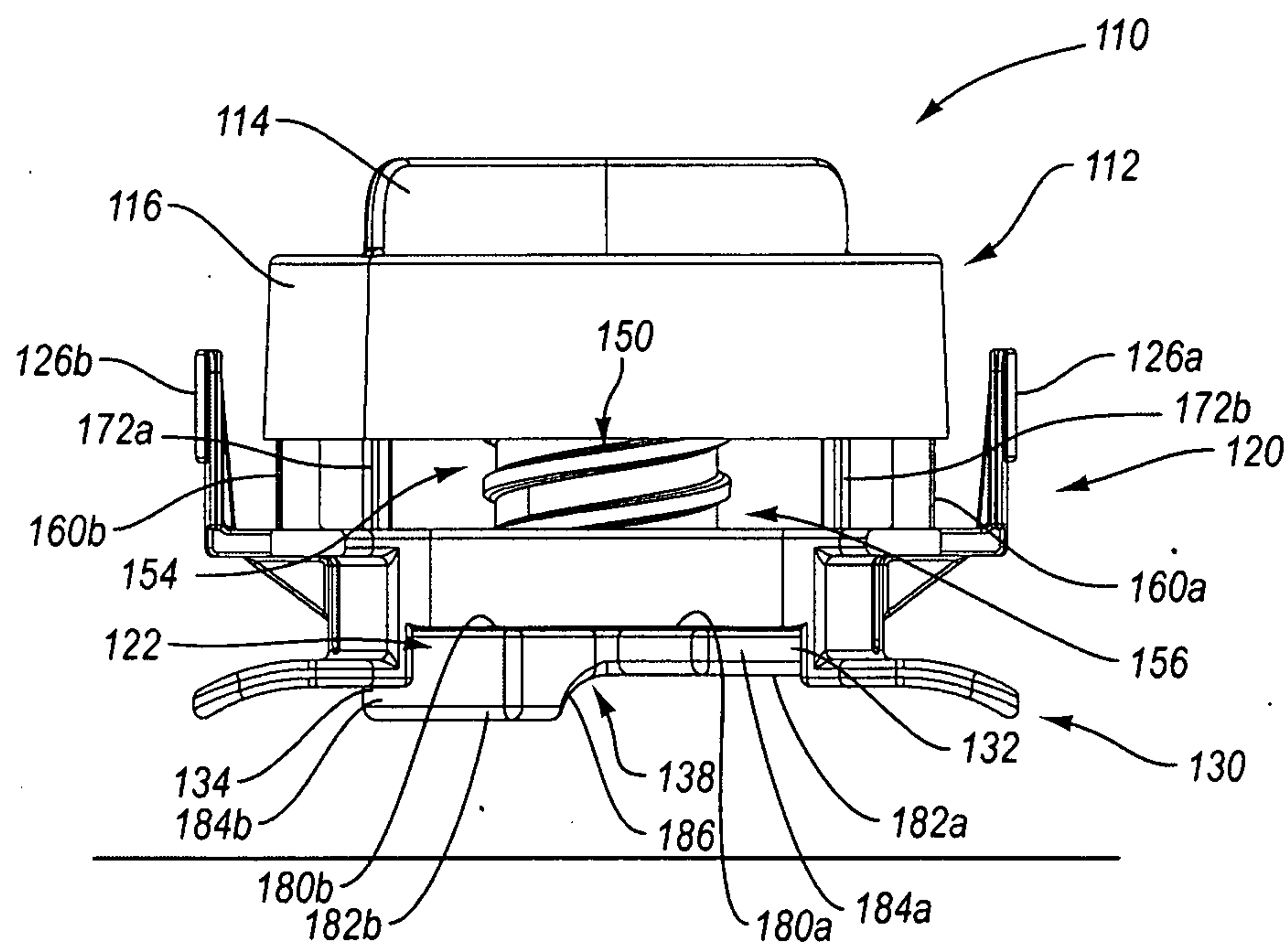


FIG. 11B

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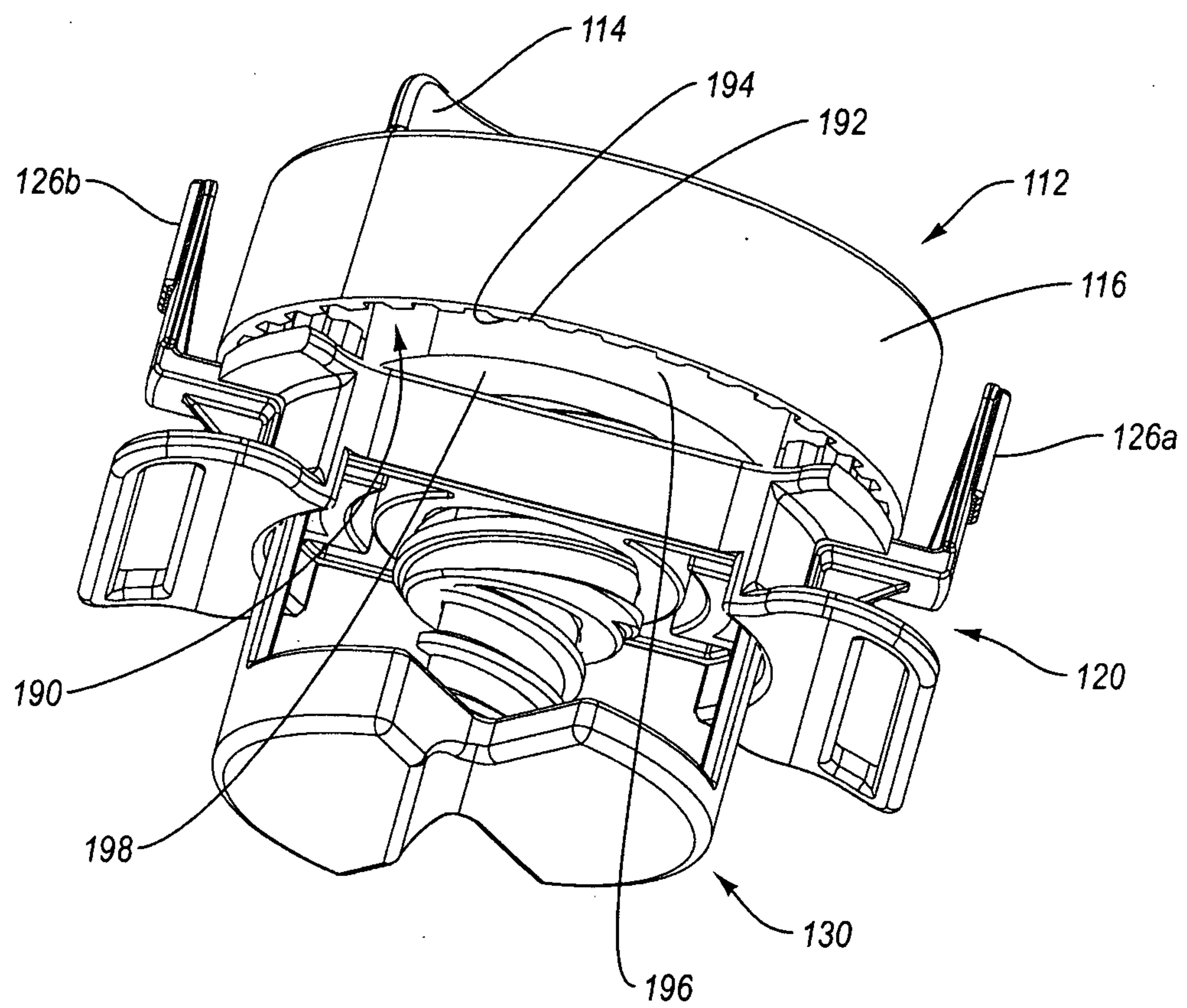


FIG. 12

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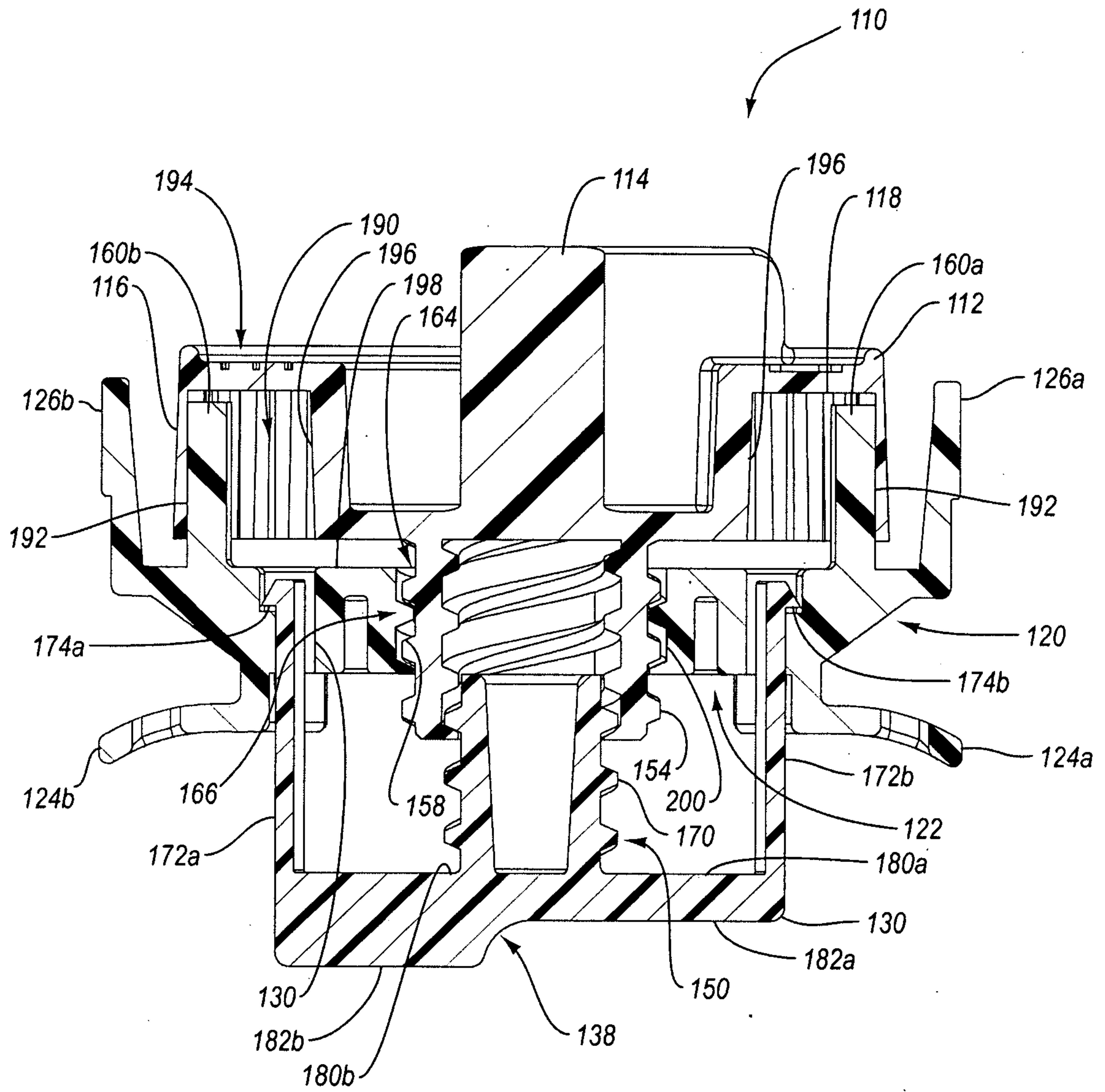


FIG. 13A

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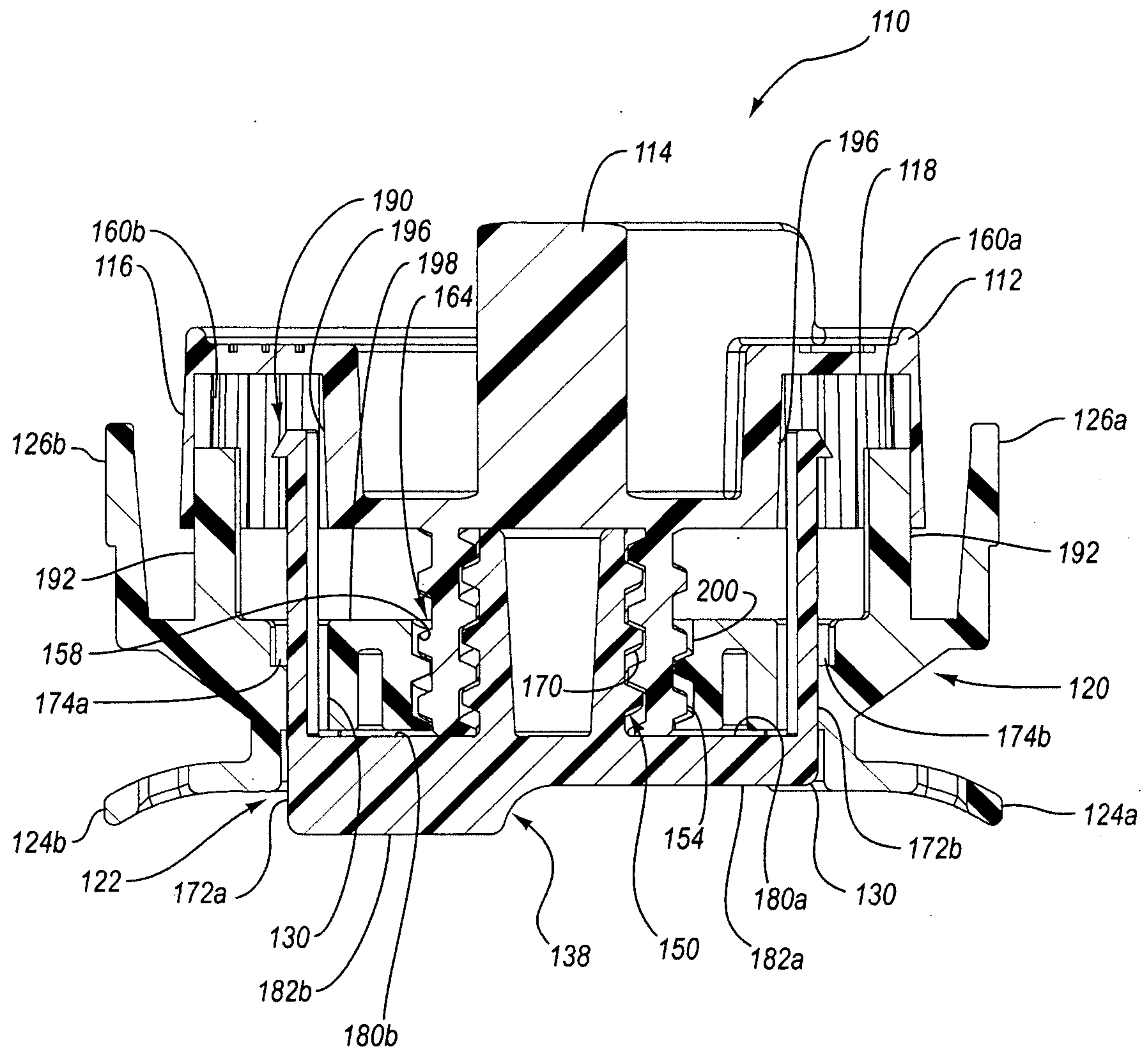
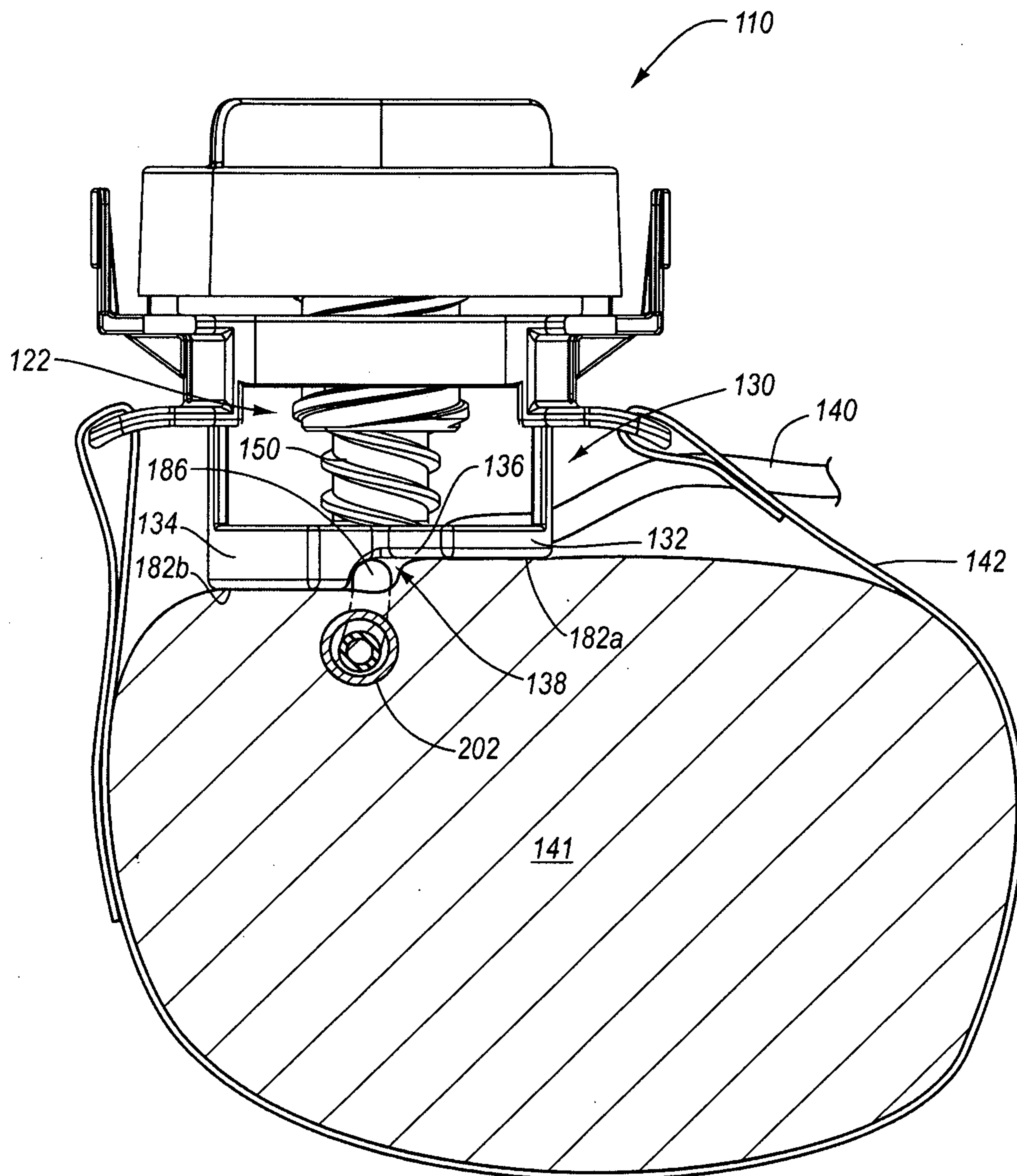


FIG. 13B

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**Figure 14**

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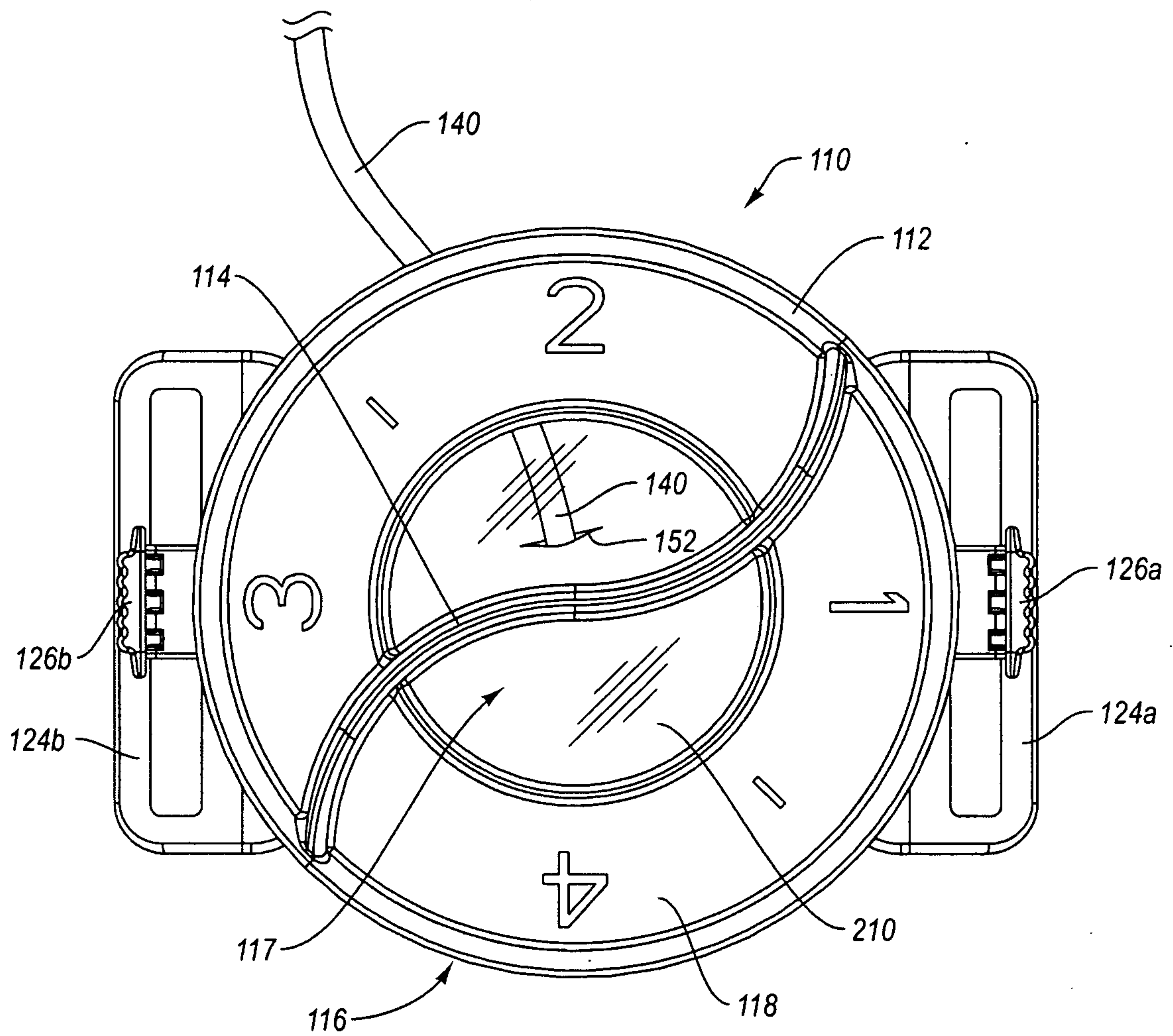


FIG. 15

