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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 February 2019 (14.02.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/030673 A1

(51) International Patent Classification:
A61B 17/10 (2006.01) *A61B 17/128* (2006.01)
A61B 17/28 (2006.01) *A61B 17/29* (2006.01)
A61B 17/068 (2006.01)

(21) International Application Number:
PCT/IB2018/055948

(22) International Filing Date:
07 August 2018 (07.08.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
15/674,121 10 August 2017 (10.08.2017) US

(71) Applicant: **ETHICON LLC** [US/US]; #475 Street C, Suite 401, Los Frailes Industrial Park, Guaynabo, 00969 (PR).

(72) Inventors: **STOKES, Michael J.**; 4545 Creek Road, Cincinnati, Ohio 45242 (US). **BAXTER, III, Chester O.**; 4545 Creek Road, Cincinnati, Ohio 45242 (US). **WYNN, Carol J.**; 4545 Creek Road, Cincinnati, Ohio 45242 (US).

(74) Agent: **SHIRTZ, Joseph F.** et al.; Johnson & Johnson, One Johnson & Johnson Plaza, New Brunswick, New Jersey 08933 (US).

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

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

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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

(54) Title: JAW FOR CLIP APPLIER

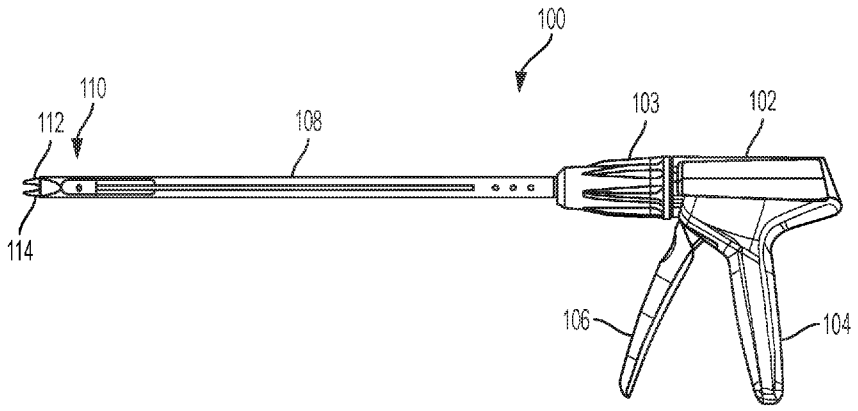


FIG. 1

(57) Abstract: Jaws of a surgical clip applier with housings formed thereon and methods for manufacturing are provided. In one exemplary embodiment, a surgical clip applier is provided having jaws on a distal end thereof with a rigid internal frame and an outer housing formed around the internal frame. The jaws of the surgical clip applier can include a variety of features to facilitate placement of surgical clips, including features to align a clip with the jaws and to prevent clip fallout during formation.

WO 2019/030673 A1

JAW FOR CLIP APPLIER

FIELD

[0001] Clip appliers having an improved jaw structure, and methods for using and manufacturing the same, are provided herein.

BACKGROUND

[0002] A variety of surgical procedures require application of clips to seal and/or secure tissue, requiring a surgical clip applier for ligating a blood vessel, a duct, shunt, a portion of body tissue, etc. during surgery. The jaws of most surgical clip appliers are formed through a process of metal stamping or machining, which can limit the possible geometry of the jaws. For example, rails of the jaws are designed to hold a clip in a clip track, however sufficient clearance is required in order to accommodate varying clip heights or other deformities between clips. This clearance can result in surgical clips being free to shift or wiggle in the clip tracks, which could result in clip malformation or clip fallout.

[0003] Accordingly, there remains a need for clip appliers having an improved structure for formation and placement of clips during surgical procedures.

SUMMARY

[0004] Clip appliers having improved jaws and methods for using and manufacturing the same are provided herein. In one embodiment, a surgical clip applier is provided and includes an elongate shaft and a jaw assembly at a distal end of the elongate shaft. The jaw assembly can include a metal frame having a proximal portion coupled to the elongate shaft and a distal portion including first and second jaws movable between open and closed positions for engaging tissue therebetween. The first and second jaws can each have an engagement feature formed thereon. The jaw assembly can also include a first outer housing around the first jaw and a second outer housing around the second jaw. The engagement feature can prevent movement of the first and second outer housings relative to the metal frame. The first and second outer housings can also have opposed inward facing surfaces, with each inward facing surface having a clip track formed therein and extending longitudinally therealong for receiving and guiding a clip into the jaws.

[0005] In one embodiment, the first and second outer housings can be overmolded around the first and second jaws, and in another embodiment, the first and second outer housings can be configured to be coupled to the first and second jaws through one of adhesive, welding, and mechanical engagement means.

[0006] In some embodiments, the first and second jaws can include opposed inward facing surfaces, and the engagement feature can be a protrusion formed on the inward facing surface. The protrusion on each of the first and second jaws can extend through the outer housing such that the protrusion is configured to contact a clip seated in the clip track.

[0007] The jaw assembly can be formed from various materials. In one embodiment, the first and second outer housings can be formed from a polymeric material. The metal frame can have a modulus of elasticity that is greater than a modulus of elasticity of a material forming the first and second outer housings.

[0008] The housings can include various features. For example, the first and second outer housings can each include a plurality of fingers protruding into the clip track for retaining a clip therein. The plurality of fingers can be flexible. The first and second outer housings can also each include upper and lower rails that define the clip track. In one embodiment, at least one cut-out can be formed in at least one of the upper and lower rails for allowing a user to view a clip seated in the clip track. In other embodiments, the first and second outer housings can each have upper and lower protrusions positioned on opposed sides of the clip track for retaining a clip seated in the clip track.

[0009] In another embodiment, a jaw insert for use with a clip applier device is provided and includes a metal body having a proximal portion and a distal portion with first and second arms having opposed inward facing surfaces. Each inward facing surface can have at least one protrusion formed thereon. The jaw insert can also include first and second housings on the first and second arms, respectively. The first and second housings can include opposed inward facing surfaces that each define a clip track extending therealong for seating a clip therein. The at least one protrusion on each of the first and second arms can extend through the inward facing surface of the first and second housings, respectively, such that the at least one protrusion on each of the first and second arms is configured to contact a clip seated in the clip track.

[0010] In one embodiment, the first and second housings can be overmolded onto the first and second arms, and in another embodiment, the first and second housings can be configured to be coupled to the first and second arms through one of adhesive, welding, and mechanical engagement means.

[0011] The protrusion can be configured to prevent longitudinal sliding of the first and second housings. In certain embodiments, the protrusion can be positioned at a substantial mid-portion of the clip track such that the protrusion is configured to engage a bend zone on a clip seated in the clip track.

[0012] The jaws can be formed from various materials. For example, the metal body can be made of a first material and the first and second housings can be made of a second material. The first material can have a modulus of elasticity that is greater than a modulus of elasticity of the second material.

[0013] The housings can include various other features. For example, each of the first and second housings can have a plurality of fingers protruding into the clip track configured for retaining a clip therein. In one aspect, the metal body can be made of a first material, the first and second housings can be made of a second material, and the plurality of fingers can be made of a third material. The third material can have a modulus of elasticity that is less than a modulus of elasticity of the first material and a modulus of elasticity of the second material.

[0014] In other embodiments, the inward facing surface of the first and second housings can include upper and lower rails that define the clip track. At least one cut-out can be formed in at least one of the upper and lower rails for allowing a user to view a clip seated in the clip track.

[0015] In another embodiment, a method of manufacturing a jaw assembly of a surgical clip applier is provided and can include forming a metal frame defining first and second jaws configured to grasp tissue therebetween. Each jaw can have an engagement feature thereon. The method can also include molding first and second housings around the first and second jaws, respectively, to form opposed inward facing surfaces having a clip track formed therein and extending therealong for receiving and guiding a clip into the jaws. The engagement feature can prevent sliding movement of the first and second housings relative to the first and second jaws.

[0016] In one embodiment, the engagement feature can be a protrusion that extends through the housing and that is configured to contact a clip seated in the clip track. Each housing can include upper and lower rails defining the clip track. At least one of the upper and lower rails can have at least one finger protruding into the clip track. The method can also include injection molding a third material into cavities formed in the clip track to form a plurality of fingers extending into the clip track.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0018] FIG. 1 is a side view of one exemplary embodiment of a surgical clip applier;

[0019] FIG. 2 is an exploded view of a distal portion of the surgical clip applier of FIG. 1;

[0020] FIG. 3 is a perspective view of a distal portion of the surgical clip applier of FIG. 1;

[0021] FIG. 4A is a perspective, partially transparent view of a proximal portion of the surgical clip applier of FIG. 1;

[0022] FIG. 4B is another perspective view of the proximal portion of the surgical clip applier of FIG. 1;

[0023] FIG. 5 is a side, transparent view of an embodiment of a portion of a jaw assembly for use with a surgical clip applier;

[0024] FIG. 6 is a front, transparent view of an inward facing surface of one of the jaws of the surgical clip applier in the direction AA of FIG. 5;

[0025] FIG. 7 is a side, transparent view of another embodiment of a portion of a jaw assembly for use with a surgical clip applier;

[0026] FIG. 8 is a side, transparent view of another embodiment of a portion of a jaw assembly for use with a surgical clip applier;

[0027] FIG. 9 is a side, transparent view of another embodiment of a portion of a jaw assembly for use with a surgical clip applier;

[0028] FIG. 10 is a front, transparent view of an inward facing surface of another embodiment of a jaw;

[0029] FIG. 11 is a front, transparent view of an inward facing surface of yet another embodiment of a jaw;

[0030] FIG. 12 is a cross-sectional view of another embodiment of a jaw;

[0031] FIG. 13 is a cross-sectional view of still another embodiment of a jaw;

[0032] FIG. 14 is a cross-sectional view of another embodiment of a jaw;

[0033] FIG. 15 is a cross-sectional view of yet another embodiment of a jaw; and

[0034] FIG. 16 is a cross-sectional view of still another embodiment of a jaw.

DETAILED DESCRIPTION

[0035] Certain exemplary embodiments will now be described to provide an overall understanding of the principles of the structure, function, manufacture, and use of the devices and methods disclosed herein. One or more examples of these embodiments are illustrated in the accompanying drawings. Those skilled in the art will understand that the devices and methods specifically described herein and illustrated in the accompanying drawings are non-limiting exemplary embodiments and that the scope of the present invention is defined solely by the claims. The features illustrated or described in connection with one exemplary embodiment may be combined with the features of other embodiments. Such modifications and variations are intended to be included within the scope of the present invention.

[0036] A surgical clip applier can generally be used to apply surgical clips to a vessel, duct, shunt, etc., during a surgical procedure. An exemplary surgical clip applier can include a jaw assembly having a frame with a pair of jaws and a housing overmolded onto the jaws with various clip aligning and engaging features. For example, the overmolded housing can have inward facing surfaces that define a clip track for receiving and guiding a clip into the jaws. The

outer overmolded housing can allow for a variety of different structures and geometries to better control formation and placement of surgical clips that are not possible with other surgical clip appliers, such as clip appliers having jaws formed through a stamping or machining process.

[0037] A surgical clip applier can generally have a variety of different forms with a variety of different jaws and clip tracks. FIGS. 1-4B illustrate one embodiment of a surgical clip applier 100. A person skilled in the art will appreciate that the jaw assemblies disclosed herein can be used with any clip applier device, or with any device having jaws. The illustrated clip applier is merely one example of a device for use with the jaw assemblies disclosed herein, and it is not intended to be limiting. As shown, the surgical clip applier 100 generally includes a housing 102 having a stationary handle 104 and a movable handle or trigger 106 that is pivotally coupled to the housing 102. An elongate shaft 108 extends distally from the housing 102 and includes a jaw assembly 110 formed on a distal end 108d thereof and including first and second jaws 112, 114 that are movable between open and closed positions. The first and second jaws 112, 114 include opposed inward facing surfaces and each inward facing surface has a clip track formed therealong for receiving and guiding legs of a clip into the first and second jaws 112, 114. The elongate shaft 108 can be rotated with respect to the housing 102 via a rotation knob 103.

[0038] As shown in FIGS. 2 and 3, the elongate shaft 108 can include an outer support tube 120, an upper shroud 122 coupled distally to the outer tube 120, and a lower shroud 124. The outer support tube 120 and the upper and lower shrouds 122, 124 form an outer casing of the shaft 108. As shown in FIGS. 2 and 3, a clip stack 126 including multiple surgical clips is disposed within a clip track or holder 128 of the shaft 108 proximal to the first and second jaws 112, 114, and is biased distally. A floor 130 extends beneath the clip stack 126 for maintaining the clip stack 126 in alignment within the shaft 108, and for guiding a distal-most clip 126d into the jaws 112, 114. A lifter spring 132 is positioned just proximal to the jaws 112, 114 and distal to the clip stack 126 for preventing distal movement of the clip stack 126, with the distal-most clip 126d disposed around the lifter spring 132. A feeder bar 134 extends through the elongate shaft 108 for feeding the distal-most clip 126d into the jaws. As shown in FIG. 3 illustrating the clip applier 100 with the upper and lower shrouds 122, 124 removed, a former tube 136 extends around a proximal end of the jaws 112, 114 and is movable distally to cam the jaws 112, 114 to a closed position for forming a clip 127 disposed therebetween.

[0039] The surgical clip applier 100 has a clip forming assembly including various components that operate together to close the jaws 112, 114 when the trigger 106 is activated to thereby cause a clip (e.g., clip 127) disposed in the jaws to be applied (formed) to the tissue. The clip forming assembly encompasses the former tube 136 and other components that are coupled to the trigger 106 configured to be activated to move the former tube 136 distally to thereby close the jaws 112, 114. A clip advancing assembly of the surgical clip applier 100 includes the feeder bar 134 that is also coupled to the trigger 106, via a link 107 extending proximally from the trigger 106, as shown in FIGS. 4A and 4B. In this way, when the trigger 106 is activated, the feeder bar 134 is caused to move proximally, opposite to a distal direction in which the former tube 136 is moved upon activation of the trigger 106.

[0040] The clip forming and clip advancing assemblies can have any suitable configurations. For example, in the illustrated embodiment, as shown in FIGS. 4A and 4B, the former tube 136 of the clip forming assembly is coupled, via an inner coupling 138, to a former plate 140 in the handle 102 that is, in turn, coupled to the trigger 106 via a pin 141, and the feeder bar 134 of the clip advancing assembly is coupled to the trigger 106 via a feeder plate 142 that is also coupled to the trigger 106, via the link 107. As shown in FIG. 4A, the feeder plate 142 has arms 144a, 144b at a distal end thereof that are disposed over and mate with a proximal end of an outer coupling 146 (shown partially transparent). A connecting pin 148 at a distal end of the outer coupling 146 attaches the feeder bar 134 to the outer coupling 146. FIGS. 4A and 4B illustrate the handle 102 with part of an outer casing removed, and FIG. 4B shows the handle 102 without the feeder plate 142, for illustration purposes only. It should be appreciated that the surgical clip applier 100 can include various other components and assemblies that are not described herein for the sake of simplicity.

[0041] In use, when the trigger 106 of the handle 102 is activated (e.g., moved towards the stationary handle 104), the former plate 140 of the clip forming assembly is advanced distally to cause the former tube 136 to advance distally over the jaws 112, 114, thereby camming the jaws 112, 114 to the closed position. At the same time, the feeder plate 142 of the clip advancing assembly is moved proximally, thereby pulling the feeder bar 134 proximally to position the feeder bar 134 proximal of the distal-most clip 126d of the clip stack 126. Once the clip 127, disposed in the jaws 112, 114 such that clip's legs are received within the clip track of each of

the jaws, is fully formed, the trigger 106 is released, which causes the clip forming assembly to move proximally while the clip advancing assembly moves distally. FIG. 2 shows the clip 127 in an original, pre-formed configuration. The proximal movement of the clip forming assembly causes the former tube 136 to retract relative to the jaws, thus allowing the jaws 112, 114 to move to the original open position, thereby releasing the formed clip. The distal movement of the clip advancing assembly causes the feeder bar 134 to move distally, and the feeder bar 134 thereby pushes the distal-most clip 126d distally, overcoming the biasing force of the lifter spring 132 and causing the lifter spring 132 to deflect out of the way, thereby allowing the distal-most clip 126d to be advanced into the jaws 112, 114. In this way, the distal-most clip becomes positioned in the jaws' clip track, like the clip 127 in FIG. 3. The floor 130 helps guide the distal-most clip into the clip tracks of the jaws 112, 114.

[0042] A person skilled in the art will appreciate that, while a trigger is shown and described, the clip appliers disclosed herein need not include a trigger, and can have a variety of other actuation mechanisms. For example, the clip applier can be powered and can include an actuation button for actuating a motor to control firing of the device. In other embodiments, the housing can be configured to couple to a robotic or telemanipulator system, such that actuation of the device is controlled through the robotic system.

[0043] A variety of different jaw assemblies incorporating various overmolded features can be used with a clip applier, such as the clip applier 100 illustrated in FIGS. 1-4A. The use of an overmolded housing can allow various features to be incorporated into the jaws that are not otherwise achievable using a typical stamping process for forming metal jaws.

[0044] FIGS. 5 and 6 illustrate a portion of one embodiment of a jaw assembly 500 that can be used with a clip applier, such as the clip applier 100, and that can be configured to grasp tissue and form and apply surgical clips, similar to the first and second jaws 112, 114 discussed above regarding clip applier 100.

[0045] The illustrated jaw assembly 500 includes a frame having a proximal portion 500p (only a portion of which is shown) that is configured to extend into the distal end of an elongate shaft of a clip applier, and a distal portion 500d with first and second jaws 502, 504 forming an approximate Y-shape. The first and second jaws 502, 504 can each include a tip portion 506,

508 having opposed inward facing surfaces 514, 515 from which engagement features, such as protrusions 510, 511, can extend towards one another into a central opening of the Y-shape of the jaws 500. The protrusions 510, 511 can be configured to help retain the overmolded housing on each jaw 502, 504, as will be discussed in more detail below. In certain embodiments, the protrusions 510, 511 can also provide support to a clip seated within the jaws during clip formation, such as being configured to provide a rigid surface that can directly contact and compress a clip. In certain exemplary embodiments, the protrusions 510, 511 can be configured to contact a bend zone or curve in the clip configured to assist in clip formation and closure, as will also be discussed in more detail below. A shroud 513 similar to the upper shroud 122 can be provided.

[0046] The engagement features, such as protrusions 510, 511, can have a variety of shapes and sizes, and can be positioned at various locations. In the illustrate embodiment, the protrusions 510, 511 are generally rectangular in shape, and the protrusions 510, 511 extend across at least part of a height of the surface 514 or entirely across the height of the surface 541, and along a portion of the length of each tip portion 506, 508, in the proximal/distal direction. There can be one or more protrusions on each tip portion 506, 508.

[0047] The jaw frame can be formed from various materials, but in an exemplary embodiment the jaw frame is formed from a stamped, machined, Electrical Discharge Machining (EDM), or Direct Metal Laser Sintering (DMLS) metal. The metal can vary in hardness (or a material's resistance to indentation as measured by the modulus of elasticity scale), depending on desired properties of the material. The jaw frame should be sufficiently flexible to allow the jaws to move between opened and closed positions, while having sufficient stiffness to prevent deformation of the jaws when forces are applied thereto. Since the metal frame need not include clip tracks or other features for retaining a clip therein, the process for manufacturing the frame can be significantly simplified.

[0048] As indicated above, features can be formed around the tip portion 506, 508 of the first and second jaws 502, 504. For example, features can be overmolded onto the tip portion or can be molded separately and attached to the tip portion by a variety of means, such as adhesives, laser weld, snap features, interference fit, etc. As illustrated in FIG. 5, overmolded housings 520,

522 can be formed over the tip portions 506, 508. The overmolded housings 520, 522 can partially or fully surround the tip portions 506, 508, and can include opposed inward facing surfaces 530, 531 positioning in alignment with the inward facing surfaces 514, 515 of the tip portions 506, 508. Each inward facing surface 530, 531 can have features that define, for example, a clip track 532, 533 extending longitudinally therealong for receiving and guiding legs of a clip 540 into the first and second jaws 502, 504. In certain embodiments, the clip tracks 532, 533 can be in the form of a generally rectangular-groove extending from a proximal end to a distal end of each inward facing surface 530, 531. Each clip track 532, 533 can be defined by opposed upper and lower rails (only one rail 532a, 533a on each clip track 532, 533 is shown) extending longitudinally along upper and lower edges of the inward facing surface 530, 531 of each housing 520, 522. The opposed legs of the clip 540 can thus extend between the rails such that the legs of the clip 540 are axially aligned with one another.

[0049] As indicated above, the protrusions 510, 511 can help prevent sliding movement of the overmolded housings 520, 522. For example, each protrusion 510, 511 can extend at least partially into the housing 520, 522 to thereby retain the housing on the jaws. This can be achieved during manufacturing by overmolding the housings 520, 522, e.g., using injection molding or other molding techniques, directly onto the tip portions 506, 508 such that the protrusions 510, 511 extend into the body of the housings 520, 522, thereby preventing movement of the housings 520, 522. The housings 520, 522 can be made with a variety of materials, such as various plastics, liquid crystal polymer (LCP), elastomers, etc., and can vary in hardness (or a material's resistance to indentation as measured by the modulus of elasticity scale), depending on desired properties of the material. In some embodiments, the modulus of elasticity of the overmolded housings 520, 522 can be less than a modulus of elasticity of at least the tip portions 506, 508 of the first and second jaws 502, 504.

[0050] The protrusions 510, 511 can also assist in clip formation. In particular, the protrusions 510, 511 can be flush, can sit proud, or can be slightly subflush of the outer surface of each clip track 532, 533 such that the protrusions 510, 511 will contact a clip either directly or indirectly (while still providing structural support and a rigid surface) when the clip is seated in the clip tracks 532, 533. In an exemplary embodiment, the protrusions 510, 511 are flush with the outer surface so that the protrusions 510, 511 directly contact a clip seating in the clip track. As a

result, the protrusions 510, 511 can provide a rigid surface for applying a force directly to the clips to aid in clip formation. In an exemplary embodiment, each protrusion 510, 511 is positioned to engage a bend zone of the clip, e.g., a region where the clip bends to move from the open configuration to the closed configuration. This is illustrated in FIG. 8, which shows protrusions 710, 711 located at about a mid-portion along the length of each tip portion and in contact with the bend zone. In other embodiments, the housings 520, 522 can be molded separately and attached to the tip portions 506, 508 by a variety of means, such as adhesives, laser welding, snap features, interference fit, etc.

[0051] In use, a clip advancing assembly can advance a clip 540 distally into the jaws 502, 504 such that the legs of the clip 540 are received within the clip track 532, 533 of each of the jaws 502, 504. The first and second jaws 502, 504 can move to the closed position, grasping tissue therebetween. This can be achieved using a former tube, for example, that is advanced around the jaws 502, 504, as previously discussed herein with respect to clip applier 100. When the jaws are closed, the clip 540 is compressed around tissue grasped therebetween. The protrusions 510, 511 act to provide additional structural force for deforming the clip 540 around the tissue.

[0052] The overmolded housings can have a variety of features and structures formed thereon as injection molding materials onto the jaws can allow for a variety of geometries that are not possible when jaws are only stamped or machined. FIG. 7 illustrates another embodiment of a jaw assembly 600 with overmolded housings 620, 622, similar to jaw assembly 500 with overmolded housings 520, 522. The illustrated jaw assembly 600 has a frame with a proximal portion 600p (only a portion of which is shown) that is configured to extend into the distal end of an elongate shaft of a clip applier, and a distal portion 600d with first and second jaws 602, 604. The first and second jaws 602, 604 can each include a tip portion 606, 608 having opposed inward facing surfaces 614, 615 from which engagement features, such as protrusions 610, 611, can extend towards one another. Overmolded features can be formed over the tip portions 606, 608, such as the overmolded housings 620, 622 with opposed inward facing surfaces 630, 631. Each inward facing surface 630, 631 can have a clip track 632, 633 formed therealong for receiving and guiding legs of a clip 640. Each clip track 632, 633 can be defined by opposed upper and lower rails (only one rail 632a, 633a on each clip track 632, 633 is shown) extending longitudinally along upper and lower edges of the inward facing surface 630, 631 of each

housing 620, 622. The opposed legs of the clip 640 can extend between the rails such that the legs of the clip 640 are axially aligned with one another. A shroud 613 similar to the upper shroud 122 can be provided.

[0053] In this embodiment, the opposed inward facing surfaces 630, 631 can also have ridges or protrusions 638, 639 formed on the upper and/or lower rails 632a, 633a that extend towards the opposed inward facing surface 630, 631 and surround the clip tracks 632, 633. As illustrated in FIG. 7, the protrusions 638, 639 can be configured to increase a depth of the clip tracks 632, 633 and/or to increase clip visibility while a clip is within the clip tracks 632, 633. The protrusions 638, 630 can also assist in grasping tissue to be clamped. The protrusions 638, 639 can be identical on each opposed jaw or can be complementary to one another for mating with one another when the jaws are closed. The protrusions 638, 639 can be made of the same material as the overmolded housings 620, 622 or can be made of a different material with a different modulus of elasticity, for example the protrusions 638, 639 can have a modulus of elasticity less than a modulus of elasticity of the material of the overmolded housings 620, 622, and thus less than a modulus of elasticity of the metal frame. When the protrusions 638, 639 are made of a different material, the overmolded housings 620, 622 can have cavities formed therein for receiving material for the protrusions 638, 639 during manufacturing.

[0054] While FIG. 7 illustrates a plurality of ridges or protrusions 638, 639 formed on the upper and lower rails that define the clip track, the overmolded housings 720, 722 can have a number of different protrusions or other features formed thereon. FIG. 8 illustrates another embodiment of a jaw assembly 700 with overmolded housings 720, 722, similar to jaw assembly 500 with overmolded housings 520, 522. The illustrated jaw assembly 700 can have a frame with a proximal portion 700p (only a portion of which is shown) that is configured to extend into the distal end of an elongate shaft of a clip applier, and a distal portion 700d with first and second jaws 702, 704. The first and second jaws 702, 704 can each include a tip portion 706, 708 having opposed inward facing surfaces 714, 715 from which engagement features, such as protrusions 710, 711, can extend towards one another. Overmolded features can be formed over the tip portions 706, 708, such as overmolded housings 720, 722 with opposed inward facing surfaces 730, 731. Each inward facing surface 730, 731 can have a clip track 732, 733 formed therealong for receiving and guiding legs of a clip 740. Each clip track 732, 733 can be defined

by opposed upper and lower rails (only one rail 732a, 733a on each clip track 732, 733 is shown) extending longitudinally along upper and lower edges of the inward facing surface 730, 731 of each housing 720, 722. The opposed legs of the clip 740 can extend between the rails such that the legs of the clip are axially aligned with one another. A shroud 713 similar to the upper shroud 122 can be provided.

[0055] The opposed inward facing surfaces 730 can have protrusions 738, 739 formed thereon that extend towards the opposed inward facing surface 730, 731, similar to the protrusions 638, 639. However, in this embodiment the protrusions 738, 739 can extend from the upper and/or lower rails 632a, 633a around the protrusions 710, 711, and can be configured to increase retention of the clip 740 within the jaw assembly 700 and help prevent clip fallout during formation. In other words, upper and lower protrusions on the upper and lower rails of each clip track can define a gap therebetween that is less than a height of the clip track, such that the upper and lower protrusions will help engage a clip seated therebetween. The protrusions 738, 739 can be made of the same material as the overmolded housings 720, 722 or can be made of a different material with a different modulus of elasticity, for example having a modulus of elasticity less than the material of the overmolded housings 720, 722. When the protrusions 738, 739 are made of a different material, the overmolded housings 720, 722 can have cavities formed therein for receiving material for the protrusions 738, 739 during manufacturing.

[0056] In other embodiments, various windows or openings can be formed in overmolded housings along clip tracks to allow users to view a location of a clip therein. As discussed above, the protrusions 638 can be configured to increase clip visibility while a clip is within the clip track 632, but openings can be formed anywhere along a length of the clip track. FIG. 9 illustrates a jaw assembly 800 with overmolded housings 820, 822, similar to jaw assembly 500 with overmolded housings 520, 522. The illustrated jaw assembly 800 has a frame with a proximal portion 800p (only a portion of which is shown) that is configured to extend into the distal end of an elongate shaft of a clip applier, and a distal portion 800d with first and second jaws 802, 804. The first and second jaws 802, 804 can each include a tip portion 806, 808 having opposed inward facing surfaces 814, 815 from which engagement features, such as protrusions 810, 811, can extend towards one another. Overmolded features can be formed over the tip portions 806, 808, such as the overmolded housings 820, 822 with opposed inward facing

surfaces 830, 831. Each inward facing surface 830, 831 can have a clip track 832, 833 formed therealong for receiving and guiding legs of a clip 840. Each clip track 832, 833 can be defined by opposed upper and lower rails (only one rail 832a, 833a on each clip track 832, 833 is shown) extending longitudinally along upper and lower edges of the inward facing surface 830, 831 of each housing 820, 822. The opposed legs of the clip 840 can extend between the rails such that the legs of the clip are axially aligned with one another. A shroud 813 similar to the upper shroud 122 can be provided.

[0057] In this embodiment, the overmolded housings 820, 822 can have openings formed therein, for example openings formed in proximal and/or distal portions of the upper and/or lower rails. FIG. 9 illustrates openings formed in distal ends of the upper and lower rails 832a, 833a, however the openings can be formed at any location that allows for visibility of a clip seating in the clip tracks. In the illustrated embodiment, ends 842, 843 of the clip 840 can be seen by a user through the distal window to thereby increase visibility of the clip 840 and assist with alignment during placement.

[0058] The clip track can also have a variety of configurations because of the injection molding process that are not possible with jaws that are stamped or machined. FIG. 10 illustrates another embodiment of a jaw assembly 900 with overmolded housings (with only one jaw and overmolded housing 920 being illustrated), similar to jaw assembly 500 with overmolded housings 520, 522. While only shown in part, the illustrated jaw assembly 900 has a frame with a proximal portion that is configured to extend into the distal end of an elongate shaft of a clip applier, and a distal portion 900d with first and second jaws (with only the first jaw 902 being illustrated, and the second jaw being a mirror image of the first jaw 902). The first and second jaws 902 can each include a tip portion 906 having opposed inward facing surfaces 914 from which engagement features, such as protrusions (not illustrated), can extend towards one another. Overmolded features can be formed over the tip portions 906, such as the overmolded housings 920 with opposed inward facing surfaces 930. Each inward facing surface 930 can have a clip track 932 formed therealong for receiving and guiding legs of a clip 940. Each clip track 932 can be defined by opposed upper and lower rails extending longitudinally along upper and lower edges of the inward facing surface 930 of each of the first and second housings 920. The opposed legs of the clip 940 can extend between the rails such that the legs of the clip are axially

aligned with one another.

[0059] In this embodiment, the clip track 932 is tapered distally with a wider portion of the clip track 932 on a proximal end 932p thereof closer to a clip applier and a narrower portion of the clip track 932 on a distal end 932d thereof. The taper in the clip track 932 can be configured to allow easy and effective feeding of the clip 940 into the clip track 932 while also reducing clearance between the clip 940 and the clip track 932 as the clip 940 is fully fed into the clip track 932 and approaches the distal end 932d thereof. Widths of distal and proximal ends of the tapered clip track 932 can vary, for example a width of the clip track 932 at the proximal end 932p can be approximately double a width of the clip track 932 at the distal end 932d.

[0060] Protrusions can also extend into the clip track itself. FIG. 11 illustrates another embodiment of a jaw assembly 1000 with overmolded housings (with only one jaw and overmolded housing 1020 being illustrated), similar to jaw assembly 500 with overmolded housings 520, 522. The illustrated jaw assembly 1000 can have a frame with a proximal portion that is configured to extend into the distal end of an elongate shaft of a clip applier, and a distal portion 1000d with first and second jaws (with only the first jaw 1002 being illustrated, and the second jaw being a mirror image of the first jaw 1002). The first and second jaws 1002 can each include a tip portion 1006 having opposed inward facing surfaces 1014 from which engagement features, such as protrusions (not illustrated), can extend towards one another. Overmolded features can be formed over the tip portions 1006, such as the overmolded housings 1020 with opposed inward facing surfaces 1030. Each inward facing surface 1030 can have a clip track 1032 formed therealong for receiving and guiding legs of a clip 1040. Each clip track 1032 can be defined by opposed upper and lower rails extending longitudinally along upper and lower edges of the inward facing surface 1030 of each of the first and second housings 1020. The opposed legs of the clip 1040 can extend between the rails such that the legs of the clip are axially aligned with one another.

[0061] As shown, protrusions 1038 can be formed at various locations along the clip track 1032, for example being formed on and extending from each of the rails, and configured to extend into the clip track 1032 and engage the clip 1040 therein. The protrusions 1038 can be configured to assist in holding and aligning the clip 1040 in the clip track 1032 during formation. The

protrusions 1038 can take a variety of forms, such as flexible fingers, pegs, fins, pads, wedges, etc., and there can be one or more protrusions 1038 formed in the clip track 1032. Widths, lengths, and stiffness levels (modulus of elasticity) of the protrusions 1038 can vary depending on desired uses. For example, the protrusions 1038 can have lengths such that a clip entering the clip track 1032 will be engaged by protrusions 1038 on either side of the clip track 1032 and be forced into an aligned, middle position in the clip track 1032, and the protrusions 1038 can be configured to flex or bend out of the way of a clip as it advances along the clip track 1038. This can be beneficial with surgical clips that have widths that vary along a length of the clip itself. The protrusions 1038 can be made of the same material as the overmolded housing 1020 or can be made of a different material with a different modulus of elasticity, for example having a modulus of elasticity less than a modulus of elasticity of the material of the overmolded housing 1020 to allow the protrusions 1038 to bend and flex with the clip 1040 while the housing 1020 provides stiffer support. When the protrusions 1038 are made of a different material, the overmolded housing 1020 can have cavities formed therein for receiving material for the protrusions 1038 during manufacturing.

[0062] Additional features can be added to a clip applier to improve clip retention in a jaw using an overmolded process, for example to keep a clip securely in a clip track with high clip retention forces while still having strong clip forming abilities. FIG. 12 illustrates another embodiment of a jaw assembly 1100 with overmolded housings (with only a cross-section of one jaw 1102 and overmolded features 1120 being illustrated), similar to jaw assembly 500 with overmolded housings 520, 522. The jaw 1102 of the illustrated jaw assembly 1100 is rigid and has overmolded features 1120 in the form of polymer rails formed thereon. As a clip 1140 is inserted into the jaw 1102, the polymer rails of the overmolded features 1120 can be configured to deform only slightly and allow for the clip 1140 to snap into place, being configured to keep the clip 1140 retained more securely against the jaw 1102 than many common designs that use only metal jaws. As illustrated in FIG. 12, the clip 1140 is configured to sit securely in a clip track 1132 of the jaw 1102.

[0063] Another embodiment with a similar structure is illustrated in FIG. 13. A jaw assembly 1200 with overmolded housings (with only a cross-section of one jaw 1202 and overmolded features 1220 being illustrated), similar to jaw assembly 500 with overmolded housings 520,

522. The jaw 1202 of the illustrated jaw assembly 1200 is rigid and has overmolded features 1220 in the form of elastomer rails formed thereon. As a clip 1240 is inserted into the jaw 1202, the elastomer rails of the overmolded features 1220 can be configured to deform and allow for the clip 1240 to deform the overmolded features 1220 and secure itself into place. As illustrated in FIG. 13, the clip 1240 is configured to sit securely in a clip track 1232 of the jaw 1202. The elastomer rails of the overmolded features 1220 can have a lower modulus of elasticity than a modulus of elasticity of the polymer rails of the overmolded features 1120. The overmolded features 1120 can thus cause the clip 1140 to snap into place in the jaw 1102 while the overmolded features 1220 allow for more deformation of the elastomer rails and an easier release of the clip 1240.

[0064] FIG. 14 illustrates another embodiment of a jaw assembly 1300 with overmolded housings (with only a cross-section of one jaw 1302 and overmolded features 1320, 1322 being illustrated), similar to jaw assembly 500 with overmolded housings 520, 522. The jaw 1302 of the illustrated jaw assembly 1300 is rigid and has first overmolded features 1320 in the form of polymer sidewall rails formed on either side of the jaw 1302 and second overmolded features 1322 in the form of elastomer inserts formed in a clip track 1332. As a clip 1340 is inserted into the jaw 1302, the polymer sidewall rails of the overmolded features 1320 can be configured to guide the clip 1340 along the clip track 1332, providing a rigid guide. The elastomer inserts can be positioned in the clip track 1332 itself and provide an interference fit between the clip 1340 and the clip track 1332 so that the clip 1340 can sit securely in the clip track 1323 while benefiting from a rigid guide from the overmolded features 1320 because the polymer sidewalls of the overmolded features 1320 can have a higher modulus of elasticity than a modulus of elasticity of the elastomer inserts of the overmolded features 1322.

[0065] While various structures are provided above for overmolded features, additional features and structures are possible. For example, FIG. 15 illustrates another embodiment of a jaw assembly 1400 with overmolded housings (with only a cross-section of one jaw 1402 and overmolded features 1420 being illustrated), similar to jaw assembly 500 with overmolded housings 520, 522. The jaw 1402 of the illustrated jaw assembly 1400 is rigid and has overmolded features 1420 in the form of polymer sidewall rails formed on either side of the jaw 1402 with arms 1422 formed to extend slightly into a clip track 1432 and help secure a clip 1440

therein.

[0066] Another possible geometry is illustrated in FIG. 16, in which another embodiment of a jaw assembly 1500 with overmolded housings (with only a cross-section of one jaw 1502 and overmolded features 1520 being illustrated), similar to jaw assembly 500 with overmolded housings 520, 522. The jaw 1502 of the illustrated jaw assembly 1500 is rigid and has overmolded features 1520 in the form of polymer sidewall rails formed on either side of the jaw 1502 in a dovetail shape such that inner surfaces 1522 of the sidewall rails are thicker than outer surfaces and are thus configured to extend slightly into a clip track 1532 to help secure a clip 1540 therein. While the materials discussed herein are polymers and elastomers, any materials can be used that can have lower values for modulus of elasticity than the rigid jaws.

[0067] The various clip retaining features disclosed herein can have a variety of other configurations, as disclosed in U.S. Application No. [ ] (Atty. Docket No. 47364-309F01US, END8262USNP), filed on even date herewith and entitled "Clip Retention for Surgical Clip Applier," which is hereby incorporated by reference in its entirety.

[0068] During manufacturing, a rigid frame defining one of the jaws 500, 600, 700, 800, 900, 1000 discussed above can be stamped from a rigid material, such as metal, including the one or more protrusions extending from distal portions thereof. Housings defining the overmolded housings 520, 522, 620, 622, 720, 722, 820, 822, 920, 1020 can be formed by injection molding a material, such as various plastics, liquid crystal polymer (LCP), elastomer, etc., around each of the corresponding jaws 500, 600, 700, 800, 900, 1000 to form the housings with the opposed inward facing surfaces defining the clip tracks therein. The protrusions on the metal frame can prevent sliding movement of the overmolded housings relative to the frame.

[0069] The various protrusions or other features of the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 discussed above located around and/or within the clip tracks can either be formed of the same material as the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 and can be injection molded simultaneously with the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 or can be made from a different material, such as various plastics, liquid crystal polymer (LCP), elastomer, etc., and can be formed after injection molding of the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 has been completed. In such an

embodiment, material for the various protrusions of the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 can be injection molded into cavities or spacings formed on the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 and configured to receive material for the protrusions therein. In some embodiments, material used to injection mold the overmolded housings 620, 622, 720, 722, 820, 822, 920, 1020 can be varied within a single overmolded housing to create varying material properties within one overmolded housing, for example increasing friction in various molded parts of the molded housings 620, 622, 720, 722, 820, 822, 920, 1020. Injection molding can thus occur in one step or over multiple steps depending on a desired complexity of the overmolded housings and how many materials are to be used in the overmolded housings.

[0070] In the present disclosure, like-numbered components of the embodiments generally have similar features, and thus within a particular embodiment each feature of each like-numbered component is not necessarily fully elaborated upon. Sizes and shapes of the devices described herein, and the components thereof, can depend at least on the anatomy of the subject in which the devices will be used, the size and shape of components with which the devices will be used, and the methods and procedures in which the devices will be used. The figures provided herein are not necessarily to scale. Although the devices and methods disclosed herein are generally directed to surgical techniques, they can also be used in applications outside of the surgical field.

[0071] Although the invention has been described by reference to specific embodiments, it should be understood that numerous changes may be made within the spirit and scope of the inventive concepts described. Accordingly, it is intended that the invention not be limited to the described embodiments, but that it have the full scope defined by the language of the following claims.

What is claimed is:

1. A surgical clip applier, comprising:

an elongate shaft;

a jaw assembly coupled to a distal end of the elongate shaft, the jaw assembly including

a metal frame having a proximal portion coupled to the elongate shaft and a distal portion including first and second jaws movable between open and closed positions for engaging tissue therebetween, the first and second jaws each having an engagement feature formed thereon, and

a first outer housing around the first jaw and a second outer housing around the second jaw, the engagement feature preventing movement of the first and second outer housings relative to the metal frame, and the first and second outer housings having opposed inward facing surfaces, each inward facing surface having a clip track formed therein and extending longitudinally therealong for receiving and guiding a clip into the jaws.

2. The surgical clip applier of claim 1, wherein the first and second outer housings are overmolded around the first and second jaws.

3. The surgical clip applier of claim 1, wherein the first and second outer housings are configured to be coupled to the first and second jaws through one of adhesive, welding, and mechanical engagement means.

4. The surgical clip applier of claim 1, wherein the first and second jaws include opposed inward facing surfaces, and wherein the engagement feature comprises a protrusion formed on the inward facing surface.

5. The surgical clip applier of claim 4, wherein the protrusion on each of the first and second jaws extends through the outer housing such that the protrusion is configured to contact a clip seated in the clip track.

6. The surgical clip applier of claim 1, wherein the first and second outer housings are formed from a polymeric material.

7. The surgical clip applier of claim 1, wherein the metal frame has a modulus of elasticity that is greater than a modulus of elasticity of a material forming the first and second outer housings.

8. The surgical clip applier of claim 1, wherein the first and second outer housings each include a plurality of fingers protruding into the clip track for retaining a clip therein.

9. The surgical clip applier of claim 1, wherein the first and second outer housings each include upper and lower rails that define the clip track.

10. The surgical clip applier of claim 9, wherein at least one cut-out is formed in at least one of the upper and lower rails for allowing a user to view a clip seated in the clip track.

11. The surgical clip applier of claim 9, wherein the first and second outer housings each have upper and lower protrusions positioned on opposed sides of the clip track for retaining a clip seated in the clip track.

12. A jaw insert for use with a clip applier device, comprising:

a metal body having a proximal portion and a distal portion with first and second arms having opposed inward facing surfaces, each inward facing surface having at least one protrusion formed thereon; and

first and second housings on the first and second arms, respectively, the first and second housings including opposed inward facing surfaces that each define a clip track extending therealong for seating a clip therein, and the at least one protrusion on each of the first and second arms extending through the inward facing surface of the first and second housings, respectively, such that the at least one protrusion on each of the first and second arms is configured to contact a clip seated in the clip track.

13. The jaw insert of claim 12, wherein the first and second housings are overmolded onto the first and second arms.

14. The jaw insert of claim 12, wherein the first and second housings are configured to be coupled to the first and second arms through one of adhesive, welding, and mechanical engagement means.

15. The jaw insert of claim 12, wherein the protrusion is configured to prevent longitudinal sliding of the first and second housings.

16. The jaw insert of claim 12, wherein the protrusion is positioned at a substantial mid-portion of the clip track such that the protrusion is configured to engage a bend zone on a clip seated in the clip track.

17. The jaw insert of claim 12, wherein the metal body is made of a first material and the first and second housings are made of a second material, the first material having a modulus of elasticity that is greater than a modulus of elasticity of the second material.

18. The jaw insert of claim 12, wherein each of the first and second housings has a plurality of fingers protruding into the clip track configured for retaining a clip therein.

19. The jaw insert of claim 18, wherein the metal body is made of a first material, the first and second housings are made of a second material, and the plurality of fingers are made of a third material, the third material having a modulus of elasticity that is less than a modulus of elasticity of the first material and a modulus of elasticity of the second material.

20. The jaw insert of claim 12, wherein the inward facing surface of the first and second housings includes upper and lower rails that define the clip track.

21. A method of manufacturing a jaw assembly of a surgical clip applier, comprising:

forming a metal frame defining first and second jaws configured to grasp tissue therebetween, each jaw having an engagement feature thereon; and

molding first and second housings around the first and second jaws, respectively, to form opposed inward facing surfaces having a clip track formed therein and extending therealong for receiving and guiding a clip into the jaws, the engagement feature preventing sliding movement of the first and second housings relative to the first and second jaws.

22. The method of claim 21, wherein the engagement feature comprises a protrusion that extends through the housing and is configured to contact a clip seated in the clip track.

23. The method of claim 21, wherein each housing includes upper and lower rails defining the clip track, at least one of the upper and lower rails having at least one finger protruding into the clip track.

24. The method of claim 21, further comprising injection molding a third material into cavities formed in the clip track to form a plurality of fingers extending into the clip track.

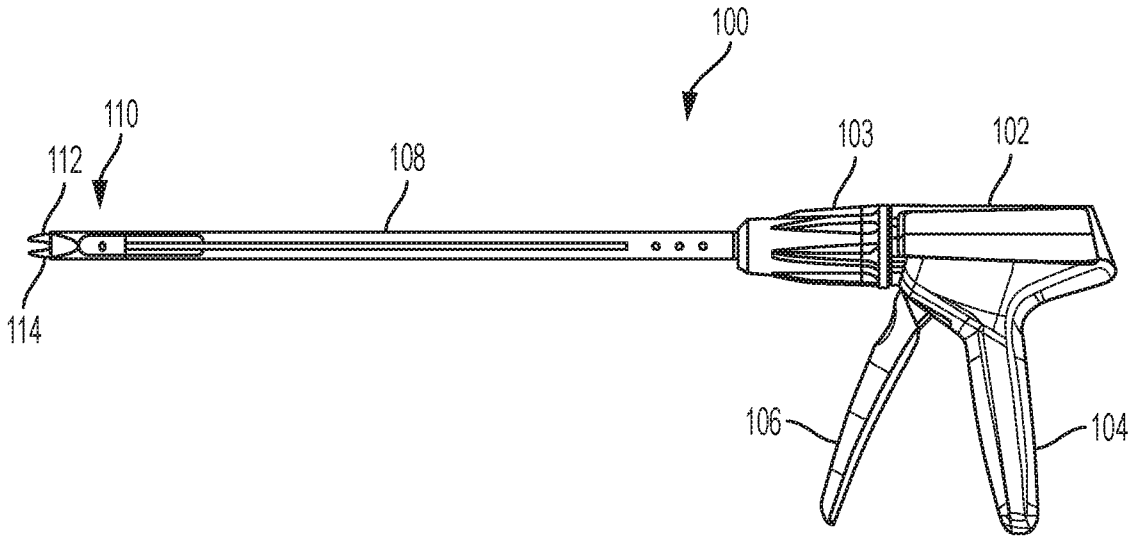

100
110
112
108
103
102
114
106
104

FIG. 1

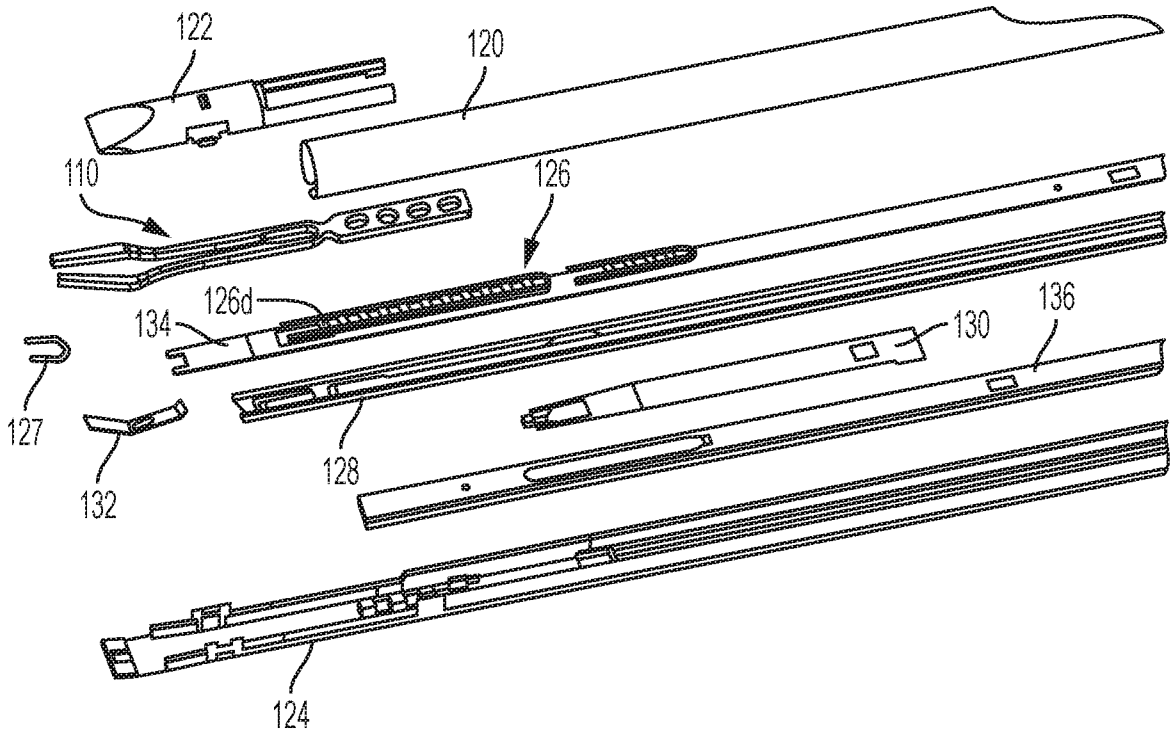

122
120
110
126
126d
134
130
136
127
128
132
124

FIG. 2

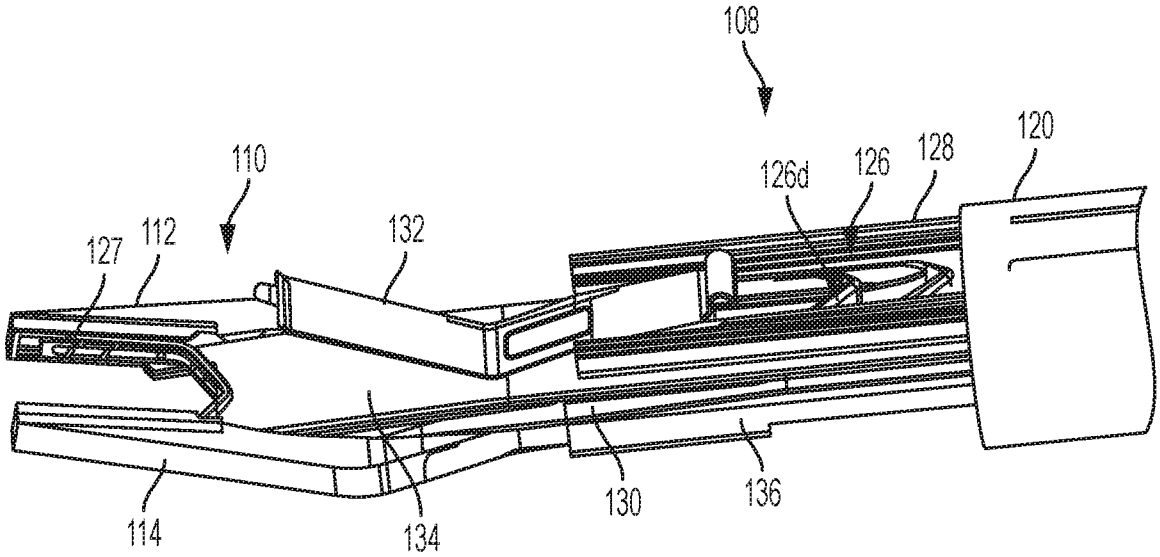

108
110
120
126d
126
128
127
112
132
114
134
130
136

FIG. 3

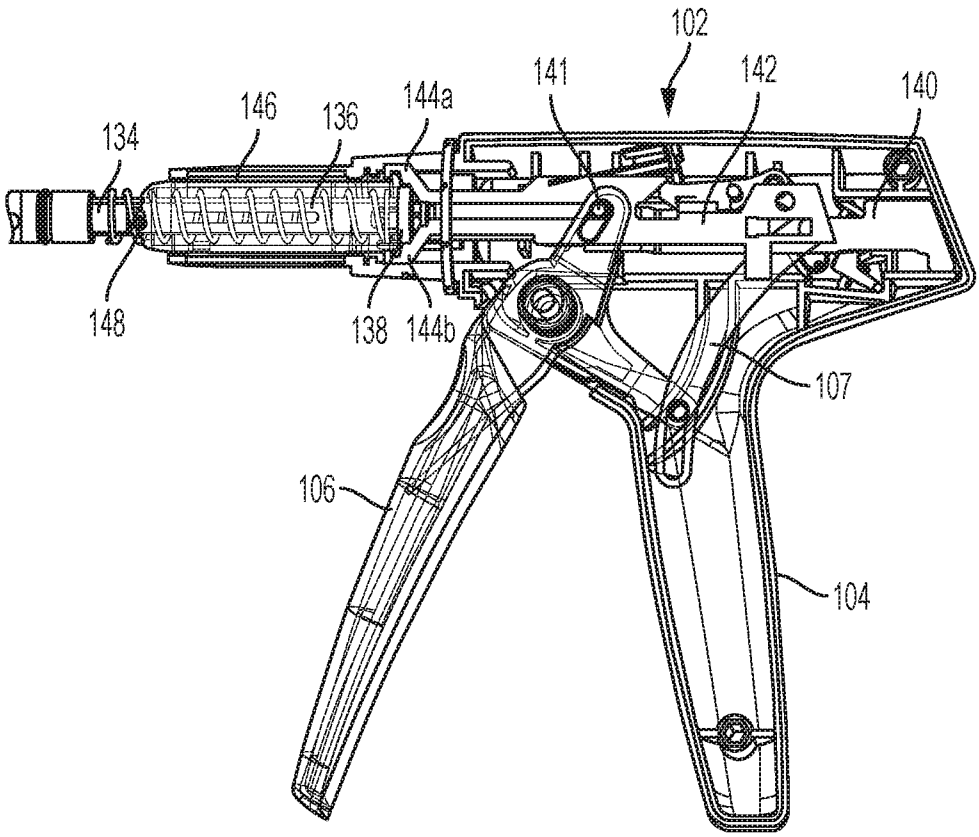

102
141
142
140
146
136
144a
134
148
138
144b
107
106
104

FIG. 4A

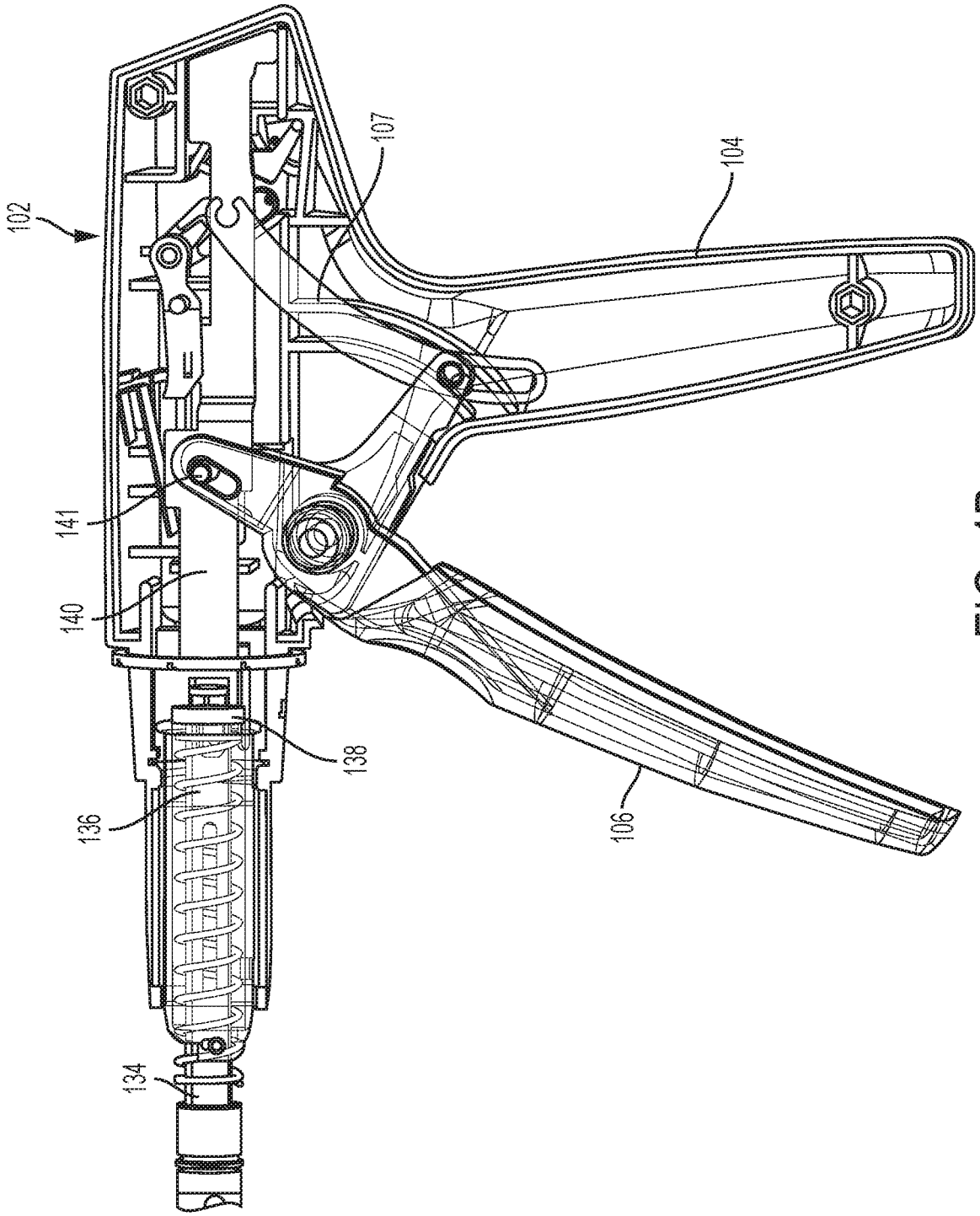


FIG. 4B

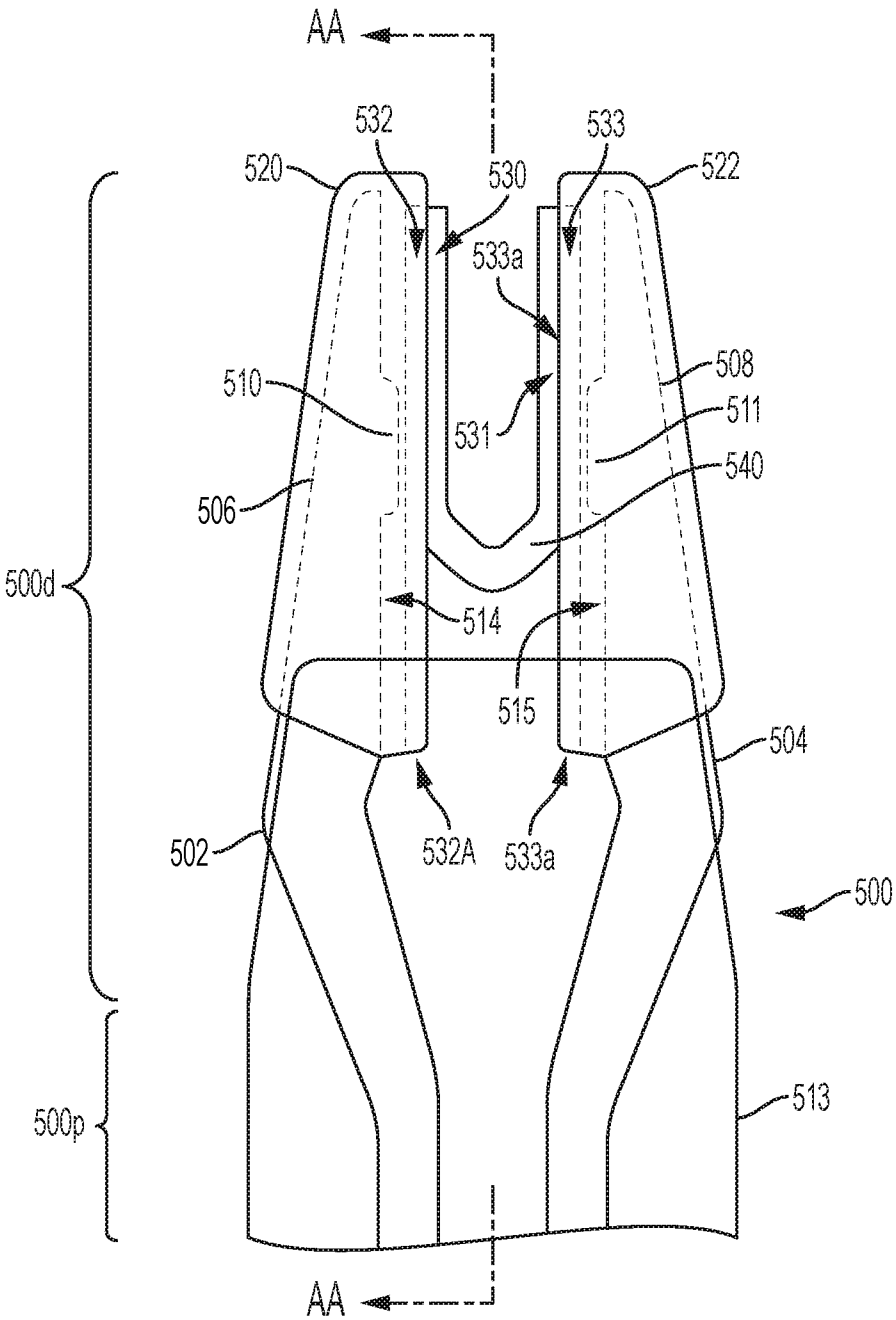

AA
532
533
520
530
522
533a
508
510
511
531
540
506
500d
514
515
504
502
532A
533a
500
513
500p
AA

FIG. 5

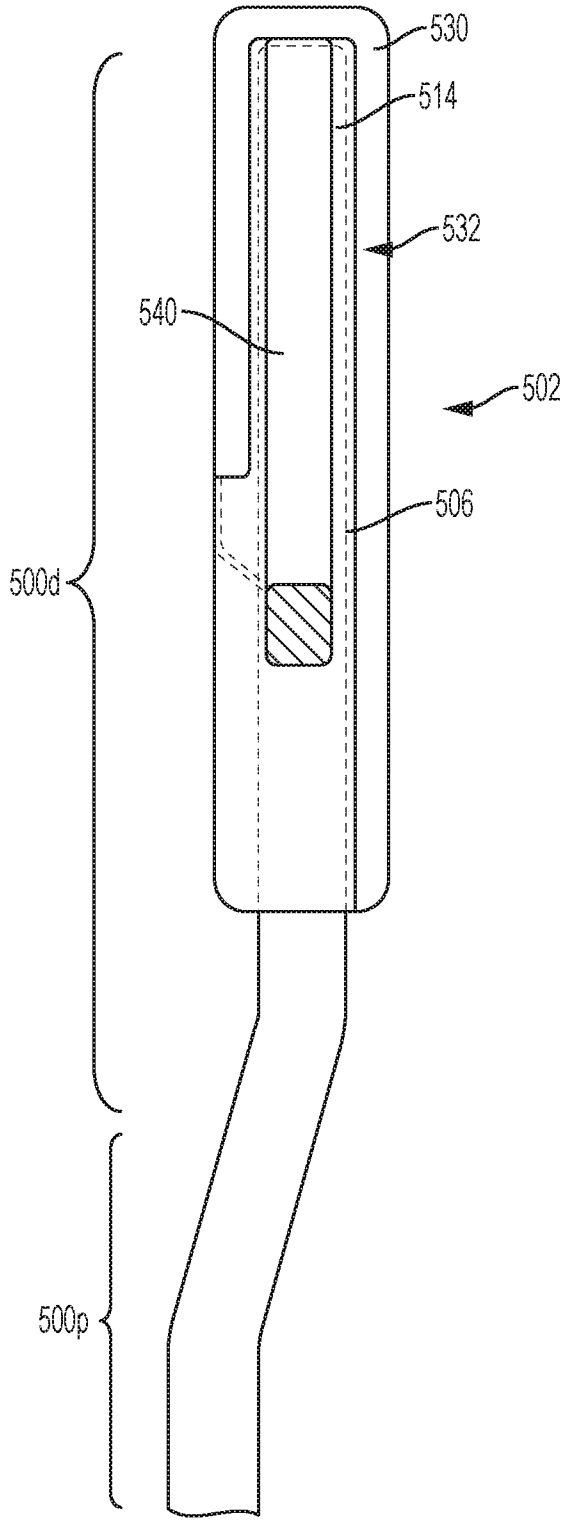


FIG. 6

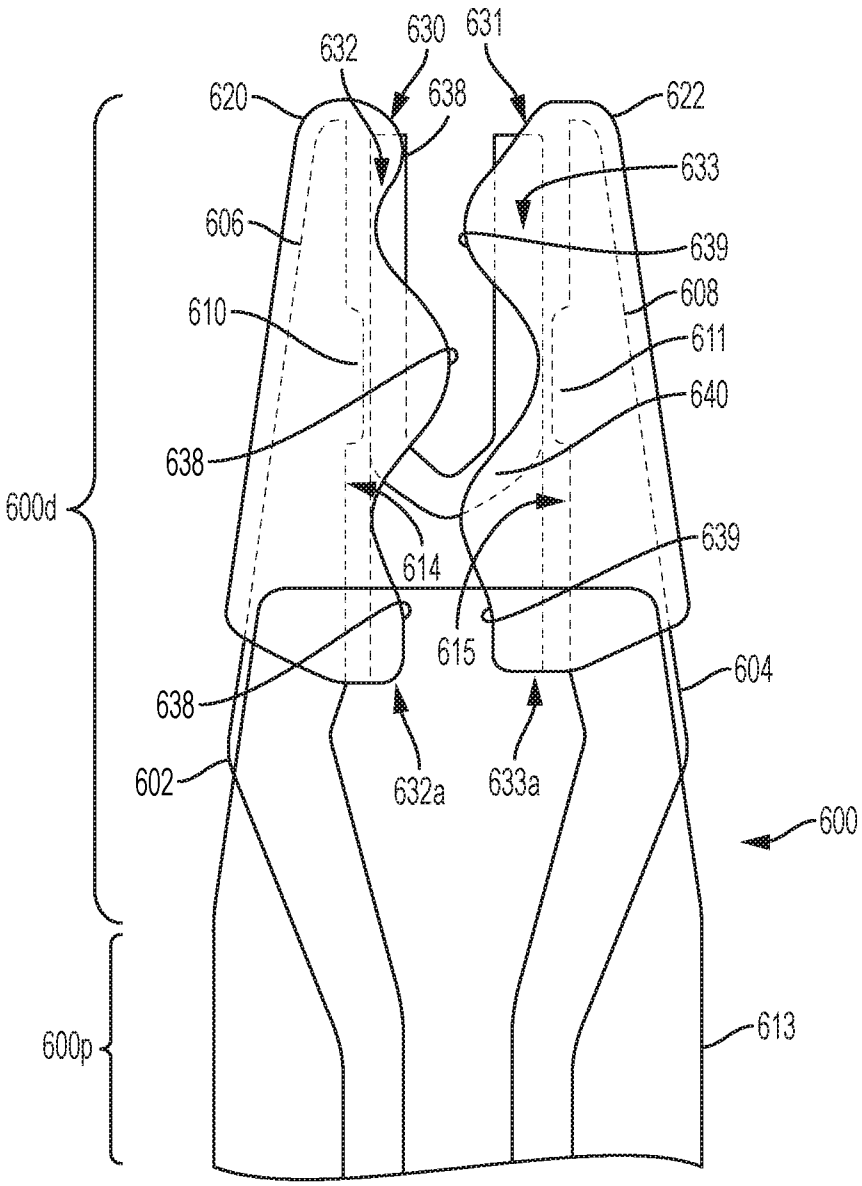

632
630
631
620
638
622
633
606
639
610
608
611
640
638
600d
614
639
615
604
638
602
632a
633a
600
600p
613

FIG. 7

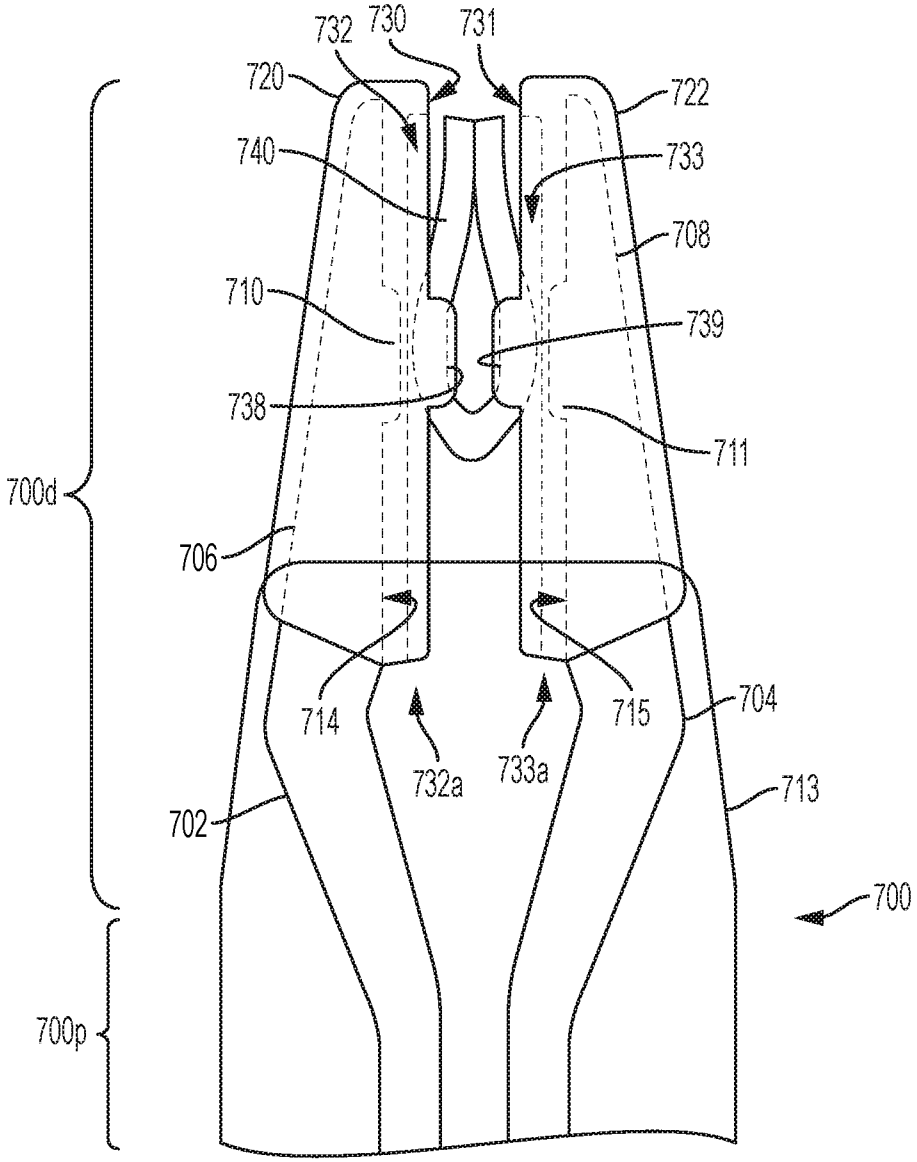

732
730
731
720
722
740
733
708
710
739
738
711
700d
706
714
715
704
732a
733a
713
702
700
700p

FIG. 8

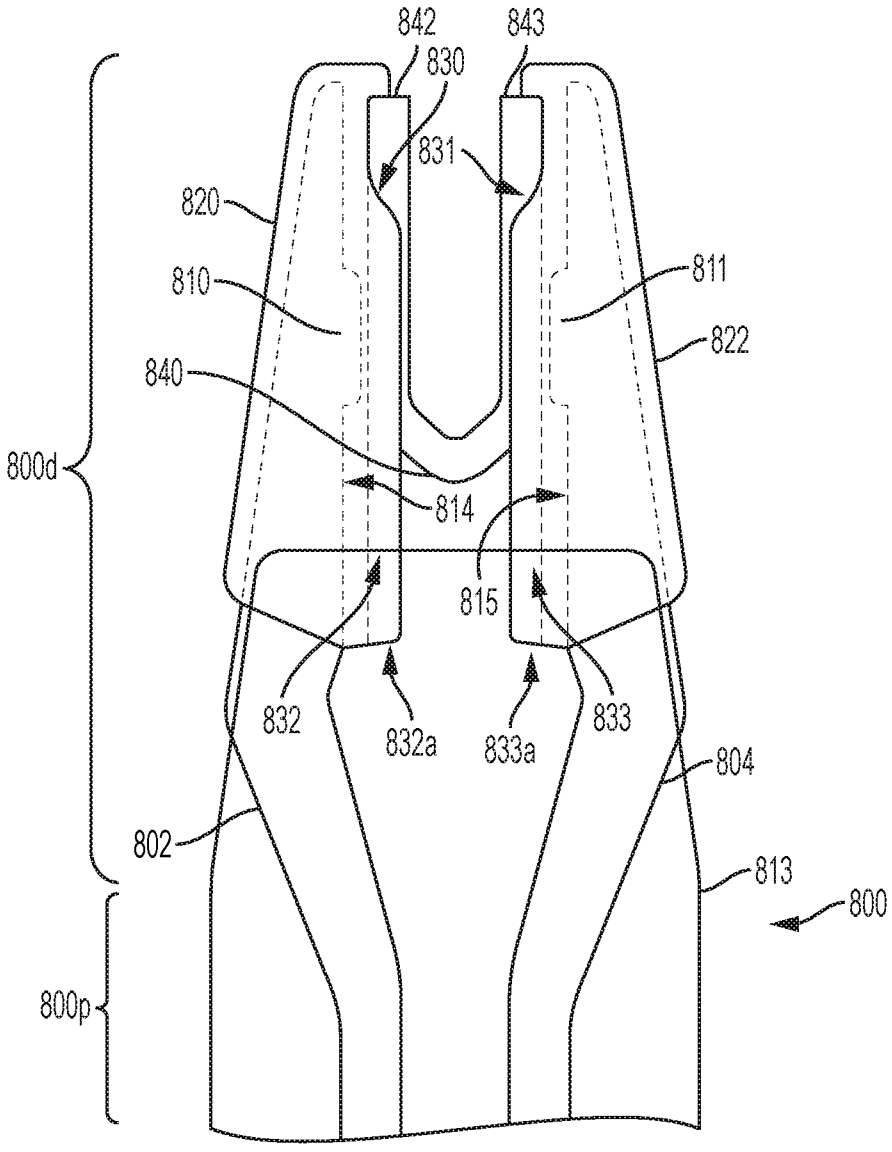

842
843
830
831
820
810
811
822
840
800d
814
815
832
832a
833a
833
804
802
813
800
800p

FIG. 9

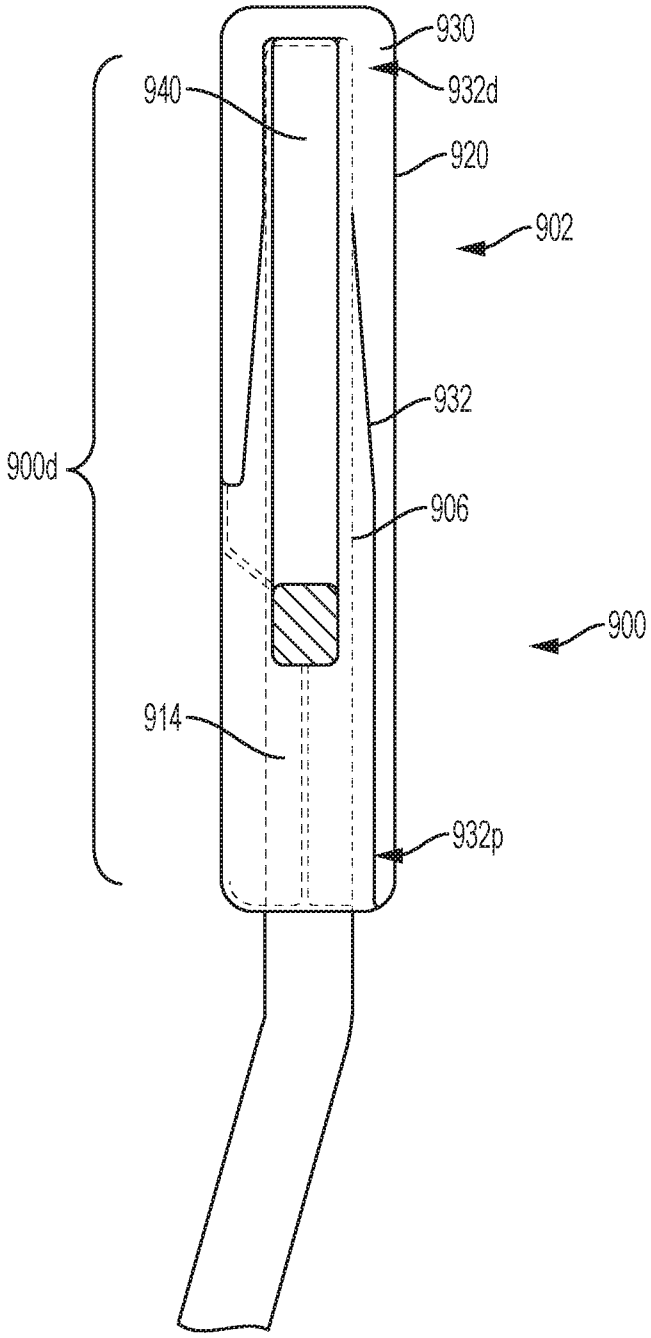


FIG. 10

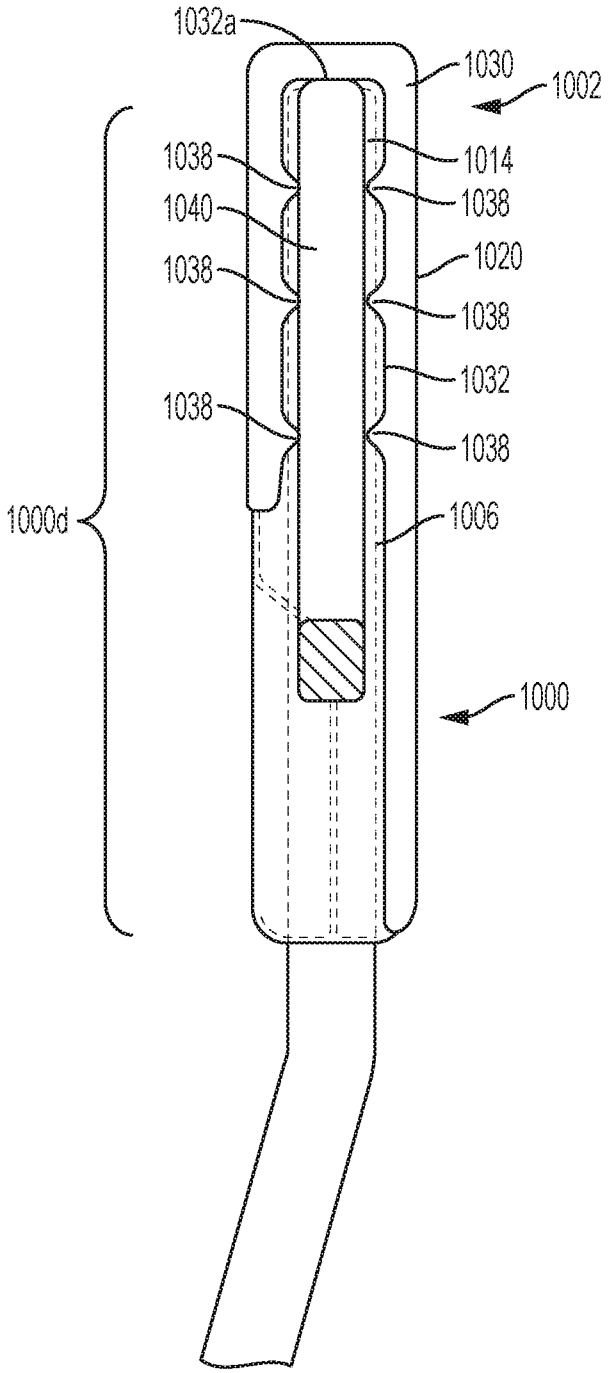

1032a
1030
1002
1038
1014
1040
1038
1020
1038
1038
1032
1038
1038
1000d
1006
1000

FIG. 11

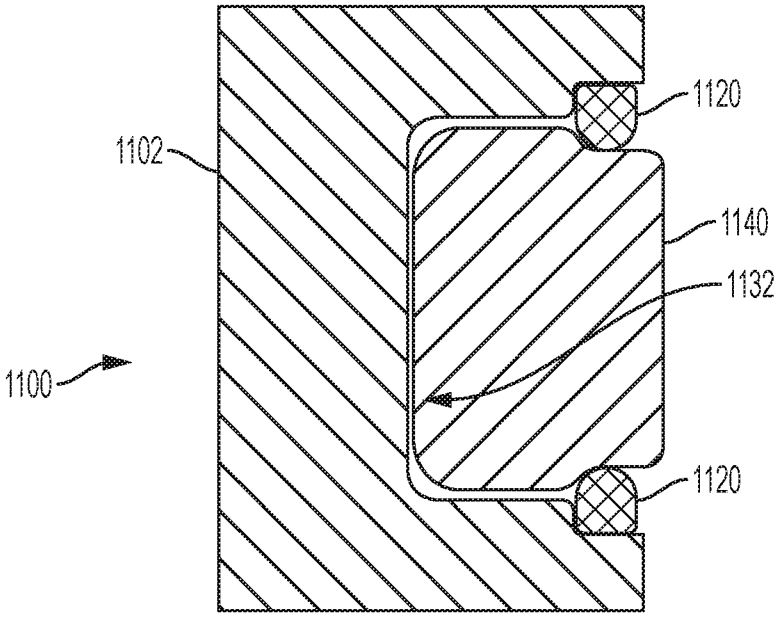


FIG. 12

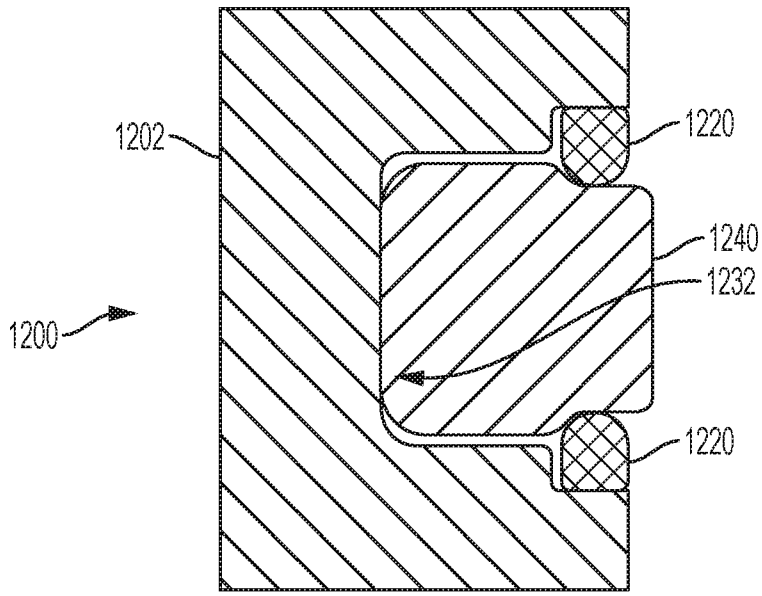


FIG. 13

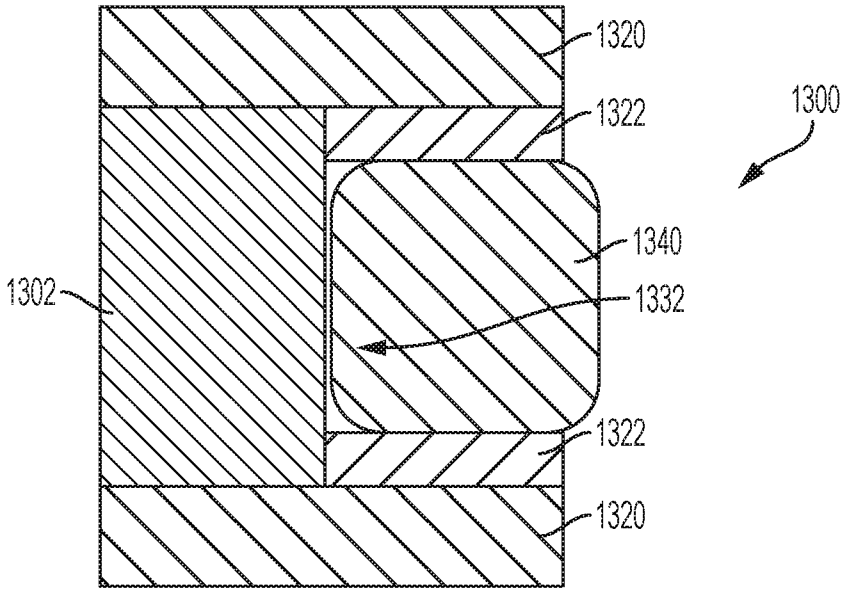

1320
1322
1300
1340
1302
1332
1322
1320

FIG. 14

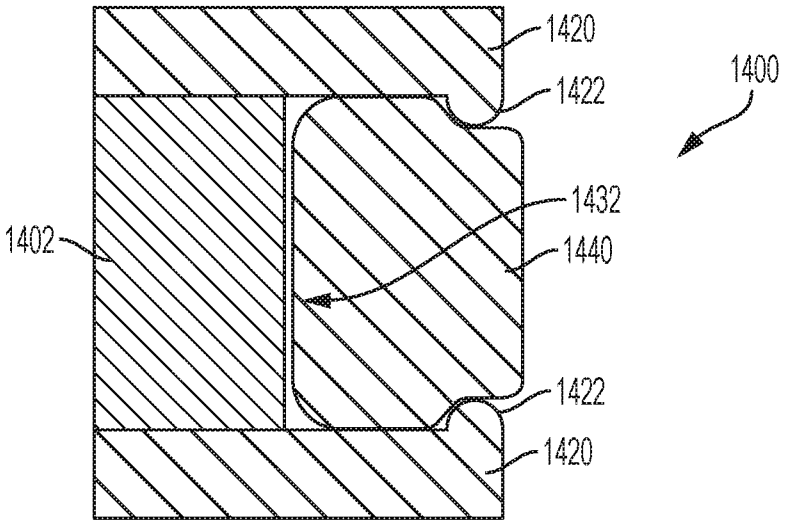

1420
1422
1400
1432
1402
1440
1422
1420

FIG. 15

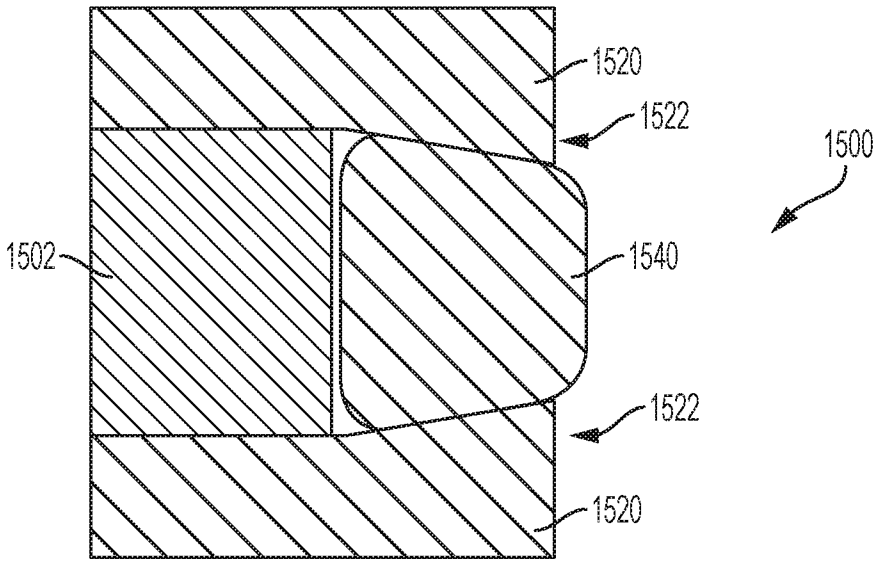


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/055948

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/10 A61B17/28 A61B17/068 A61B17/128 A61B17/29
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 824 547 B2 (PILLING WECK INC [US]) 30 November 2004 (2004-11-30)	1-7, 9-17, 20-22
A	figures 1,12-14 column 7, paragraph 4th column 10, paragraph 3rd	8,18,19, 23,24

X	US 4 509 518 A (MCGARRY RICHARD A [US] ET AL) 9 April 1985 (1985-04-09)	1,3-7,9, 11,12, 14,15, 17,20
A	figures 2,7,16 column 3 - column 5	2,8,10, 13,16, 18,19, 21-24

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 November 2018	26/11/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lüddemann, Tobias

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/055948

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/097971 A1 (HUGHETT J DAVID [US]) 20 May 2004 (2004-05-20)	1,3,6-11
A	figures 2,3,7,8 paragraphs [0066], [0077]	4,5, 12-24

X	WO 03/099137 A2 (NDO SURGICAL INC [US]; CERIER JEFFREY C [US]; CRUZ AMOS [US]; O'KEEFE) 4 December 2003 (2003-12-04)	1,3-7, 9-11
A	column 1; figures 17A-G page 27, paragraph 3rd page 10, paragraph 3rd	2,8, 12-24

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2018/055948

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6824547 B2	30-11-2004	EP 1416860 A2	12-05-2004
		EP 2548521 A2	23-01-2013
		ES 2676875 T3	25-07-2018
		JP 4263594 B2	13-05-2009
		JP 2004535236 A	25-11-2004
		US 2003014060 A1	16-01-2003
		WO 03005878 A2	23-01-2003
US 4509518 A	09-04-1985	AU 562816 B2	18-06-1987
		BR 8305929 A	10-01-1984
		CA 1195897 A	29-10-1985
		DE 3332435 A1	26-01-1984
		DE 3332435 T1	26-01-1984
		EP 0086721 A2	24-08-1983
		GB 2132894 A	18-07-1984
		GB 2155791 A	02-10-1985
		JP S622528 B2	20-01-1987
		JP S59500203 A	16-02-1984
		US 4509518 A	09-04-1985
		WO 8302887 A1	01-09-1983
US 2004097971 A1	20-05-2004	NONE	
WO 03099137 A2	04-12-2003	NONE	