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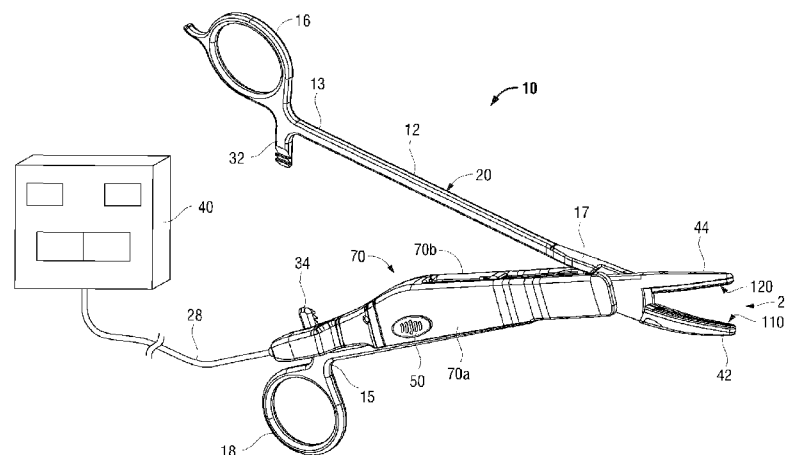


FIG. 1

(57) Abstract: A bipolar forceps (10) includes a mechanical forceps (20) including first and second shafts (12, 14) each having a jaw member (42, 44) extending from a distal end (17, 19) thereof and a handle (16, 18) disposed at a proximal end (13, 15) thereof for effecting movement of the jaw members (42, 44) relative to one another about a pivot (25). A disposable housing (70) is configured to releasably couple to at least one of the shafts (12, 14) and an electrode assembly (21) has electrodes (110, 120) releasably coupleable to the jaw members (42, 44) and adapted to connect to a source of electro-surgical energy to allow selective conduction of electro-surgical energy through tissue (150) held therebetween to effect a tissue seal. An electrically conductive cutting element (85) is disposed on at least one of the electrodes (110, 120) and is adapted to connect to the source of electro-surgical energy to allow selective conduction of electro-surgical energy through tissue (150) held between the electrodes (110, 120) to effect a tissue cut.



BIPOLAR SURGICAL INSTRUMENT

BACKGROUND

1. Background of Related Art

[0001] The present disclosure relates to forceps used for open surgical procedures. More particularly, the present disclosure relates to a bipolar forceps for treating tissue that is capable of sealing and cutting tissue.

2. Technical Field

[0002] A hemostat or forceps is a simple plier-like tool which uses mechanical action between its jaws to constrict vessels and is commonly used in open surgical procedures to grasp, dissect and/or clamp tissue. Electrosurgical forceps utilize both mechanical clamping action and electrical energy to effect hemostasis by heating the tissue and blood vessels to coagulate, cauterize and/or seal tissue.

[0003] Certain surgical procedures require sealing and cutting blood vessels or vascular tissue. Several journal articles have disclosed methods for sealing small blood vessels using electrosurgery. An article entitled Studies on Coagulation and the Development of an Automatic Computerized Bipolar Coagulator, J. Neurosurg., Volume 75, July 1991, describes a bipolar coagulator which is used to seal small blood vessels. The article states that it is not possible to safely coagulate arteries with a diameter larger than 2 to 2.5 mm. A second article is entitled Automatically Controlled Bipolar Electrocoagulation – “COA-COMP”, Neurosurg. Rev. (1984), pp. 187-190, describes a method for terminating electrosurgical power to the vessel so that charring of the vessel walls can be avoided.

[0004] By utilizing an electrosurgical forceps, a surgeon can either

cauterize, coagulate/desiccate, reduce or slow bleeding and/or seal vessels by controlling the intensity, frequency and duration of the electrosurgical energy applied to the tissue. Generally, the electrical configuration of electrosurgical forceps can be categorized in two classifications: 1) monopolar electrosurgical forceps; and 2) bipolar electrosurgical forceps.

[0005] Monopolar forceps utilize one active electrode associated with the clamping end effector and a remote patient return electrode or pad which is typically attached externally to the patient. When the electrosurgical energy is applied, the energy travels from the active electrode, to the surgical site, through the patient and to the return electrode.

[0006] Bipolar electrosurgical forceps utilize two generally opposing electrodes which are disposed on the inner opposing surfaces of the end effectors and which are both electrically coupled to an electrosurgical generator. Each electrode is charged to a different electric potential. Since tissue is a conductor of electrical energy, when the effectors are utilized to grasp tissue therebetween, the electrical energy can be selectively transferred through the tissue.

SUMMARY

[0007] The present disclosure relates to forceps used for open surgical procedures. More particularly, the present disclosure relates to a bipolar forceps for electrosurgically sealing and cutting tissue.

[0008] As is traditional, the term “distal” refers herein to an end of the apparatus that is farther from an operator, and the term “proximal” refers herein to the end of the electrosurgical forceps that is closer to the operator.

[0009] According to one aspect of the present disclosure, a bipolar forceps

is provided. The bipolar forceps generally includes a mechanical forceps, a disposable housing, an electrode assembly, and an electrically conductive cutting element. The mechanical forceps includes first and second shafts each having a jaw member extending from its distal end and a handle disposed at its proximal end for effecting movement of the jaw members relative to one another about a pivot from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue. The disposable housing is configured to releasably couple to at least one of the shafts. The electrode assembly has a first electrode releasably coupleable to the jaw member of the first shaft and a second electrode releasably coupleable to the jaw member of the second shaft. Each electrode is adapted to connect to a source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue to effect a tissue seal. The electrically conductive cutting element is disposed on one or both of the electrodes and is adapted to connect to the source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue held between the electrodes to effect a tissue cut.

[0010] Additionally or alternatively, one or both of the electrodes may include a channel defined along its length in vertical registration with the conductive cutting element and configured to engage the conductive cutting element when the jaw members are in the second position to provide a gap distance between the electrodes.

[0011] Additionally or alternatively, the conductive cutting element may extend from the electrode thereof a distance between about 0.004" and about 0.010" and the channel may define a depth of up to about 0.006".

[0012] Additionally or alternatively, the extension distance of the conductive cutting element and the depth of the channel may cooperate to provide a gap distance of about 0.004”.

[0013] Additionally or alternatively, the bipolar forceps may also include one or more switches disposed through the housing and configured to selectively deliver electrosurgical energy to one or both of the electrically conductive cutting element and the electrodes.

[0014] Additionally or alternatively, the switch may be configured to selectively deliver electrosurgical energy to the electrodes and the electrically conductive cutting element in response to a single activation of the switch.

[0015] Additionally or alternatively, each of the electrodes may include an electrically conductive sealing surface and at least one insulating substrate.

[0016] Additionally or alternatively, a ratio of a prominence of the conductive cutting element to half a width of the electrically conductive sealing surface of the electrode thereof is between about 0.25 and about 0.30.

[0017] Additionally or alternatively, the conductive cutting element may define a base portion and a body portion. The base portion may define a width of at least 0.022” and the body may define a minimum width of about 0.015”.

[0018] Additionally or alternatively, the pivot may include a first surface configured to be received in an aperture defined through the first jaw member and a second surface configured to be received in an aperture defined through the second jaw member.

[0019] Additionally or alternatively, each of the electrodes may include one or more mechanical interfaces configured to complement a corresponding mechanical interface on one of the jaw members to releasably couple the electrode to the respective jaw member.

[0020] Additionally or alternatively, the bipolar forceps may also include a tissue stop disposed at a proximal end of one or both of the jaw members and configured to maintain tissue between the electrodes during tissue sealing.

[0021] According to another aspect of the present disclosure, a bipolar forceps is provided. The bipolar forceps generally includes a mechanical forceps, a disposable housing, an electrode assembly, an electrically conductive cutting element, one or more channels, and one or more switches. The mechanical forceps including first and second shafts each having a jaw member extending from its distal end and a handle disposed at its proximal end for effecting movement of the jaw members relative to one another about a pivot from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue. The disposable housing has opposing halves configured to be releasably coupled to each other to at least partially encompass one or both of the shafts. The electrode assembly has a first electrode releasably coupleable to the jaw member of the first shaft and a second electrode releasably coupleable to the jaw member of the second shaft. Each electrode is adapted to connect to a source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue to effect a tissue seal. The electrically conductive cutting element is disposed on one or both of the electrodes and is adapted to connect to the source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue held between the electrodes to effect a tissue cut. The channel is defined along a length of one or both of electrodes and is in vertical registration with the conductive cutting element. The conductive cutting element is configured to engage the channel when the jaw members are in the second position to

provide a gap distance between the electrodes. The switch is disposed on the housing and is configured to selectively deliver electrosurgical energy to one or both of the electrically conductive cutting element and the electrodes.

[0022] Additionally or alternatively, the switch may be configured to selectively deliver electrosurgical energy to the electrodes and the electrically conductive cutting element in response to a single activation thereof.

[0023] Additionally or alternatively, the source of electrosurgical energy may be configured to emit a first audible tone in response to completion of the tissue seal and a second audible tone in response to completion of cutting of the sealed tissue.

[0024] Additionally or alternatively, at least a portion of the jaw members are separated by the pivot.

[0025] According to another aspect of the present disclosure, a method of manufacturing forceps is provided. The method includes press-fitting a first surface of a pivot into an aperture defined in a first shaft member and pressing a second surface of the pivot into an aperture defined through a first jaw member disposed on a second shaft member. The method also includes pressing a third surface of the pivot into an aperture defined through a second jaw member such that at least a portion of the pivot is disposed between at least a portion of the first and second jaw members to provide separation therebetween. The method also includes coupling a distal end portion of the first shaft member to the second jaw member.

[0026] Additionally or alternatively, the method may include coupling an electrode to one or both of the jaw members. The electrode may include one or more of a tissue sealing surface, an insulative substrate, and an electrically conductive cutting element.

[0027] Additionally or alternatively, the method may also include welding the distal end portion of the first shaft member to the second jaw member.

[0028] Additionally or alternatively, the method may also include coupling a housing to one or both of the shaft members.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] Various embodiments of the subject instrument are described herein with reference to the drawings wherein:

[0030] FIG. 1 is a perspective view of a bipolar forceps according to an embodiment of the present disclosure including a mechanical forceps, a disposable housing, and an electrode assembly;

[0031] FIG. 2 is an enlarged, perspective view of a distal end of the bipolar forceps of FIG. 1;

[0032] FIG. 3 is a perspective view of the mechanical forceps of FIG. 1 with parts separated;

[0033] FIGS. 4 and 5 are greatly-enlarged, perspective views of electrodes of the electrode assembly of FIG. 1 with parts separated;

[0034] FIG. 6 is a perspective view of the bipolar forceps of FIG. 1 grasping tissue to effect a tissue seal; and

[0035] FIG. 7 is a transverse, cross-sectional view of another electrode assembly configured for use with the bipolar forceps of FIG. 1.

DETAILED DESCRIPTION

[0036] Referring initially to FIGS. 1-3, a bipolar forceps 10 for use with open and/or laparoscopic surgical procedures includes a mechanical forceps 20 having an end effector 24 and a disposable electrode assembly 21 (FIG. 2).

Mechanical forceps 20 includes first and second elongated shaft members 12 and 14. Elongated shaft member 12 includes proximal and distal end portions 13 and 17, respectively, and elongated shaft member 14 includes proximal and distal end portions 15 and 19, respectively. Disposed at proximal end portions 13, 15 of shaft members 12, 14 are handle members 16 and 18, respectively, that are configured to allow a user to effect movement of at least one of the shaft members 12 and 14 relative to the other. The end effector 24 includes opposing jaw members 42, 44 that extend from the distal end portions 17 and 19 of shaft members 12 and 14, respectively. The jaw members 42, 44 are movable relative to each other in response to movement of shaft members 12, 14.

[0037] Shaft members 12 and 14 are affixed to one another about a pivot 25 such that movement of shaft members 12, 14, imparts movement of the jaw members 42, 44 from an open configuration (FIG. 2) wherein the jaw members 44, 42 are disposed in spaced relation relative to one another to a clamping or closed configuration wherein the jaw members 42, 44 cooperate to grasp tissue 150 therebetween (FIG. 6). In some embodiments, forceps 10 may be configured such that movement of one or both of shaft members 12, 14 causes only one of the jaw members to move with respect to the other jaw member. As further detailed below, pivot 25 serves to sufficiently space the distal end portions 17, 19 of shaft members 12, 14, respectively, from each other to provide clearance therebetween during movement of shaft members 12, 14 about pivot 25.

[0038] Each shaft member 12 and 14 also includes a ratchet portion 32 and 34, respectively. Each ratchet 32, 34 extends from the proximal end portion 13, 15 of its respective shaft member 12, 14 towards the other ratchet

in a generally vertically aligned manner such that the inner facing surfaces of each ratchet 32 and 34 abut one another when the shaft members 12, 14 are approximated. Each ratchet 32 and 34 includes a plurality of flanges 31 and 33 (FIG. 3), respectively, that project from the inner facing surface of each ratchet 32 and 34 such that the ratchets 32 and 34 may interlock at one or more positions. In some embodiments, each ratchet position holds a particular strain energy in the shaft members 12 and 14 to impart a specific closure force to the end effector 24. At least one of the shaft members, e.g., shaft member 12, includes a tang 99 that facilitates manipulation of forceps 20 during surgical conditions.

[0039] A housing 70 having a pair of housing halves 70a, 70b is configured to matingly engage and releasably encompass at least a portion of shaft member 14. An interior of each of housing half 70a, 70b may include a plurality of cooperating mechanical interfaces disposed at various positions to effect mechanical coupling of housing halves 70a, 70b to form housing 70.

[0040] Forceps 10 includes an electrical cable 28 extending from housing 70 configured to electrically connect forceps 10 to a source of electrosurgical energy, such as an electrosurgical generator 40, as shown in FIG. 1. One example of an electrosurgical generator is the LIGASURE® Vessel Sealing Generator and the ForceTriad® Generator sold by Covidien.

[0041] With reference to FIG. 3, jaw members 42 and 44 include flanges 36 and 38, respectively, extending proximally from a distal portion thereof. Each of flanges 36 and 38 defines a bearing aperture 29c and 29b, respectively, defined therethrough. Pivot 25 includes a press-fit surface 25a and a pair of bearing surfaces 25b and 25c that extend from opposing sides of a clearance surface 25d. Press-fit surface 25a is configured to be press-fit into an aperture

29a defined through a distal end portion 17 of shaft member 12. Bearing surfaces 25b and 25c are configured to be pressed into bearing apertures 29b and 29c, respectively, defined through flanges 38 and 36, respectively. Once shaft members 12, 14 are coupled together about pivot 25, pivot may be secured to shaft members 12, 14 via a suitable welding technique. Shaft members 12, 14 are configured to rotate about pivot 25 such that bearing apertures 29b, 29c pivot about respective bearing surfaces 25b, 25c.

[0042] In some embodiments, mechanical forceps 20 may be assembled as follows: Press-fit surface 25a is inserted through aperture 29b such that press-fit surface 25a is press-fit into aperture 29a defined through distal end portion 17 of shaft member 12 and bearing surface 25b is pressed into bearing aperture 29b defined through flange 38 such that clearance surface 25d engages a surface of distal end portion 17 that surrounds bearing aperture 29b. Bearing surface 25c is pressed into bearing aperture 29c defined through flange 36 of jaw member 42 such that clearance surface 25d engages a surface of flange 36 that surrounds bearing aperture 29c and is disposed between flanges 36 and 38. The term “pressed” may refer to any suitable coupling of bearing surfaces 25b, 25c to bearing apertures 29b, 29c, respectively, such as an interface-fit (press-fit, friction-fit, etc.), a transition fit, or a sliding fit. Clearance surface 25d serves to maintain clearance between flanges 36, 38 during pivoting of jaw members 42, 44 about pivot between the open and closed configurations. Clearance surface 25d also serves to limit the distance by which the flanges 36, 38 may be compressed together during assembly of mechanical forceps 20. Once pivot 25 is properly fitted within apertures 29a, 29b, and 29c, as described hereinabove, jaw member 42 may be coupled to distal end portion 17 of shaft member 12. For example, jaw member 42 may be welded along one or

more lap joints to distal end portion 17 of shaft member 12. In some embodiments, jaw member 42 may be monolithically formed with shaft member 12 as similarly depicted with respect to jaw member 44 and shaft member 14 (FIG. 3). The term “pressing” refers herein to any suitable interface-fit between

[0043] Referring to FIG. 2, disposable electrode assembly 21 includes a pair of electrodes 110, 120 configured to releasably couple to mechanical forceps 20, as detailed below. With reference to FIG. 5, electrode 110 includes an electrically conductive sealing surface 116 configured to conduct electrosurgical energy through tissue to effect a tissue seal, an electrically conductive cutting element 85 configured to cut tissue by conducting electrosurgical energy therethrough, and a pair of electrically insulative substrates 109 and 111. In some embodiments, substrates 109, 111 may be made from an injection molded plastic material. Substrate 109 is disposed between sealing surface 116 and cutting element 85 and serves to electrically insulate sealing surface 116 from cutting element 85. Substrate 111 serves to electrically insulate jaw member 44 from sealing surface 116 and cutting element 85. A cutting element channel 58a is defined in sealing surface 116 and is configured to align in vertical registration with a corresponding cutting element channel 58b defined in substrate 109. Cutting element 85 is disposed between substrate 109 and substrate 111 and extends through cutting element channels 58a and 58b such that cutting element 85 extends beyond or is raised above a tissue contacting portion of sealing surface 116. Substrate 109 includes retention features 54 formed thereon configured to be received within corresponding retaining apertures 56 disposed along an outer periphery of sealing surface 116 (FIG. 5) to couple sealing surface 116 to substrate 109.

During assembly of electrode 110, sealing surface 116 is coupled to substrate 109 and cutting element 85 is disposed between substrate 109 and substrate 111 such that cutting element 85 extends through channels 58a, 58b. Substrate 111 is subsequently overmolded to the retention features 54 formed on substrate 109 to secure sealing surface 116 to substrate 111.

[0044] Substrate 111 includes a plurality of bifurcated anchor members 112 extending therefrom that are configured to compress during insertion into a corresponding plurality of sockets 43 disposed at least partially through an inner facing surface 47 (FIG. 3) of jaw member 44 and subsequently expand to releasably engage corresponding sockets 43 after insertion to couple electrode 110 to inner facing surface 47. Substrate 111 also includes an alignment pin 128 (FIG. 4) that is configured to engage an aperture 65 disposed at least partially through inner facing surface 47 of jaw member 44 to ensure proper alignment of electrode 110 with jaw member 44 during assembly. Sealing surface 116 includes a termination 155 extending from a proximal end thereof configured to electrically connect to a wire 61 (FIG. 2) extending from a distal end of housing 70. Cutting element 85 includes a termination 165 extending from a proximal end thereof and configured to electrically connect to a wire 62 extending from a distal end of housing 70 (FIG. 2).

[0045] As shown in FIGS. 2 and 5, a proximal end of substrate 111 forms a pair of opposing tissue stops 113a, 113b extending therefrom that serve to maintain tissue between sealing surfaces 116, 126 during tissue sealing and prevent tissue from entering the pivot area (e.g., where shaft members 12, 14 rotate about pivot 25). As shown in FIG. 2, tissue stops 113a, 113b are suitably spaced from each other to accommodate the movement of jaw member 44 therebetween relative to jaw member 42. At least one longitudinal indicator

114 (FIG. 5) is formed along the longitudinal length of substrate 111 and includes a distal end 114a that aligns laterally with a distal end of cutting element 85 so that when the jaw members 42, 44 are in the closed configuration (FIG. 6) and the cutting element 85 may not be visible, the user may reference distal end 114a of indicator 114 to determine the position of cutting element 85 relative to tissue grasped between the jaw members 42, 44 prior to energizing cutting element 85 to effect a tissue cut.

[0046] Substantially as described above with respect to electrode 110, and with reference to FIG. 4, electrode 120 includes an electrically conductive sealing surface 126 configured to conduct electrosurgical energy through tissue and a pair of electrically insulative substrates 119 and 121. In some embodiments, substrates 119, 121 are made from an injection molded plastic material. Substrate 121 serves to electrically insulate jaw member 42 from sealing surface 126. A channel 59a is defined in sealing surface 126 and is configured to align in vertical registration with a corresponding gap stop channel 59b defined in substrate 119. Gap stop channel 59b may be formed along substrate 119 such that upon movement of the jaw members 42, 44 to the closed configuration (FIG. 6), cutting element 85 extends through channel 59a in sealing surface 126 and engages gap stop channel 59b to prohibit further approximation of sealing surfaces 116, 126, as further detailed below. Substrate 119 includes retention features 64 formed thereon configured to be received within corresponding retaining apertures 66 disposed along an outer periphery of sealing surface 126 (FIG. 4) to couple sealing surface 126 to substrate 119. During assembly of electrode 120, sealing surface 126 is coupled to substrate 119 and substrate 121 is subsequently overmolded to the retention features 64 formed on substrate 119 to secure sealing surface 126 to

substrate 121.

[0047] Substrate 121 includes a plurality of bifurcated anchor members 122 extending therefrom that are configured to compress during insertion into a corresponding plurality of sockets 41 disposed at least partially through an inner facing surface 45 (FIG. 3) of jaw member 42 and subsequently expand to releasably engage corresponding sockets 41 after insertion to couple electrode 120 to inner facing surface 45. Substrate 121 also includes an alignment pin 124 (FIG. 4) that is configured to engage an aperture 67 disposed at least partially through inner facing surface 45 of jaw member 42 (FIG. 3) to ensure proper alignment of electrode 120 with jaw member 42 during assembly. Sealing surface 126 includes a termination 145 configured to electrically connect to a wire 63 disposed therein (FIG. 3). In some embodiments, electrodes 110, 120 may be coupled to jaw members 42, 44 before, during, or after assembly of mechanical forceps 20 described above with reference to FIG. 3.

[0048] Substrate 121 may also include at least one longitudinal indicator 117 (FIG. 4) formed along the longitudinal length thereof to complement longitudinal indicator 114 of substrate 111. Longitudinal indicator 117 includes a distal end 117a that aligns laterally with a distal end of cutting element 85 so that when the jaw members 42, 44 are in the closed configuration (FIG. 6) and the cutting element 85 may not be visible, the user may reference distal end 117a of indicator 117 to determine the position of cutting element 85 relative to tissue grasped between the jaw members 42, 44 prior to energizing cutting element 85 to effect a tissue cut.

[0049] To electrically control the end effector 24, the housing 70 supports at least one depressible activation button 50 (FIG. 1) that is operable by the

user to actuate a corresponding electrical switch (not shown) disposed within housing 70 and electrically interconnected with wires 61, 62, and 63. Button 50 may itself be an electrical switch that serves to initiate and terminate delivery of electrosurgical energy from the generator 40 to sealing surfaces 116, 126 to effect a tissue seal and to cutting element 85 to cut sealed tissue. Wires 61, 62, and 63 are bundled to form cable 28, which extends through housing 70 and terminates at a suitable connector (not shown) configured to mechanically and electrically couple to the generator 40.

[0050] FIG. 6 shows bipolar forceps 10 during use wherein the shaft members 12 and 14 are approximated to apply clamping force to tissue 150 and to effect a tissue seal. Once sealed, tissue 150 may be cut along the tissue seal by energizing cutting element 85. Cutting element 85 serves to provide a gap distance “G” (FIG. 6) between sealing surfaces 116, 126 during tissue sealing and to cut the tissue along the seal. In some embodiments, cutting element 85 is made from an insulative or non-conductive material and includes a conductive coating disposed thereon. When sealing surfaces 116, 126 are energized during tissue sealing, cutting element 85 may not necessarily be energized so that current is concentrated between sealing surfaces 116, 126 to effectively seal the tissue.

[0051] Tissue seal effectiveness may be influenced by the pressure applied to tissue between jaw members 44, 42 and the gap distance between sealing surfaces 116, 126 (FIG. 6) during tissue sealing. Jaw members 42, 44 may be pivoted about pivot 25 to move jaw members 42, 44 to the closed configuration of FIG. 6 wherein sealing surfaces 116, 126 provide a pressure to tissue grasped therebetween. In some embodiments, to provide an effective seal, a pressure within a range between about 3 kg/cm² to about 16 kg/cm² is

applied to tissue and, in other embodiments, a pressure within a range between about 7 kg/cm² to about 13 kg/cm² is applied to the tissue. In the closed configuration of jaw members 42, 44, gap distance "G" may be maintained between sealing surfaces 116, 126 by cutting element 85. Cutting element 85 extends through channel 59a of sealing surface 126 and engages stop gap channel 59b (FIG. 4) defined in substrate 119 to prohibit further approximation of sealing surfaces 116, 126 and to create gap distance "G" (FIG. 6) between sealing surface 116, 126 during tissue sealing. In some embodiments, to provide an effective tissue seal, an appropriate gap distance of about 0.001 inches to about 0.010 inches and, in other embodiments, between about 0.002 and about 0.005 inches may be provided.

[0052] Cutting element 85 may be independently activated by the surgeon or automatically activated by generator 40 once tissue sealing is complete. Generator 40 may employ a suitable safety algorithm to assure that an accurate and complete tissue seal is formed before cutting element 85 is energized to cut tissue. An audible or visual indicator (not shown) may be employed to assure the surgeon that an effective tissue seal has been achieved and the surgeon may be required to press button 50 again or deactivate a safety mechanism (not shown) to initiate tissue cutting.

[0053] In some embodiments, tissue sealing and tissue cutting may be completed using a single activation step without the need to re-grasp tissue between sealing surfaces 116, 126 or without the need to perform a second activation step (e.g., pressing button 50 disposed on housing 70) to initiate tissue cutting following completion of tissue sealing. For example, generator 40 may be configured with a suitable tissue sealing and/or tissue cutting control algorithm that allows tissue sealing and tissue cutting to be performed

in response to a single activation step, i.e., the pressing of button 50 disposed on housing 70. In this scenario, the tissue sealing process is started and completed following activation of button 50. A first audible tone may be emitted by generator 40 to signal the completion of the tissue sealing process. Generator 40 next initiates the tissue cutting process to cut the previously sealed tissue and, upon completion of the tissue cutting process, emits a second audible tone (e.g., a tone different than the first tone) to signal the completion of the tissue cutting process. In some embodiments, generator 40 includes a suitable user interface configured to allow a user to switch generator 40 between a tissue cut only mode, a tissue seal only mode, or a combined tissue cut and tissue seal mode that allows tissue sealing and cutting in response to a single activation step, as described above.

[0054] According to one aspect of the present disclosure, a method of manufacturing a forceps (e.g., mechanical forceps 20) includes press-fitting a first surface of a pivot (e.g., pivot 25) into an aperture defined in a first shaft member (e.g., shaft member 12) and pressing a second surface of the pivot into an aperture defined through a first jaw member (e.g., jaw member 44) disposed on a second shaft member (e.g., shaft member 14). The method also includes pressing a third surface of the pivot into an aperture defined through a second jaw member (e.g., jaw member 42) such that the pivot is disposed to provide separation between the jaw members. The method also includes coupling a distal end portion of the first shaft member to the second jaw member. The method may also include coupling an electrode (e.g., electrode 110 or 120) to at least one of the jaw members. The electrode may include at least one of a tissue sealing surface (e.g., tissue sealing surface 116 or 126), an insulative substrate (e.g., substrate 109, 111, 119, or 121) and an electrically conductive

cutting element (e.g., cutting element 85). The method may also include welding the distal end portion of the first shaft member to the second jaw member. The method may also include coupling a housing (e.g., housing 70) to at least one of the shaft members.

[0055] Turning now to FIG. 7, another electrode assembly 210 provided in accordance with the present disclosure and configured for use with bipolar forceps 10 (FIG. 1) is shown. Electrode assembly 210 may include any or all of the features of electrode assembly 21 (FIGS. 2, 4, and 5), described above. Likewise, electrode assembly 21 (FIGS. 2, 4, and 5) may incorporate any or all of the features of electrode assembly 210. Electrode assembly 210 is described in detail below.

[0056] Electrode assembly 210 generally includes first and second electrodes 1100, 1200, respectively. First electrode 1100 includes an electrically conductive sealing surface 1160 configured to conduct electrosurgical energy through tissue to effect a tissue seal, an electrically conductive cutting element 850 configured to cut tissue by conducting electrosurgical energy therethrough, and a pair of electrically insulative substrates 1090 and 1110. Substrate 1090 is disposed between sealing surface 1160 and cutting element 850 and serves to electrically insulate sealing surface 1160 from cutting element 850. Substrate 1110 serves to electrically insulate jaw member 42 from sealing surface 1160 and cutting element 850. Cutting element 850 is disposed within and extends from substrate 1090 such that cutting element 850 extends beyond or is raised above a tissue contacting portion of sealing surface 1160. More specifically, cutting element 850 may be configured to extend from the tissue contacting portion of sealing surface 1160 between about 0.004" and about 0.010". That is, cutting element 850 may

define a prominence “P” of between about 0.004” and about 0.010”. Further, the ratio of the prominence “P” of cutting element 850 to the width “W” of each portion of sealing surface 1160 may be between about 0.25 to about 0.30. For example, for a width “W” of about 0.25”, the prominence “P” may be about 0.007”. Other prominence configurations are also contemplated. It has been found that a prominence "P" of between about 0.004” and about 0.010” provides increased cut performance, particularly with respect to thicker and/or more fatty tissue.

[0057] Cutting element 850 includes a base portion 852 substantially disposed within substrate 1090, and a body portion 854 extending from substrate 1090 towards the opposed jaw member 42. Base portion 852 defines a greater width than body portion 854 to inhibit cutting element 850 from sinking into substrate 1090, e.g., to inhibit variation in the prominence of cutting element 850. The width of base portion 852 may be at least about 0.022”, while the minimum width of body portion 854 may be about 0.015”, although other configurations are also contemplated.

[0058] Electrode 1200 includes an electrically conductive sealing surface 1260 configured to conduct electrosurgical energy through tissue and a pair of electrically insulative substrates 1290 and 1210. Substrate 1210 serves to electrically insulate jaw member 44 from sealing surface 1260. Substrate 1290 extends into a channel 590a defined in sealing surface 1260 and is configured to align in vertical registration with cutting element 850 to electrically insulate cutting element 850 from sealing surface 1260. Substrate 1290 may be recessed relative to a tissue contacting portion of sealing surface 1260 or may be substantially flush therewith. More specifically, substrate 1290 may be recessed within channel 590a and relative to the tissue contacting portion of

sealing surface 1260 by up to about 0.006", although no recess is also contemplated. Further, the recessed distance of substrate 1290 (or lack or recession of substrate 1290) and the prominence of cutting element 850 may cooperate to establish a minimum gap distance between electrodes 1100, 1200 when approximated relative to one another. The minimum gap distance may be about 0.004", although other gap distances are also contemplated. Thus, for example, the prominence of cutting element 850 may be about 0.007" and the recessed distance of substrate 1190 may be about 0.003" to establish a minimum gap distance of about 0.004", although other configurations are also contemplated. As can be appreciated, this combination of a recessed substrate 1190 and prominent cutting member 850 provides the benefit of a prominent cutting member 850, as detailed above, while maintaining a desired minimum gap distance.

[0059] While several embodiments of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as examples of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

[0060] Although the foregoing disclosure has been described in some detail by way of illustration and example, for purposes of clarity or understanding, it will be obvious that certain changes and modifications may be practiced within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A bipolar forceps, comprising:

a mechanical forceps including first and second shafts each having a jaw member extending from a distal end thereof and a handle disposed at a proximal end thereof for effecting movement of the jaw members relative to one another about a pivot from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue therebetween;

a disposable housing configured to releasably couple to at least one of the shafts;

an electrode assembly having a first electrode releasably coupleable to the jaw member of the first shaft and a second electrode releasably coupleable to the jaw member of the second shaft, each electrode adapted to connect to a source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue held therebetween to effect a tissue seal; and

an electrically conductive cutting element disposed on at least one of the electrodes and adapted to connect to the source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue held between the electrodes to effect a tissue cut.

2. The bipolar forceps according to claim 1, wherein at least one of the electrodes includes a channel defined along a length thereof in vertical registration with the conductive cutting element and configured to engage the conductive cutting element when the jaw members are in the second position

to provide a gap distance between the electrodes.

3. The bipolar forceps according to claim 2, wherein the conductive cutting element extends from the at least one electrode a distance between about 0.004” and about 0.010” and wherein the channel defines a depth of up to about 0.006”.

4. The bipolar forceps according to claim 3, wherein the extension distance of the conductive cutting element and the depth of the channel cooperate to provide a gap distance of about 0.004”.

5. The bipolar forceps according to claim 1, further comprising at least one switch disposed through the housing configured to selectively deliver electrosurgical energy to at least one of the electrically conductive cutting element and the electrodes.

6. The bipolar forceps according to claim 5, wherein the switch is configured to selectively deliver electrosurgical energy to the electrodes and the electrically conductive cutting element in response to a single activation thereof.

7. The bipolar forceps according to claim 1, wherein each of the electrodes includes an electrically conductive sealing surface and at least one insulating substrate coupled thereto.

8. The bipolar forceps according to claim 7, wherein a ratio of a

prominence of the conductive cutting element to half a width of the electrically conductive sealing surface of the at least one electrode is between about 0.25 and about 0.30.

9. The bipolar forceps according to claim 1, wherein the conductive cutting element defines a base portion and a body portion, the base portion defining a width of at least 0.022” and the body defining a minimum width of about 0.015”.

10. The bipolar forceps according to claim 1, wherein the pivot includes a first surface configured to be received in an aperture defined through the first jaw member and a second surface configured to be received in an aperture defined through the second jaw member.

11. The bipolar forceps according to claim 1, wherein each of the electrodes includes at least one mechanical interface configured to complement a corresponding mechanical interface on one of the jaw members to releasably couple the electrode to the respective jaw member.

12. The bipolar forceps according to claim 1, further comprising a tissue stop disposed at a proximal end of at least one of the jaw members and configured to maintain tissue between the electrodes during tissue sealing.

13. A bipolar forceps, comprising:
a mechanical forceps including first and second shafts each having a jaw member extending from a distal end thereof and a handle disposed at a

proximal end thereof for effecting movement of the jaw members relative to one another about a pivot from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue therebetween;

a disposable housing having opposing halves configured to be releasably coupled to each other to at least partially encompass at least one of the shafts;

an electrode assembly having a first electrode releasably coupleable to the jaw member of the first shaft and a second electrode releasably coupleable to the jaw member of the second shaft, each electrode adapted to connect to a source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue held therebetween to effect a tissue seal;

an electrically conductive cutting element disposed on at least one of the electrodes and adapted to connect to the source of electrosurgical energy to allow selective conduction of electrosurgical energy through tissue held between the electrodes to effect a tissue cut;

a channel defined along a length of at least one of the electrodes and in vertical registration with the conductive cutting element, the conductive cutting element configured to engage the channel when the jaw members are in the second position to provide a gap distance between the electrodes; and

at least one switch disposed on the housing configured to selectively deliver electrosurgical energy to at least one of the electrically conductive cutting element and the electrodes.

14. The bipolar forceps according to claim 13, wherein the switch is configured to selectively deliver electrosurgical energy to the electrodes and

the electrically conductive cutting element in response to a single activation thereof.

15. The bipolar forceps according to claim 14, wherein the source of electrosurgical energy is configured to emit a first audible tone in response to completion of the tissue seal and a second audible tone in response to completion of cutting of the sealed tissue.

16. The bipolar forceps according to claim 13, wherein at least a portion of the jaw members are separated by the pivot.

17. A method of manufacturing a forceps, comprising:
press-fitting a first surface of a pivot into an aperture defined in a first shaft member;

pressing a second surface of the pivot into an aperture defined through a first jaw member disposed on a second shaft member;

pressing a third surface of the pivot into an aperture defined through a second jaw member such that at least a portion of the pivot is disposed between at least a portion of the first and second jaw members to provide separation therebetween; and

coupling a distal end portion of the first shaft member to the second jaw member.

18. The method according to claim 17, further comprising coupling an electrode to at least one of the jaw members, the electrode including at least one of a tissue sealing surface, an insulative substrate, and an electrically

conductive cutting element.

19. The method according to claim 17, further comprising welding the distal end portion of the first shaft member to the second jaw member.

20. The method according to claim 18, further comprising coupling a housing to at least one of the shaft members.

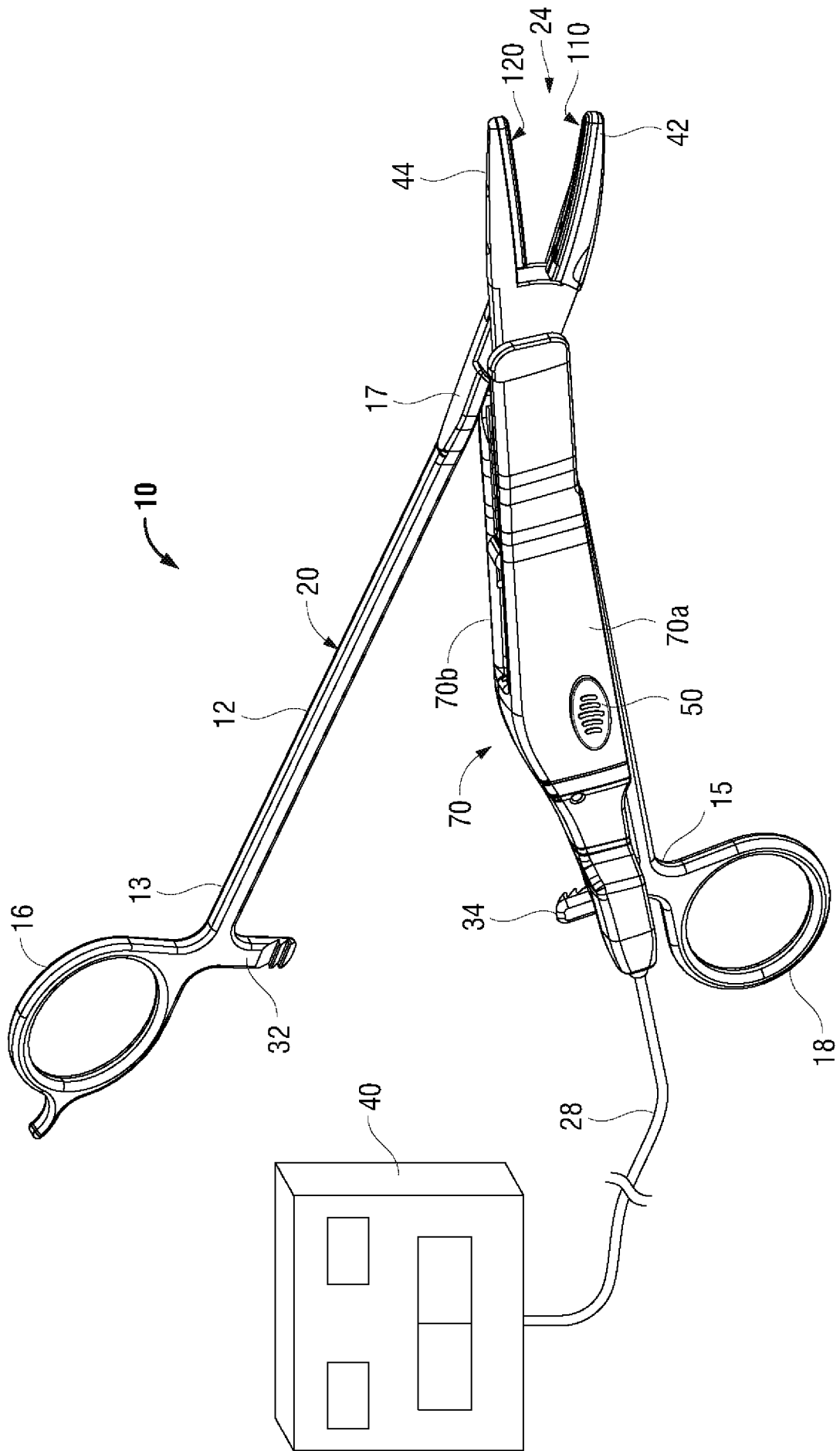


FIG. 1

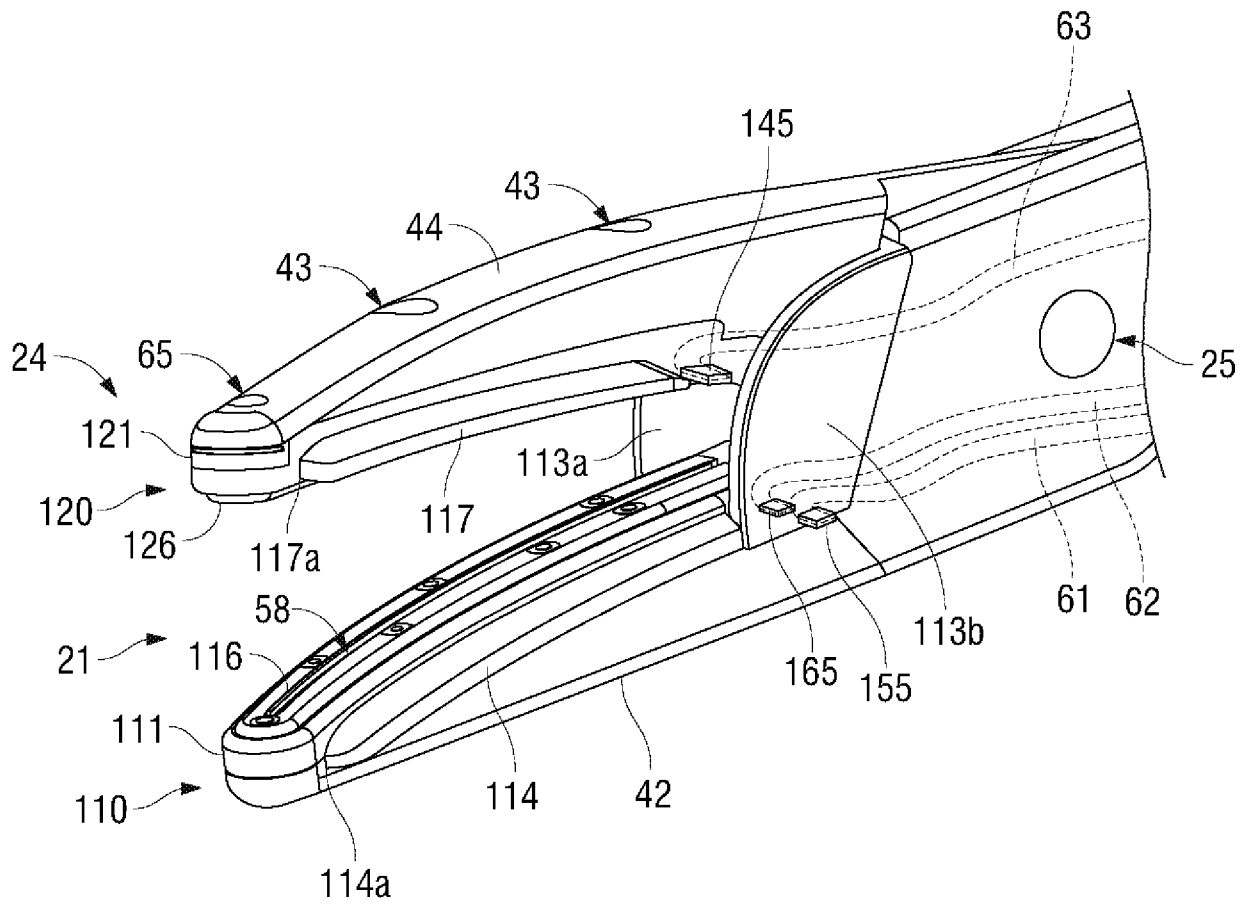


FIG. 2

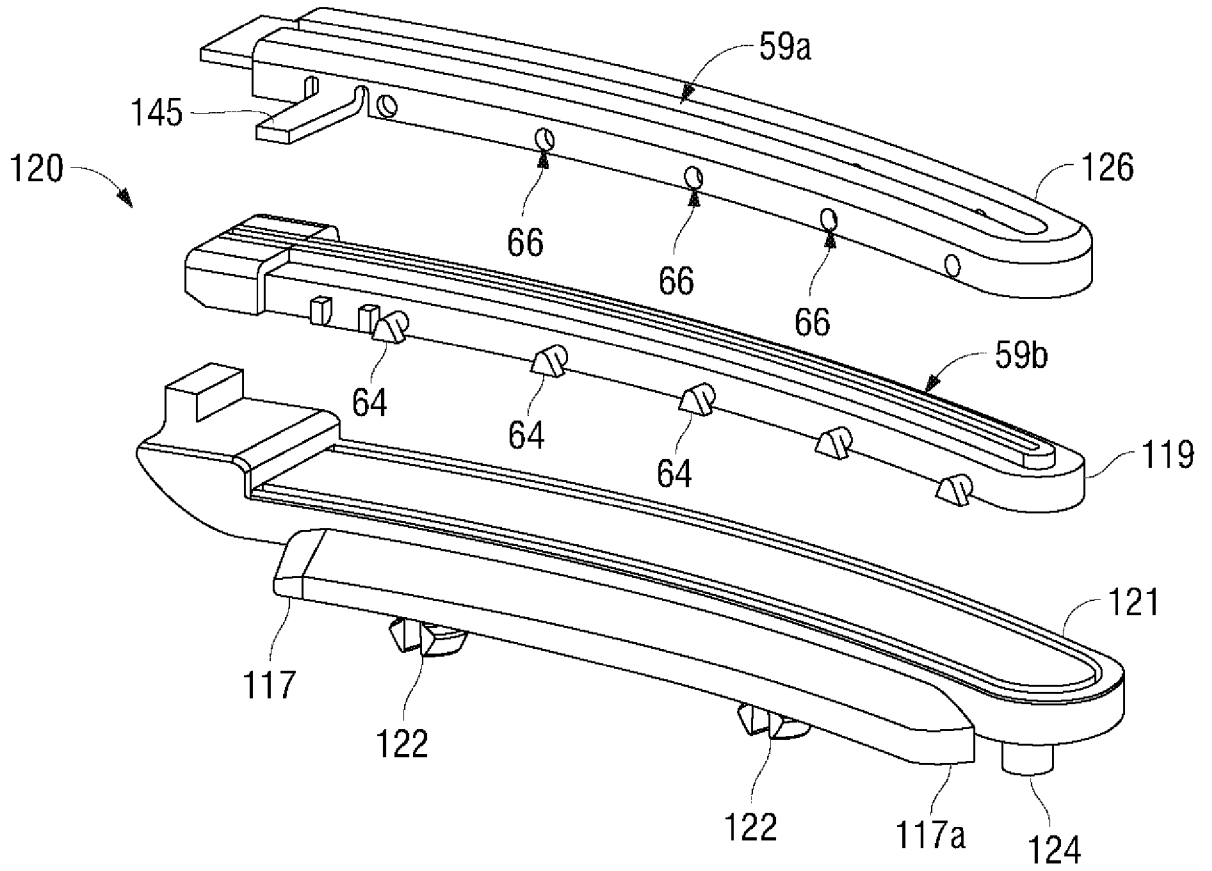


FIG. 4

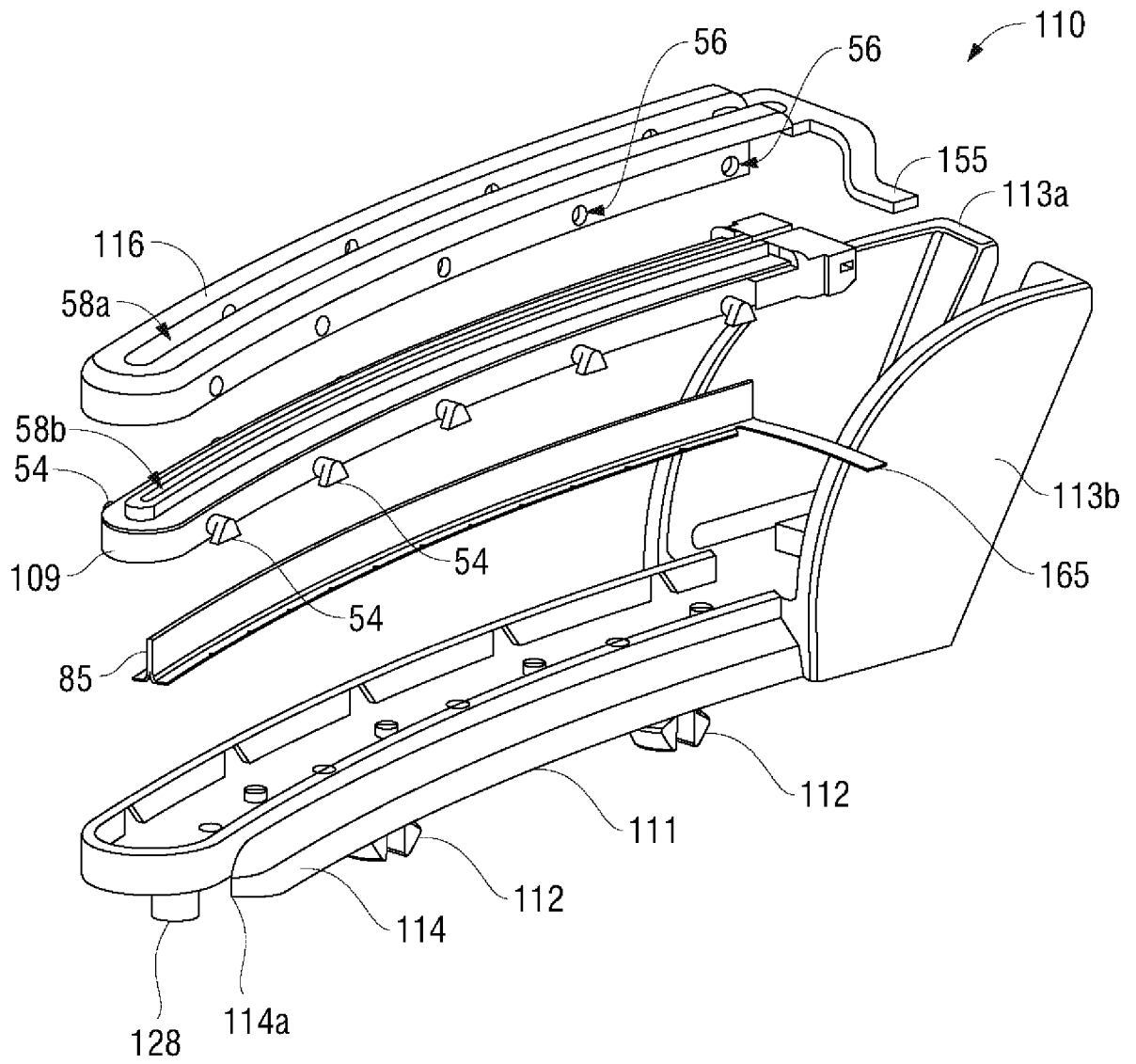


FIG. 5

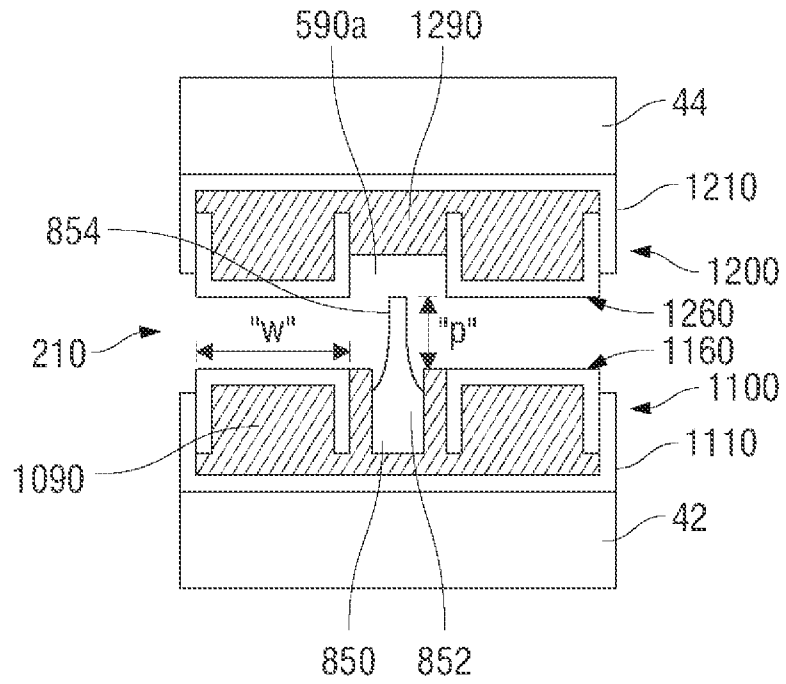


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2013/080944

A. CLASSIFICATION OF SUBJECT MATTER		
A61B 18/12(2006.01)i; A61B 17/295(2006.01)i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
A61B 17; A61B 18		
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)		
CNABS, VEN, CNKI:forceps releasabl+ disposabl+ cut+ seal separat+ gap		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005113826A1 ((KRISTIN D JOHNSON ET AL.)) 26 May 2005 (2005-05-26) description, paragraphs [0050] to [0120], claims 1-13 and figures 1A-7E	1-15
Y	US 2005113826A1 ((KRISTIN D JOHNSON ET AL.)) 26 May 2005 (2005-05-26) description, paragraphs [0050] to [0120], claims 1-13 and figures 1A-7E	16-20
Y	US 2011301592A1 ((TYCO HEALTHCARE)) 08 December 2011 (2011-12-08) description, paragraphs [0033] to [0045] and figures 1A-2B	16-20
A	US 7731713B2 ((SURGICAL INV & INNOVATIONS)) 08 June 2010 (2010-06-08) the whole document	1-20
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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	“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
“E”	earlier application or patent but published on or after the international filing date	“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
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“O”	document referring to an oral disclosure, use, exhibition or other means	“&” document member of the same patent family
“P”	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search		Date of mailing of the international search report
15 April 2014		30 April 2014
Name and mailing address of the ISA/ STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA(ISA/CN) 6,Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 China		Authorized officer FAN, Wenyang
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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