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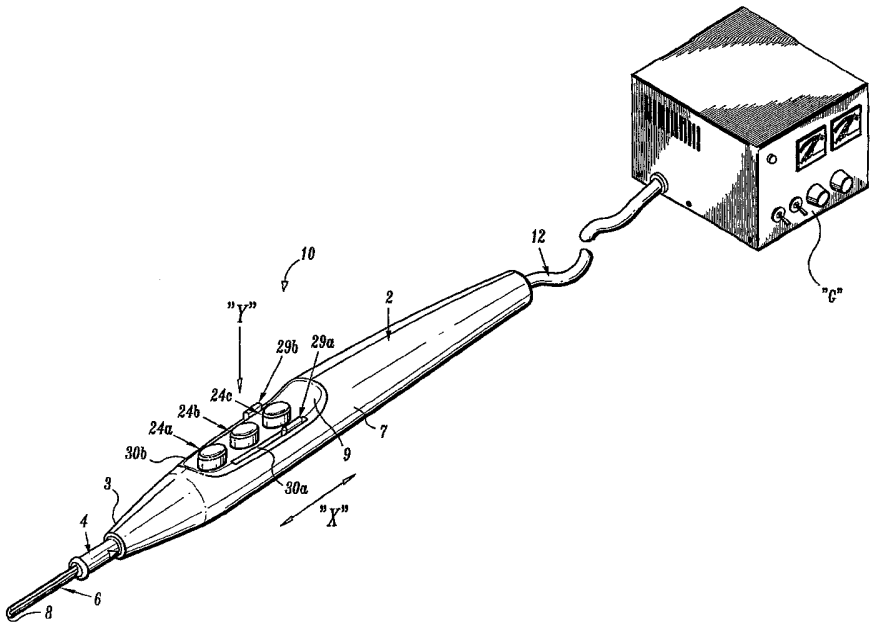

(57) Abstract: An electrosurgical pencil is provided which includes an elongated housing, an electrocautery blade supported within the housing and extending distally from the housing. The electrocautery blade is connected to a source of electrosurgical energy. The pencil also includes at least one activation switch supported on the housing which is configured and adapted to complete a control loop extending from the source of electrosurgical energy. At least one voltage divider network is also supported on the housing and is electrically connected to the source of electrosurgical energy.

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ELECTROSURGICAL PENCIL WITH PLURALITY OF CONTROLS

BACKGROUND

1. Technical Field

The present disclosure relates generally to electrosurgical instruments and, more particularly, to an electrosurgical pencil having a plurality of hand-accessible variable controls.

2. Background of Related Art

Electrosurgical instruments have become widely used by surgeons in recent years. Accordingly, a need has developed for equipment and instruments which are easy to handle, are reliable and are safe in an operating environment. By and large, most electrosurgical instruments are hand-held instruments, e.g., an electrosurgical pencil, which transfer radio-frequency (RF) electrical energy to a tissue site. The electrosurgical energy is returned to the electrosurgical source via a return electrode pad positioned under a patient (i.e., a monopolar system configuration) or a smaller return electrode positionable in bodily contact with or immediately adjacent to the surgical site (i.e., a bipolar system configuration). The waveforms produced by the RF source yield a predetermined electrosurgical effect known generally as electrosurgical cutting and fulguration.

In particular, electrosurgical fulguration includes the application of electric spark to biological tissue, for example, human flesh or the tissue of internal organs, without significant cutting. The spark is produced by bursts of radio-frequency electrical energy generated from an appropriate electrosurgical generator. Coagulation is defined as a process of desiccating tissue wherein the tissue cells are ruptured and dehydrated/dried. Electrosurgical cutting/dissecting, on the other hand, includes applying an electrical spark to tissue in order to produce a cutting, dissecting and/or dividing effect. Blending

includes the function of cutting/dissecting combined with the production of a hemostasis effect. Meanwhile, sealing/hemostasis is defined as the process of liquefying the collagen in the tissue so that it forms into a fused mass.

As used herein the term "electrosurgical pencil" is intended to include instruments which have a handpiece which is attached to an active electrode and which is used to cauterize, coagulate and/or cut tissue. Typically, the electrosurgical pencil may be operated by a handswitch or a foot switch. The active electrode is an electrically conducting element which is usually elongated and may be in the form of a thin flat blade with a pointed or rounded distal end. Alternatively, the active electrode may include an elongated narrow cylindrical needle which is solid or hollow with a flat, rounded, pointed or slanted distal end. Typically electrodes of this sort are known in the art as "blade", "loop" or "snare", "needle" or "ball" electrodes.

As mentioned above, the handpiece of the electrosurgical pencil is connected to a suitable electrosurgical energy source (i.e., generator) which produces the radio-frequency electrical energy necessary for the operation of the electrosurgical pencil. In general, when an operation is performed on a patient with an electrosurgical pencil, electrical energy from the electrosurgical generator is conducted through the active electrode to the tissue at the site of the operation and then through the patient to a return electrode. The return electrode is typically placed at a convenient place on the patient's body and is attached to the generator by a conductive material. Typically, the surgeon activates the controls on the electrosurgical pencil to select the modes/waveforms to achieve a desired surgical effect. Typically, the "modes" relate to the various electrical waveforms, e.g., a cutting waveform has a tendency to cut tissue, a coagulating wave form has a tendency to coagulate tissue and a blend wave form is somewhere between a cut and coagulate wave from. The power or energy parameters are typically controlled from outside the sterile field which requires an intermediary like a circulating nurse to make such adjustment.

A typical electrosurgical generator has numerous controls for selecting an electrosurgical output. For example, the surgeon can select various surgical "modes" to treat tissue: cut, blend (blend levels 1-3), low cut, desiccate,

fulgurate, spray, etc. The surgeon also has the option of selecting a range of power settings typically ranging from 1-300W. As can be appreciated, this gives the surgeon a great deal of variety when treating tissue. However, so many options also tend to complicate simple surgical procedures and may lead to confusion. Moreover, surgeons typically follow preset control parameters and stay within known modes and power settings. Therefore, there exists a need to allow the surgeon to selectively control and easily select and regulate the various modes and power settings utilizing simple and ergonomically friendly controls associated with the electrosurgical pencil.

Existing electrosurgical instrument systems allow the surgeon to change between two pre-configured settings (i.e., coagulation and cutting) via two discrete switches disposed on the electrosurgical pencil itself. Other electrosurgical instrument systems allow the surgeon to increment the power applied when the coagulating or cutting switch of the instrument is depressed by adjusting or closing a switch on the electrosurgical generator. The surgeon then needs to visually verify the change in the power being applied by looking at various displays and/or meters on the electrosurgical generator. In other words, all of the adjustments to the electrosurgical instrument and parameters being monitored during the use of the electrosurgical instrument are typically located on the electrosurgical generator. As such, the surgeon must continually visually monitor the electrosurgical generator during the surgical procedure.

Accordingly, the need exists for electrosurgical instruments which do not require the surgeon to continually monitor the electrosurgical generator during the surgical procedure. In addition, the need exists for electrosurgical instruments whose power output can be adjusted without the surgeon having to turn his vision away from the operating site and toward the electrosurgical generator.

SUMMARY

The present disclosure is directed to an electrosurgical pencil having variable controls. In accordance with one aspect of the present disclosure the

electrosurgical pencil includes an elongated housing and an electrocautery blade supported within the housing and extending distally from the housing, the electrocautery blade being connected to a source of electrosurgical energy. Advantageously, the pencil includes a plurality of activation switches or switches supported on the housing, each activation switch being configured and adapted to selectively complete a control loop extending from the source of electrosurgical energy upon actuation thereof. Preferably, at least one voltage divide network is advantageously supported on the housing, the voltage divider network (hereinafter "VDN") is electrically connected to the source of electrosurgical energy for controlling the intensity of electrosurgical energy being delivered to the electrocautery blade. The activation switch (or switches) is advantageously configured and adapted to control a waveform duty cycle to achieve a desired surgical intent. Additional switches may be utilized to control the so-called "mode" of operation, i.e., cut, coagulate, blend, and/or may be utilized to control the intensity/power.

In one particularly advantageous embodiment, the electrosurgical pencil further includes three mode activation switches supported on the housing. Each mode activation switch preferably delivers a characteristic signal to the source of electrosurgical energy which, in turn, transmits a corresponding waveform duty cycle to the electrosurgical pencil. For example, t is contemplated that a first activation switch delivers a first characteristic signal to the source of electrosurgical energy which, in turn, transmits a waveform duty cycle which produces a cutting effect. A second activation switch is also included which delivers a second characteristic signal to the source of electrosurgical energy which, in turn, transmits a waveform duty cycle which produces a blending effect. A third activation switch delivers a third characteristic signal to the source of electrosurgical energy which, in turn, transmits a waveform duty cycle which produces a coagulating effect.

Advantageously, a single VDN may be supported on the housing which is configured and adapted to adjust the intensity or power of the waveform duty cycle corresponding to a particular activation switch. The VDN preferably includes a plurality of discrete or analog intensity settings. For typical monopolar applications, the VDN may be advantageously configured and

adapted to vary the current intensity at 2K ohms from a minimum of about 60 mA to a maximum of about 240 mA, and more advantageously, from a minimum of about 100 mA to a maximum of about 200 mA at 2K ohms.

In one particularly advantageous embodiment, the VDN is slidably supported on the housing. As such, the VDN is set to a minimum when the VDN is placed at a first position, e.g., distal-most, and is set to a maximum when the VDN is placed at a second position, proximal-most (or vice versa). The VDN is also positionable at varying places therebetween. The VDN may also be configured and adapted to provide a plurality of incremental (i.e., discreet) intensity settings or may be variable through a range. Alternatively, the VDN may be rotatably supported on the housing.

It is envisioned that the electrocautery blade can be a blade, needle, a loop or a ball. It is also contemplated that the VDN may be a slide potentiometer and include a pair of nubs slidably supported, one each, on either side of the plurality of activation switches. The potentiometer may be advantageously operable from either side of the electrosurgical instrument for use by ambidextrous users.

It is further envisioned that the housing may include a recess formed in the outer surface thereof. The plurality of activation switches and the nubs of the voltage divider network are disposed within the recess. Advantageously, the electrosurgical pencil includes a molded hand grip operatively supported on the housing which is preferably shaped and dimensioned to reduce fatigue on the hand of the user.

According to another particularly advantageous aspect of the present disclosure, an electrosurgical pencil is provide and includes an elongate housing and an electrocautery end effector supported within the housing and extending distally from the housing. The electrosurgical pencil also includes a plurality of activation switches supported on the housing, wherein each activation switch is configured and adapted to energize the end effector with electrosurgical energy. The pencil still further includes at least one VDN supported on the housing which is configured and adapted to control the intensity of the electrosurgical energy being delivered to the electrocautery blade. Each activation switch is advantageously configured and adapted to

energize the end effector with a waveform duty cycle to achieve a desired surgical intent.

Preferably, the electrosurgical pencil includes three mode activation switches supported on the housing, wherein each of the three mode activation switches is advantageously configured and adapted to deliver a characteristic signal (voltage or current level, impedance, capacitance, inductance and/or frequency) to a source of electrosurgical energy which source of electrosurgical energy in turn transmits a corresponding waveform duty cycle to the end effector. A first activation switch activates a waveform duty cycle which produces a dissecting effect, a second activation switch activates a waveform duty cycle which produces a dissecting and hemostatic effect, and a third activation switch activates a waveform duty cycle which produces a hemostatic effect. These effects have been typically referred to as cut, blend, and coagulation effects or modes.

It is envisioned that the VDN may include a pair of nubs slidably supported on the housing, one each, on either side of the activation switches. It is also contemplated that the VDN may be configured as a rheostat wherein, the VDN has a first position corresponding to a minimum intensity, a second position corresponding to a maximum intensity and a plurality of other positions corresponding to intensities between the minimum and the maximum intensity.

The VDN may be advantageously configured and adapted to vary a current intensity at 2K ohms from a minimum of about 60 mA to a maximum of about 240 mA, preferably from a minimum of about 100 mA to a maximum of about 200 mA at 2K ohms. Preferably, the VDN is set to the minimum when the at least one voltage divider network is placed at a first position and is set to the maximum when placed at a second position. The VDN may also be configured and adapted to provide a plurality of discreet or analog intensity settings. It is also contemplated that the waveform duty cycle of the activation switches may be advantageously configured to vary with a change in intensity produced by the VDN.

These and other objects will be more clearly illustrated below by the description of the drawings and the detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 is a perspective view of an electrosurgical pencil in accordance with the present disclosure;

FIG. 2 is a partially broken away perspective view of the electrosurgical pencil of FIG. 1;

FIG. 3 is an exploded perspective view of the electrosurgical pencil of FIG. 1;

FIG. 4 is a perspective view of an electrosurgical pencil in accordance with another embodiment of the present disclosure;

FIG. 5 is a top plan view of the electrosurgical pencil of FIG. 4;

FIG. 6 is a side elevational view of the electrosurgical pencil of FIG. 4;

FIG. 7 is a partially broken away, side elevational view of the electrosurgical pencil of FIG. 4;

FIG. 8 is a front elevational view of the electrosurgical pencil of FIG. 4;

FIG. 9 is a side elevational view of an electrosurgical pencil according to another embodiment of the present disclosure;

FIG. 10 is a top plan view of the electrosurgical pencil of FIG. 9;

FIG. 11 is a front perspective view of a distal end portion of an electrosurgical pencil according to yet another embodiment of the present disclosure;

FIG. 12 is a front perspective view of a distal end portion of an electrosurgical pencil according to still another embodiment of the present disclosure;

FIG. 13 is an enlarged perspective view of a portion of an electrosurgical pencil illustrating a set of exemplary switches disposed thereon;

FIG. 14 is an enlarged perspective view of a portion of an electrosurgical pencil illustrating another set of exemplary switches disposed thereon; and

FIG. 15 is a perspective view of the switch of FIG. 14.

DETAILED DESCRIPTION

Preferred embodiments of the presently disclosed electrosurgical pencil will now be described in detail with reference to the drawing figures wherein like reference numerals identify similar or identical elements. As used herein, the term "distal" refers to that portion which is further from the user while the term "proximal" refers to that portion which is closer to the user or surgeon.

FIG. 1 sets forth a perspective view of an electrosurgical pencil constructed in accordance with one embodiment of the present disclosure and generally referenced by numeral 10. While the following description will be directed towards electrosurgical pencils it is envisioned that the features and concepts (or portions thereof) of the present disclosure can be applied to any electrosurgical type instrument, e.g., forceps, suction coagulator, vessel sealers, etc.

As seen in FIGS. 1-3, electrosurgical pencil 10 includes an elongated housing 2 configured and adapted to support a blade receptacle 4 at a distal end 3 thereof which, in turn, receives a replaceable electrocautery end effector 6 in the form of a loop and/or blade therein. Electrocautery blade 6 is understood to include a planar blade, a loop, a needle and the like. A distal end portion 8 of blade 6 extends distally from receptacle 4 while a proximal end portion 11 (see FIG. 3) of blade 6 is retained within distal end 3 of housing 2. It is contemplated that electrocautery blade 6 is fabricated from a conductive type material, such as, for example, stainless steel, or is coated with an electrically conductive material.

As shown, electrosurgical pencil 10 is coupled to a conventional electrosurgical generator "G" via a cable 12. Cable 12 includes a transmission wire 14 (see FIG. 3) which electrically interconnects electrosurgical generator "G" with proximal end portion 11 of electrocautery blade 6. Cable 12 further includes control wires 16 which electrically interconnect mode activation switches (as will be described in greater detail below), supported on an outer surface 7 of housing 2, with electrosurgical generator "G". For the purposes

herein the terms "switch" or "switches" includes electrical actuators, mechanical actuators, electro-mechanical actuators (rotatable actuators, pivotable actuators, toggle-like actuators, buttons, etc.) or optical actuators.

Turning back to FIGS. 1-3, as mentioned above, electrosurgical pencil 10 further includes at least one activation switch, preferably three activation switches 24a-24c, each of which are supported on an outer surface 7 of housing 2. Each activation switch 24a-24c is operatively connected to a location on a tactile element 26a-26c (e.g., a snap-dome is shown) which, in turn, controls the transmission of RF electrical energy supplied from generator "G" to electrosurgical blade 6. More particularly, tactile elements 26a-26c are operatively connected to a voltage divider network 27 (hereinafter "VDN 27") which forms a switch closure (e.g., here shown as a film-type potentiometer). For the purposes herein, the term "voltage divider network" relates to any known form of resistive, capacitive or inductive switch closure (or the like) which determines the output voltage across a voltage source (e.g., one of two impedances) connected in series. A "voltage divider" as used herein relates to a number of resistors connected in series which are provided with taps at certain points to make available a fixed or variable fraction of the applied voltage.

In use, depending on which activation switch 24a-24c is depressed a respective switch 26a-26c is pressed into contact with VDN 27 and a characteristic signal is transmitted to electrosurgical generator "G" via control wires 16. Control wires 16 are preferably electrically connected to switches 26a-26c via a terminal 15 (see FIG. 2 and 3). By way of example only, electrosurgical generator "G" may be used in conjunction with the device wherein generator "G" includes a circuit for interpreting and responding to the VDN settings.

Activation switches 24a-24c are configured and adapted to control the mode and/or "waveform duty cycle" to achieve a desired surgical intent. For example, activation switch 24a can be set to deliver a characteristic signal to electrosurgical generator "G" which in turn transmits a duty cycle and/or waveform shape which produces a cutting and/or dissecting effect/function. Meanwhile, activation switch 24b can be set to deliver a characteristic signal to

electrosurgical generator "G" which in turn transmits a duty cycle and/or waveform shape which produces a blending effect/function (e.g., a combination of a dissecting and a hemostatic effect/function). Finally, activation switch 24c can be set to deliver a characteristic signal to electrosurgical generator "G" which in turn transmits a duty cycle and/or waveform shape which produces a hemostatic effect/function.

The hemostatic effect/function can be defined as having waveforms with a duty cycle from about 1% to about 12%. The blending effect/function can be defined as having waveforms with a duty cycle from about 12% to about 75%. The cutting and/or dissecting effect/function can be defined as having waveforms with a duty cycle from about 75% to about 100%. It is important to note that these percentages are approximated and may be customized to deliver the desired surgical effect for various tissue types and characteristics.

Electrosurgical pencil 10 further includes an intensity controller 28 slidingly supported on housing 2. Intensity controller 28 includes a pair of nubs 29a, 29b which are slidingly supported, one each, in respective guide channels 30a, 30b, formed in outer surface 7 of housing 2 on either side of activations switches 24a-24c. By providing nubs 29a, 29b on either side of activation switches 24a-24c, controller 28 can be easily manipulated by either hand of the user or the same electrosurgical pencil can be operated by a right-handed or a left-handed user.

Preferably, intensity controller 28 is a slide potentiometer wherein nubs 29a, 29b have a first position (e.g., proximal-most position closest to cable 12) corresponding to a relative low intensity setting, a second position (e.g., a distal-most position closest to electrocautery end effector 6) corresponding to a relative high intensity setting, and a plurality of intermediate positions corresponding to intermediate intensity settings. As can be appreciated, the intensity settings from proximal end to distal end may be reversed as well, e.g., high to low. It is contemplated that nubs 29a, 29b of intensity controller 28 and corresponding guide channels 30a, 30b may be provided with a series of cooperating discreet or dented positions defining a series of positions, preferably five, to allow easy selection of the output intensity from the low intensity setting to the high intensity setting. The series of cooperating discreet

or detented positions also provide the surgeon with a degree of tactile feedback. As best seen in FIG. 2, intensity controller 28 can include a series of indicia 31 provided thereon which are visible through guide channels 30a, 30b. Indicia 31 are preferably a series of numbers (e.g., numbers 1-5) which reflect the level of intensity that is to be transmitted. Alternatively, level indicators may be printed alongside the sides of guide channels 30a, 30b along which nubs 29a, 29b slide.

Intensity controller 28 is configured and adapted to adjust the power parameters (e.g., voltage, power and/or current intensity) and/or the power verses impedance curve shape to affect the perceived output intensity. For example, the greater intensity controller 28 is displaced in a distal direction the greater the level of the power parameters transmitted to electrocautery blade 6. Conceivably, current intensities can range from about 60 mA to about 240 mA when using an electrosurgical blade and having a typical tissue impedance of about 2K ohms. An intensity level of 60 mA provides very light and/or minimal cutting/dissecting/hemostatic effects. An intensity level of 240 mA provides very aggressive cutting/dissecting/hemostatic effects. Accordingly, the preferred range of current intensity is from about 100 mA to about 200 mA at 2K ohms.

The intensity settings are preferably preset and selected from a look-up table based on a choice of electrosurgical instruments/attachments, desired surgical effect, surgical specialty and/or surgeon preference. The selection may be made automatically or selected manually by the user. The intensity values may be predetermined or adjusted by the user.

In operation and depending on the particular electrosurgical function desired, the surgeon depresses one of activation switches 24a-24c, in the direction indicated by arrow "Y" (see FIG. 1) thereby urging a corresponding switch 26a-26c against VDN 27 and thereby transmitting a respective characteristic signal to electrosurgical generator "G". For example, the surgeon can depress activation switch 24a to perform a cutting and/or dissecting function, activation switch 24b to perform a blending function, or activation switch 24c to perform a hemostatic function. In turn, generator "G" transmits an appropriate waveform output to electrocautery blade 6 via transmission wire 14.

In order to vary the intensity of the power parameters of electrosurgical pencil 10, the surgeon displaces intensity controller 28 in the direction indicated by double-headed arrow "X". As mentioned above, the intensity can be varied from approximately 60 mA for a light effect to approximately 240 mA for a more aggressive effect. For example, by positioning nubs 29a, 29b of intensity controller 28 closer to the proximal-most end of guide channels 30a, 30b (i.e., closer to cable 12) a lower intensity level is produced and by positioning nubs 29a, 29b of intensity controller 28 closer to the distal-most end of guide channels 30a, 30b (i.e., closer to electrocautery end effector 6) a larger intensity level is produced resulting in a more aggressive effect being produced. It is envisioned that when nubs 29a, 29b of intensity controller 28 are positioned at the proximal-most end of guide channels 30a, 30b, VDN 27 is set to a null and/or open position. Preferably, electrosurgical pencil 10 is shipped with intensity controller 28 set to the null and/or open positions.

As described above, intensity controller 28 can be configured and adapted to provide a degree of tactile feedback. Alternatively, audible feedback can be produced from intensity controller 28 (e.g., a "click"), from electrosurgical energy source "G" (e.g., a "tone") and/or from an auxiliary sound-producing device such as a buzzer (not shown).

Preferably, as seen in FIGS. 1 and 3, intensity controller 28 and activation switches 24a-24c are supported in a recess 9 formed in outer wall 7 of housing 2. Desirably, activation switches 24a-24c are positioned at a location where the fingers of the surgeon would normally rest when electrosurgical pencil 10 is held in the hand of the surgeon while nubs 29a, 29b of intensity controller 28 are placed at locations which would not be confused with activation switches 24a-24c. Alternatively, nubs 29a, 29b of intensity controller 28 are positioned at locations where the fingers of the surgeon would normally rest when electrosurgical pencil 10 is held in the hand of the surgeon while activation switches 24a-24c are placed at locations which would not be confused with nubs 29a, 29b of intensity controller 28. In addition, recess 9 formed in outer wall 7 of housing 2 advantageously minimizes inadvertent activation (e.g., depressing, sliding and/or manipulating) of activation switches

24a-24c and intensity controller 28 while in the surgical field and/or during the surgical procedure.

As seen in FIG. 3, electrosurgical pencil 10 includes a molded/contoured hand grip 5 which substantially surrounds the distal and proximal ends of housing 2 as well as the underside of housing 2. Contoured hand grip 5 is shaped and dimensioned to improve the handling of electrosurgical pencil 10 by the surgeon. Accordingly, less pressure and gripping force is required to use and/or operate electrosurgical pencil 10 thereby potentially reducing the fatigue experienced by the surgeon.

Turning now to FIGS. 4-8, an electrosurgical pencil constructed in accordance with another embodiment of the present disclosure is shown generally as 100. Electrosurgical pencil 100 includes at least one activation switch, preferably three activation switches 124a-124c, each of which are supported on an outer surface 107 of housing 102. Each activation switch 124a-124c is operatively connected to a respective switch 126a-126c which, in turn, controls the transmission of RF electrical energy supplied from generator "G" to electrosurgical blade 106. More particularly, switches 126a-126c are electrically coupled to control loop 116 and are configured to close and/or complete control loop 116 to thereby permit RF energy to be transmitted to electrocautery blade 106 from electrosurgical generator "G".

Activation switches 124a-124c are configured and adapted to control the mode and/or "waveform duty cycle" to achieve a desired surgical intent in the same manner as activation switches 24a-24c of electrosurgical pencil 10 described above.

Electrosurgical pencil 100 further includes at least one intensity controller, preferably two intensity controllers 128a and 128b, each of which are slidingly supported in guide channels 130a, 130b, respectively, which are formed in outer surface 107 of housing 102. Preferably, each intensity controller 128a and 128b is a slide-like potentiometer. It is contemplated that each intensity controller 128a and 128b and respective guide channel 130a and 130b may be provided with a series of cooperating discreet or detented positions defining a series of positions, preferably five, to allow easy selection of output intensity from a minimum amount to a maximum amount. The series

of cooperating discreet or detented positions also provide the surgeon with a degree of tactile feedback. It is further envisioned that one of the series of positions for intensity controllers 128a, 128b is an off position (i.e., no level of electrical or RF energy is being transmitted).

Intensity controllers 128a, 128b is configured and adapted to adjust one of the power parameters (e.g., voltage, power and/or current intensity) and/or the power verses impedance curve shape to affect the perceived output intensity.

For example, the greater intensity controllers 128a, 128b are displaced in a distal direction (i.e., in the direction of electrocautery blade 106) the greater the level of the power parameters transmitted to electrocautery blade 106. Conceivably, current intensities can range from about 60 mA to about 240 mA when using an electrosurgical blade and having a typical tissue impedance of about 2000 ohms. An intensity level of 60 mA provides very light and/or minimal cutting/dissecting/hemostatic effects. An intensity level of 240 mA provides very aggressive cutting/dissecting/hemostatic effects. Accordingly, the preferred range of current intensity is from about 100 mA to about 200 mA at 2K ohms.

The intensity settings are preferably preset and selected from a look-up table based on a choice of electrosurgical instruments/attachments, desired surgical effect, surgical specialty and/or surgeon preference. The selection may be made automatically or selected manually by the user. The intensity values may be predetermined or adjusted by the user.

In operation and depending on the particular electrosurgical function desired, the surgeon depresses one of activation switches 124a-124c, in the direction indicated by arrow "Y" (see FIGS. 4 and 7) thereby closing a corresponding switch 126a-126c and closing and/or completing control loop 116. For example, the surgeon can depress activation switch 124a to perform a cutting or dissecting function, activation switch 124b to perform a dissecting/hemostatic function, or activation switch 124c to perform a hemostatic function. In turn, generator "G" transmits an appropriate waveform output to electrocautery blade 106 via transmission wire 114.

In order to vary the intensity of the power parameters of electrosurgical pencil 100, preferably, the current intensity, the surgeon displaces at least one of intensity controllers 128a, 128b in the direction indicated by double-headed arrow "X". As mentioned above, the intensity can be varied from approximately 60 mA for a light effect to approximately 240 mA for a more aggressive effect. For example, by positioning one of intensity controllers 128a, 128b closer to the proximal-most end (i.e., closer to cable 112) a light effect is produced and by positioning one of intensity controllers 128a, 128b closer to the distal-most end (i.e., closer to electrocautery blade 106) a more aggressive effect is produced. As described above, each intensity controller 128a, 128b can be configured and adapted to provide a degree of tactile feedback. Alternatively, audible feedback can be produced from each intensity controller 128a, 128b (e.g., a "click"), electrosurgical energy source "G" (e.g., a "tone") and/or an auxiliary sound-producing device such as a buzzer (not shown).

In an alternative embodiment, as seen in FIGS. 9 and 10, sliding intensity controllers 128a, 128b have been replaced with intensity controllers 228a, 228b in the form of dial-like VDNs. Intensity controllers 228a, 228b function to vary the intensity of the power parameters via a rotation of dial controllers 228a, 228b in either a clockwise or counter-clockwise direction as indicated by double headed arrow "Z". As seen in FIGS. 6 and 7, dial controllers 228a, 228b are disposed externally of housing 102, however, it is contemplated that dial controllers 228a, 228b are disposed within housing 102 with only a portion projecting therefrom for manipulation by the surgeon. It is envisioned that intensity controllers 228a, 228b can be a single controller having a pair of opposed knobs/dials provided, one each, on either side of housing 102. In this manner, the intensity can be controlled from either side of electrosurgical pencil 100.

Since the surgeon has a number of controls at his finger tips, the surgeon is able to create a pallet of varying therapeutic effects ranging from a pure "cutting" effect to a pure "coagulating" effect and a number of effects in between at a number of intensities. Moreover, with some pre-setting of the electrosurgical energy source "G", electrosurgical pencil 100 will have all the useful settings available to the surgeon within the sterile field. Accordingly, it is

not necessary that the surgeon interact with hardware outside the sterile field (e.g., electrosurgical energy source "G") once the surgical procedure begins thus allowing the surgeon to focus attention on the surgical procedure.

While embodiments of electrosurgical pencils according to the present disclosure have been described herein, it is not intended that the disclosure be limited there and the above description should be construed as merely exemplifications of preferred embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the present disclosure.

For example, as seen in FIG. 11, an alternative embodiment of an electrosurgical pencil is shown generally as 200. Electrosurgical pencil 200 is similar to electrosurgical pencil 10 and/or 100 and will only be discussed in detail to the extent necessary to identify differences in construction and operation. As seen in FIG. 11, electrosurgical pencil 200 includes a plurality of nubs, preferably, three nubs, 229a-229c which are slidingly supported, one each, in respective guide channels 230a-230c, formed in outer surface 7 of housing 2, at a position proximal of activation switches 24a-24c. Nubs 229a-229c are each operatively engaged with a slide potentiometer.

Accordingly, electrosurgical pencil 200 can be configured such that each activation switch 24a-24c is a separate mode, such as, for example, activation switch 24a can be set such that electrosurgical pencil 200 performs "division" when depressed, activation switch 24b can be set such that electrosurgical pencil 200 performs "division with hemostasis" when depressed, and activation switch 24c can be set such that electrosurgical pencil 200 performs "hemostasis" when depressed. In addition, each nub 229a-229c is in operative engagement with a corresponding activation switch 24a-24c such that the power for each mode of operation of electrosurgical pencil 200 can be independently adjusted.

As seen in FIG. 12, nubs 229a-229c of electrosurgical pencil 200 have been replaced with toggles 231a-231c operatively engaged with a respective activation switch 24a-24c. Each toggle 231a-231c can be operatively engaged with a rocker-type switch (not shown) or a rotational dial (not shown) in place of the slide-type potentiometer described above.

Turning now to FIGS. 13-15, an electrosurgical pencil, in accordance with still another embodiment of the present disclosure, is generally designated as 300. Electrosurgical pencil 300 is similar to electrosurgical pencil 10 and/or 100 and will only be discussed in detail to the extent necessary to identify differences in construction and operation. As seen in FIGS. 13 and 14, nubs 29a, 29b have been replaced with a dial 329 rotatably supported in an aperture 330 formed in outer surface 7 of housing 2. Preferably, dial 329 is positioned forward of activation switch 24a such that dial 329 is not inadvertently rotated during the depression of any one of activation switches 24a-24c.

As seen in FIG. 13, a side surface 331 of dial 329 can be provided with indicia and/or markings "M" in the form of a scale and/or other form of gradient to indicate to the surgeon the degree of and/or level of power at which electrosurgical pencil 300 is set.

As seen in FIGS. 14 and 15, windows 332 can be formed on either side of dial 329 in outer surface 7 of housing 2. As seen in FIG. 15, windows 332 provide the surgeon with visibility to indicia "M" provided on stub 333 extending from the central axis of dial 329. Indicia "M" can be in the form of numbers, letters, colors and, as seen in FIGS. 14 and 15, an enlarging gradient. It is envisioned that each dial 329 can perform a dual function, for example, dial 329 can be rotated to set the desired power level and can be pressed down to activate the electrosurgical pencil with the desired mode.

For example, it is further envisioned that any of the electrosurgical pencils disclosed herein can be provided with a lock-out mechanism/system (not shown) wherein when one of the activation switches is depressed, the other remaining activation switches can either not be depressed or can not cause transmission of electrosurgical energy to electrocautery blade 106.

It is also envisioned that the electrosurgical pencil 100 may include a smart recognition technology which communicates with the generator to identify the electrosurgical pencil and communicate various surgical parameters which relate to treating tissue with electrosurgical pencil 100. For example, the electrosurgical pencil 100 may be equipped with a bar code or Aztec code which is readable by the generator and which presets the generator to default parameters associated with treating tissue with electrosurgical pencils. The bar

code or Aztec code may also include programmable data which is readable by the generator and which programs the generator to specific electrical parameters prior to use. Other smart recognition technology is also envisioned which enable the generator to determine the type of instrument being utilized or to insure proper attachment of the instrument to the generator as a safety mechanism. One such safety connector is identified in U.S. Patent Application Serial No. [203-3756], filed on the same date herewith and entitled "CONNECTOR SYSTEMS FOR ELECTROSURGICAL GENERATOR", the entire contents of which being incorporated by reference herein. For example, in addition to the smart recognition technology described above, such a safety connector can include a plug or male portion operatively associated with the electrosurgical pencil and a complementary socket or female portion operatively associated with the electrosurgical generator. Socket portion is "backward compatible" to receive connector portions of electrosurgical pencils disclosed therein and to receive connector portions of prior art electrosurgical instruments.

It is also envisioned that the current controls may be based on current density or designed to deliver a specific current for a defined surface area (amp/cm^2).

IN THE CLAIMS

1. An electrosurgical pencil, comprising:

an elongated housing;

an electrocautery electrode supported within the housing and extending distally from the housing, the electrocautery electrode being connected to a source of electrosurgical energy;

a plurality of activation switches supported on the housing, each activation switch being configured and adapted to selectively complete a control loop extending from the source of electrosurgical energy upon actuation thereof; and

at least one voltage divider network supported on the housing, the at least one voltage divider network being electrically connected to the source of electrosurgical energy for controlling the intensity of electrosurgical energy being delivered to the electrocautery electrode.

2. The electrosurgical pencil according to claim 1, wherein at least one activation switch is configured and adapted to control a waveform duty cycle to achieve a desired surgical intent.

3. The electrosurgical pencil according to any preceding claim, further including three mode activation switches supported on the housing.

4. The electrosurgical pencil according to any preceding claim, wherein each mode activation switch delivers a characteristic signal to the source of electrosurgical energy which in turn transmits a corresponding waveform duty cycle to the electrosurgical pencil.

5. The electrosurgical pencil according to any preceding claim, wherein a first activation switch delivers a first characteristic signal to the source of electrosurgical energy which in turn transmits a waveform duty cycle which produces a cutting effect, a second activation switch delivers a second characteristic signal to the source of electrosurgical energy which in turn

transmits a waveform duty cycle which produces a blending effect, and wherein a third activation switch delivers a third characteristic signal to the source of electrosurgical energy which in turn transmits a waveform duty cycle which produces a coagulating effect.

6. The electrosurgical pencil according to any preceding claim, wherein the voltage divider network is a potentiometer.

7. The electrosurgical pencil according to any preceding claim, wherein the potentiometer is a rheostat having discreet values and configured and adapted to adjust the intensity of the waveform duty cycle corresponding to a particular activation switch.

8. The electrosurgical pencil according to any preceding claim, wherein the potentiometer has a plurality of intensity settings.

9. The electrosurgical pencil according to any preceding claim, wherein the potentiometer is configured and adapted to vary a current intensity from a minimum of about 60 mA to a maximum of about 240 mA at 2K ohms.

10. The electrosurgical pencil according to any preceding claim, wherein the potentiometer is configured and adapted to vary a current intensity from a minimum of about 100 mA to a maximum of about 200 mA at 2K ohms.

11. The electrosurgical pencil according to any preceding claim, wherein the potentiometer is slidably supported on the housing.

12. The electrosurgical pencil according to any preceding claim, wherein the potentiometer is set to a minimum when the potentiometer is placed at a first position and is set to a maximum when the potentiometer is placed at a second position.

13. The electrosurgical pencil according to any preceding claim, wherein the voltage divider network is a slide potentiometer and includes a pair of nubs slidably supported, one each, on either side of the plurality of activation switches such that the potentiometer is operable from either side of the electrosurgical pencil.

14. The electrosurgical pencil according to any preceding claim, wherein the housing includes a recess formed in the outer surface thereof, and wherein the plurality of activation switches and the nubs of the voltage divider network are disposed within the recess.

15. An electrosurgical pencil, comprising:

an elongate housing;

an electrocautery end effector supported within the housing and extending distally from the housing;

a plurality of mode activation switches supported on the housing, wherein each mode activation switch is configured and adapted to energize the end effector with electrosurgical energy; and

at least one voltage divider network supported on the housing, wherein the at least one voltage divider network is configured and adapted to control the intensity of the electrosurgical energy being delivered to the electrocautery electrode.

16. The electrosurgical pencil according to claim 15, wherein each mode activation switch is configured and adapted to energize the end effector with a waveform duty cycle to achieve a desired surgical intent.

17. The electrosurgical pencil according to claim 15 or 16, wherein the electrosurgical pencil includes three mode activation switches supported on the housing, wherein each of the three mode activation switches is configured and adapted to deliver a characteristic signal to a source of electrosurgical energy which source of electrosurgical energy in turn transmits a corresponding waveform duty cycle to the end effector.

18. The electrosurgical pencil according to claim 15, 16 or 17, wherein a first mode activation switch activates a waveform duty cycle which produces a dissecting effect, a second mode activation switch activates a waveform duty cycle which produces a dissecting and hemostatic effect, and a third mode activation switch activates a waveform duty cycle which produces a hemostatic effect.

19. The electrosurgical pencil according to claim 15, 16, 17 or 18, wherein the at least one voltage divider network has a first position corresponding to a minimum intensity, a second position corresponding to a maximum intensity and a plurality of other positions corresponding to intensities between the minimum and the maximum intensity.

20. The electrosurgical pencil according to claim 15, 16, 17, 18 or 19, wherein the at least one voltage divider network is configured and adapted to vary a current intensity from a minimum of about 60 mA to a maximum of about 240 mA at 2K ohms

21. The electrosurgical pencil according to claim 15, 16, 17, 18, 19 or 20, wherein the at least one voltage divider network is configured and adapted to provide a plurality of intensity settings.

22. The electrosurgical pencil according to claim 15, 16, 17, 18, 19, 20 or 21, wherein the waveform duty cycle of the activation switches varies with a change in intensity produced by the at least one voltage divider network.

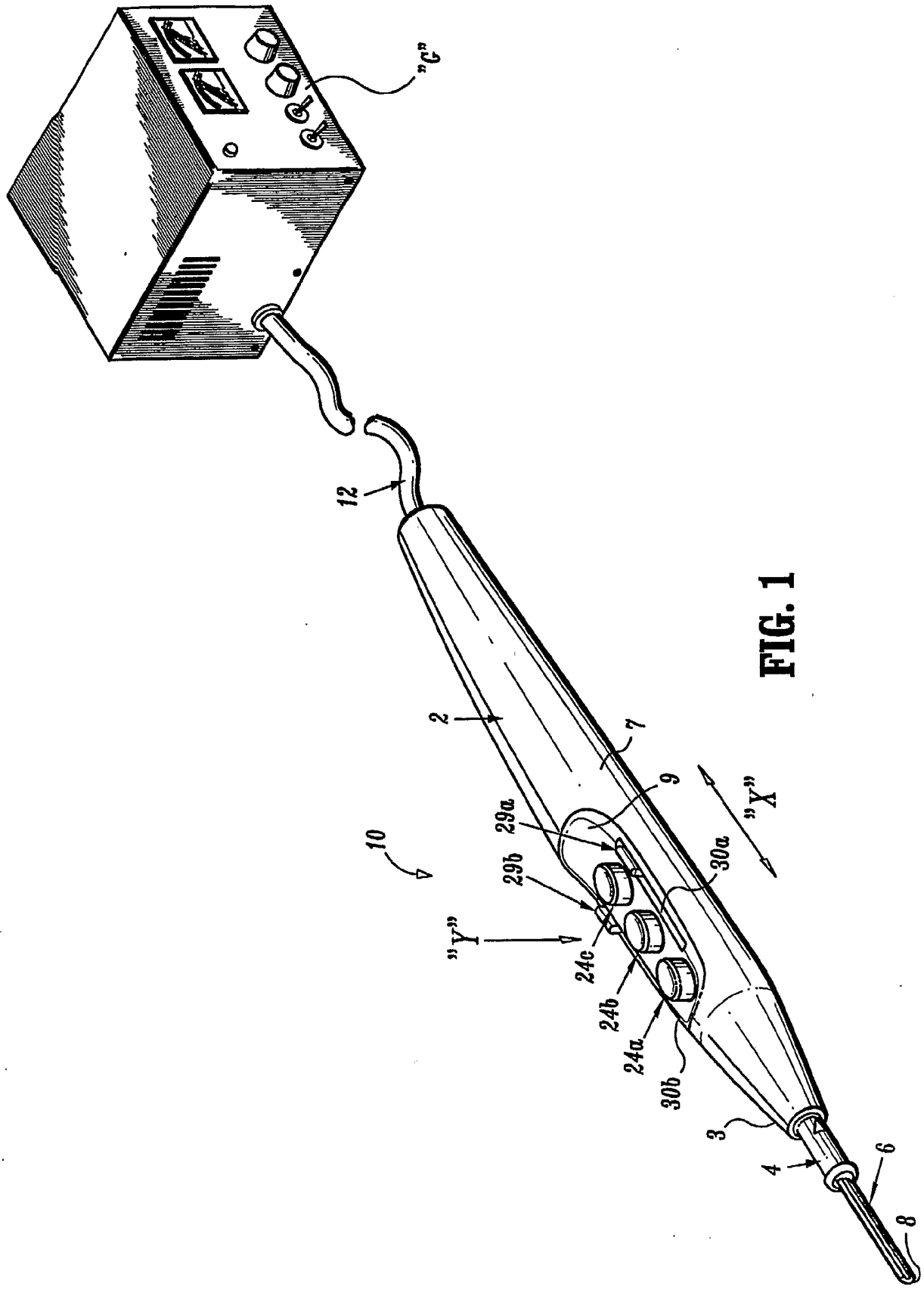

FIG. 1

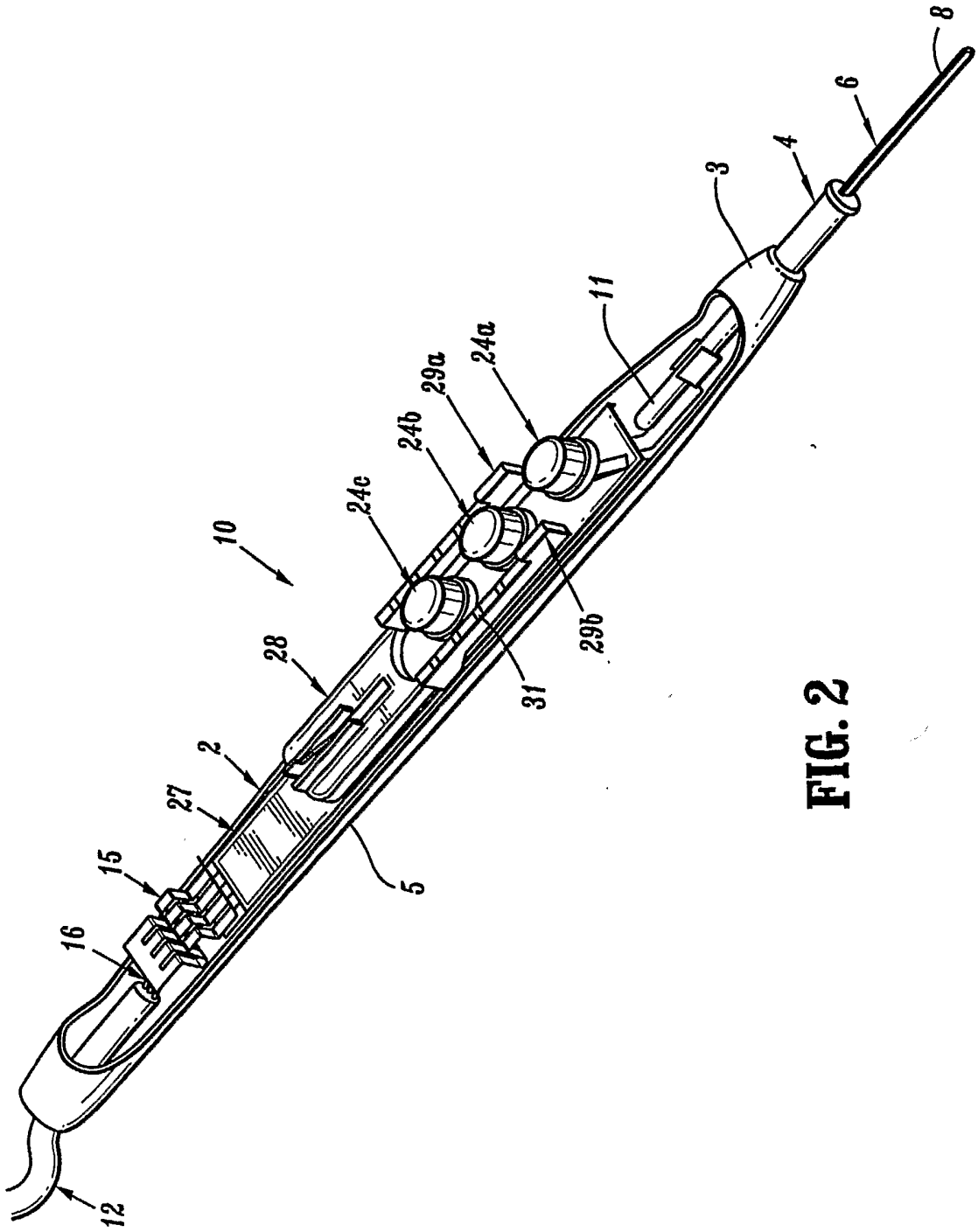

FIG. 2

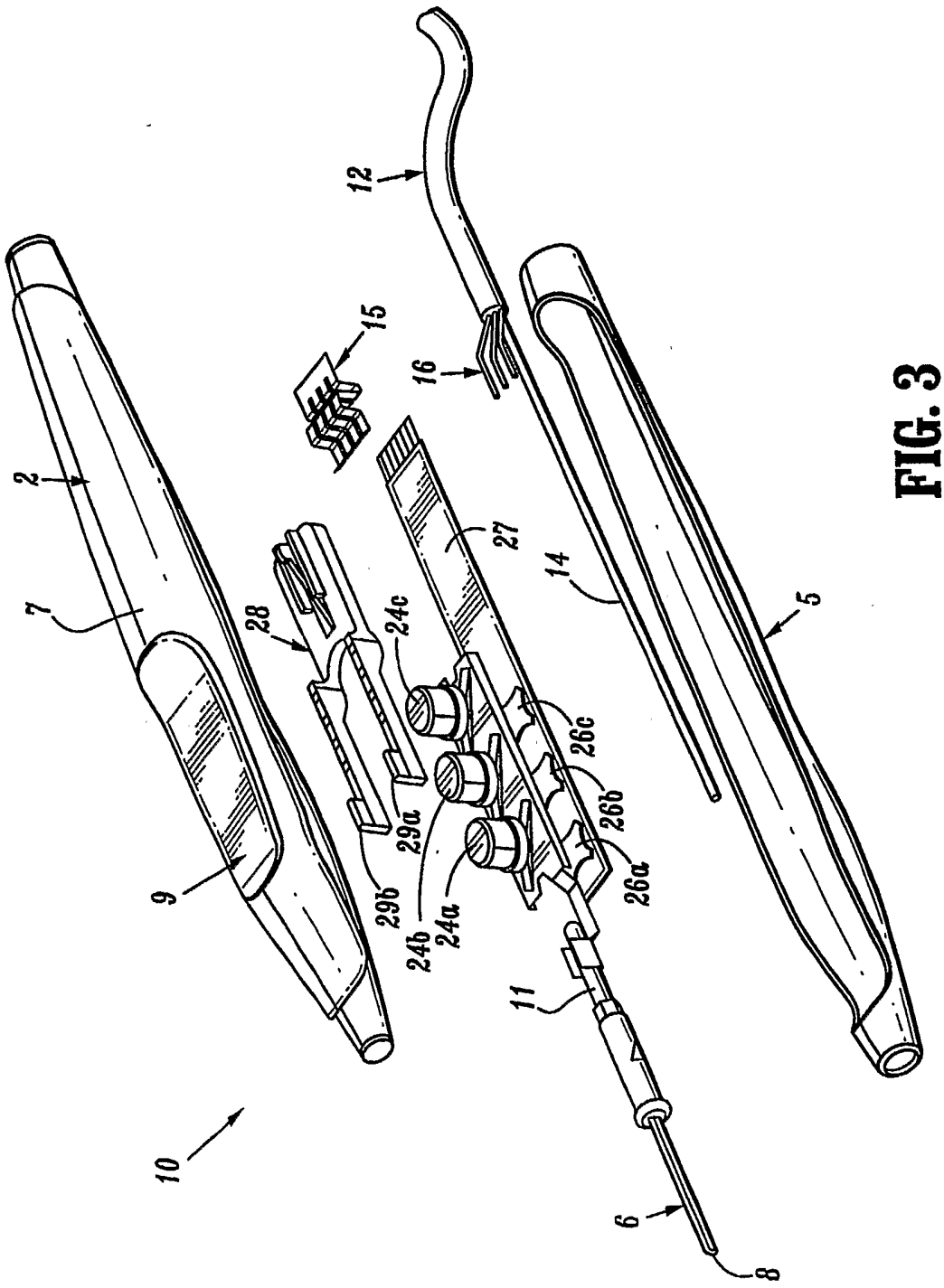

FIG. 3

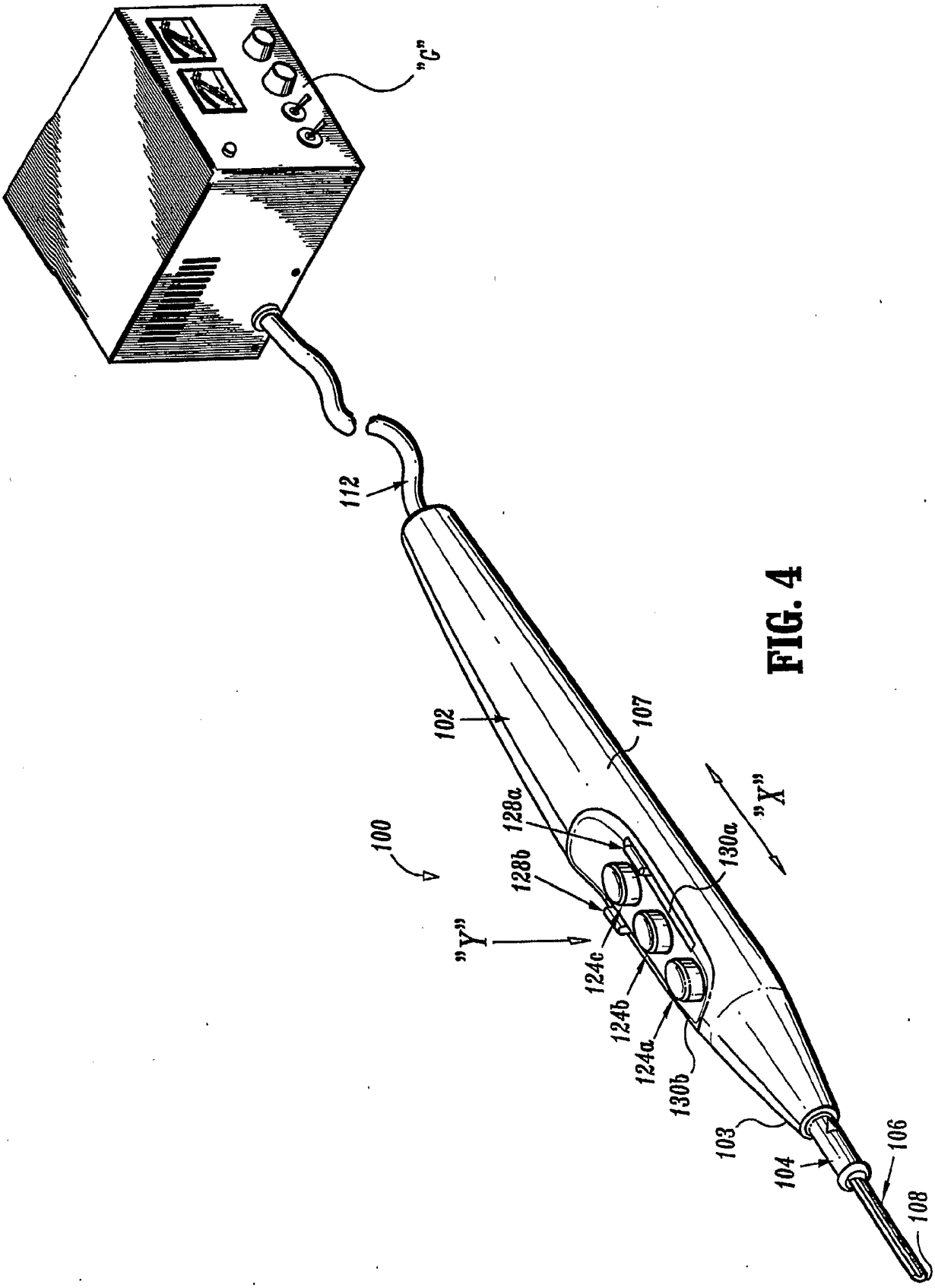
"C"
112
102
107
100
128a
128b
"Y"
"X"
130a
124c
124b
124a
130b
103
104
106
108

FIG. 4

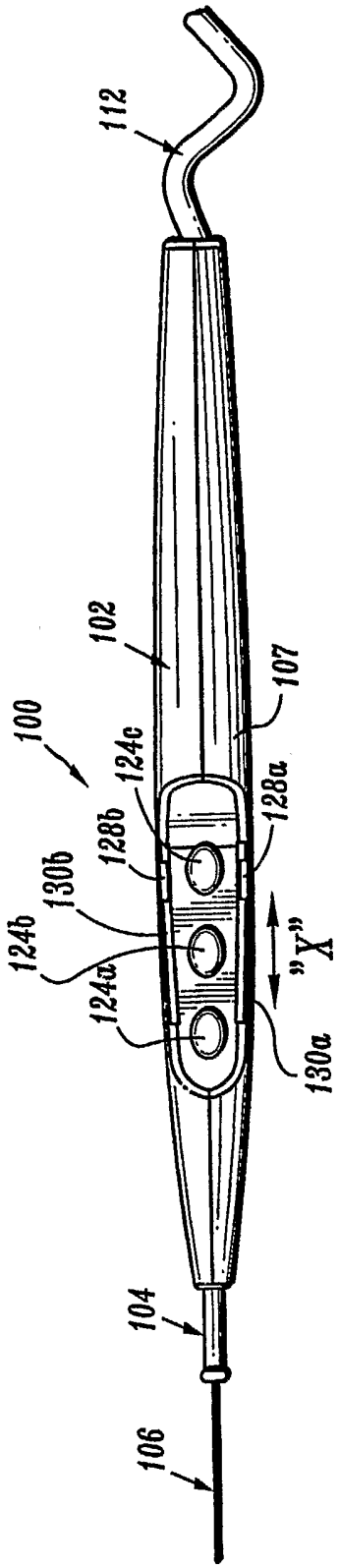

FIG. 5

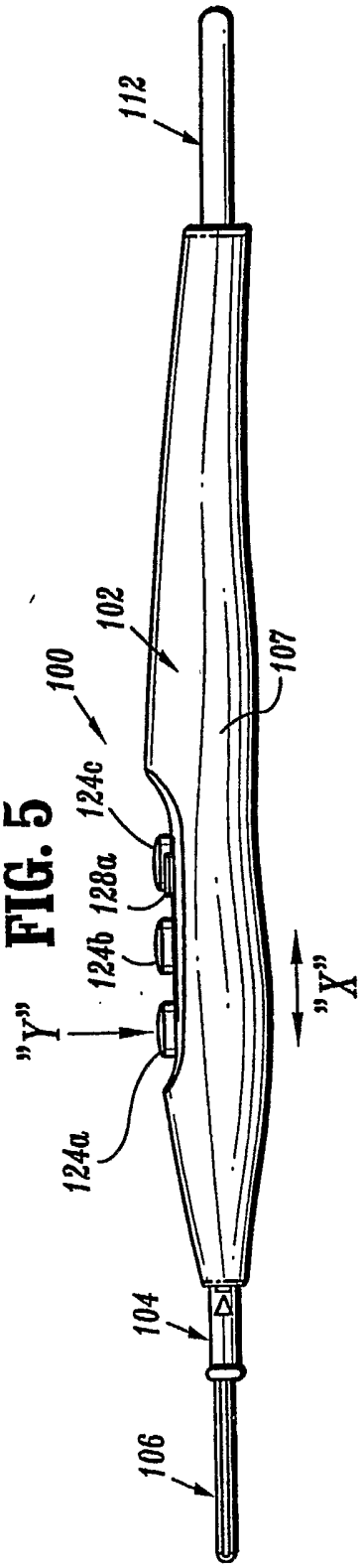

FIG. 6

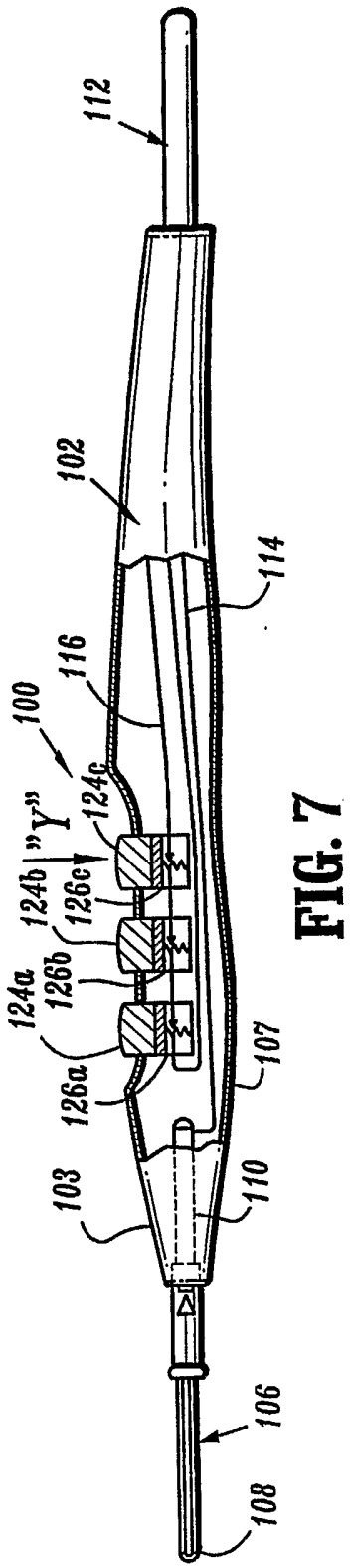

FIG. 7

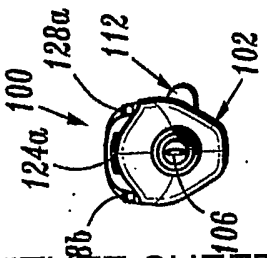

FIG. 8

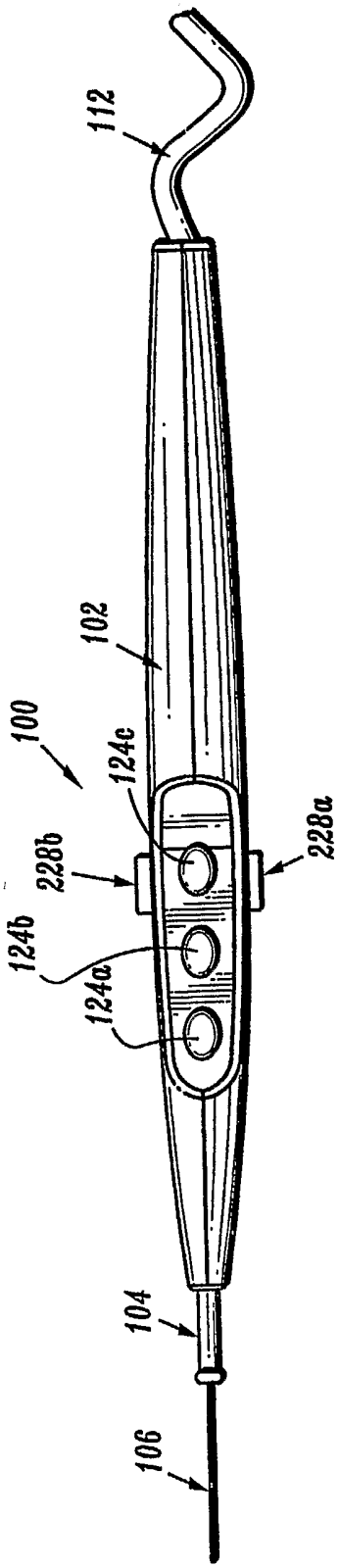
112
102
100
124c
228b
228a
124b
124a
104
106

FIG. 9

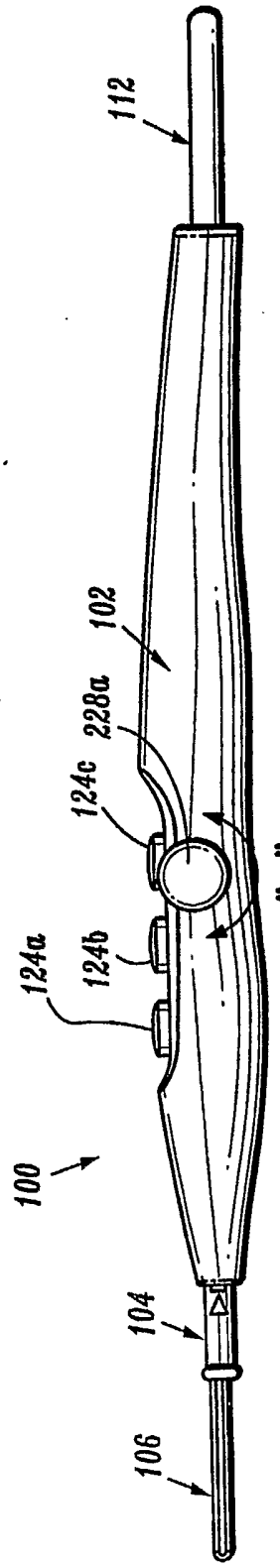
112
102
228a
124c
"Z"
124a
124b
100
104
106

FIG. 10

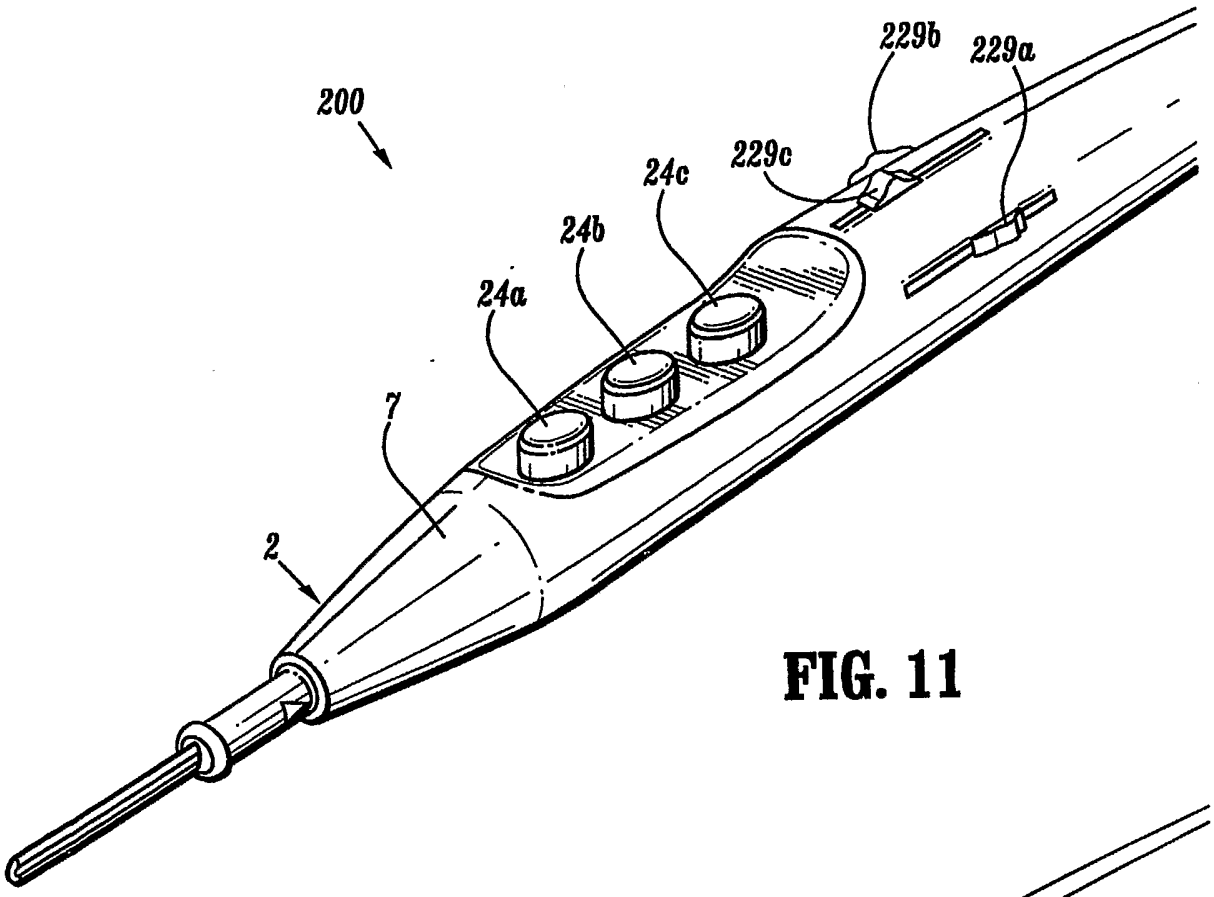
200
229b
229a
229c
24c
24b
24a
7
2

FIG. 11

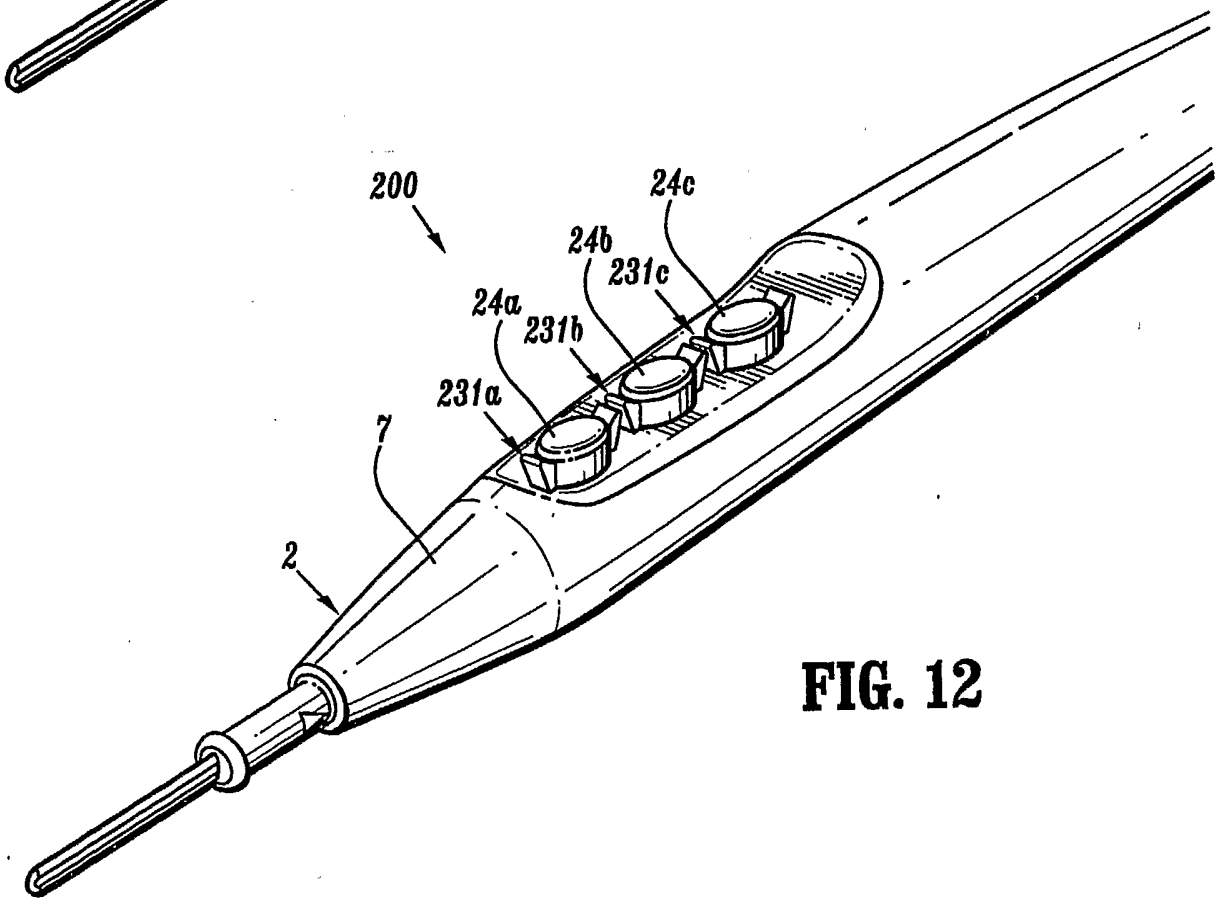
200
24c
24b
231c
24a
231b
231a
7
2

FIG. 12

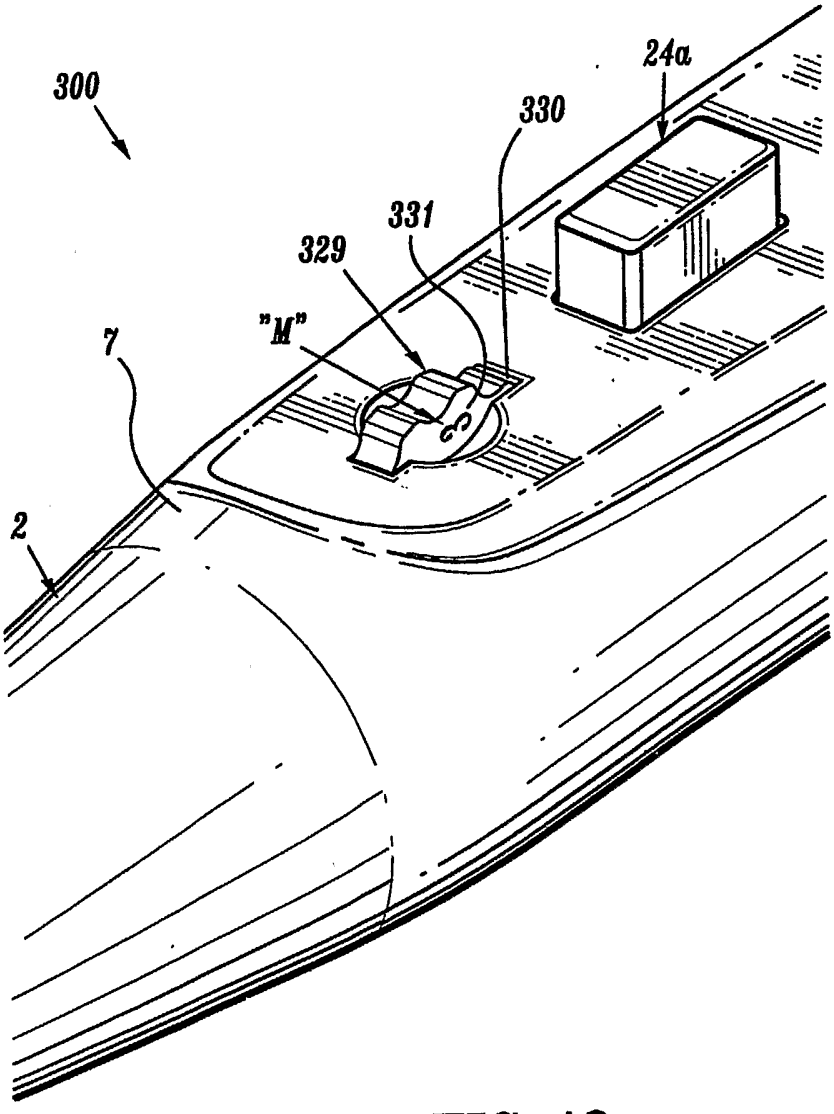

FIG. 13

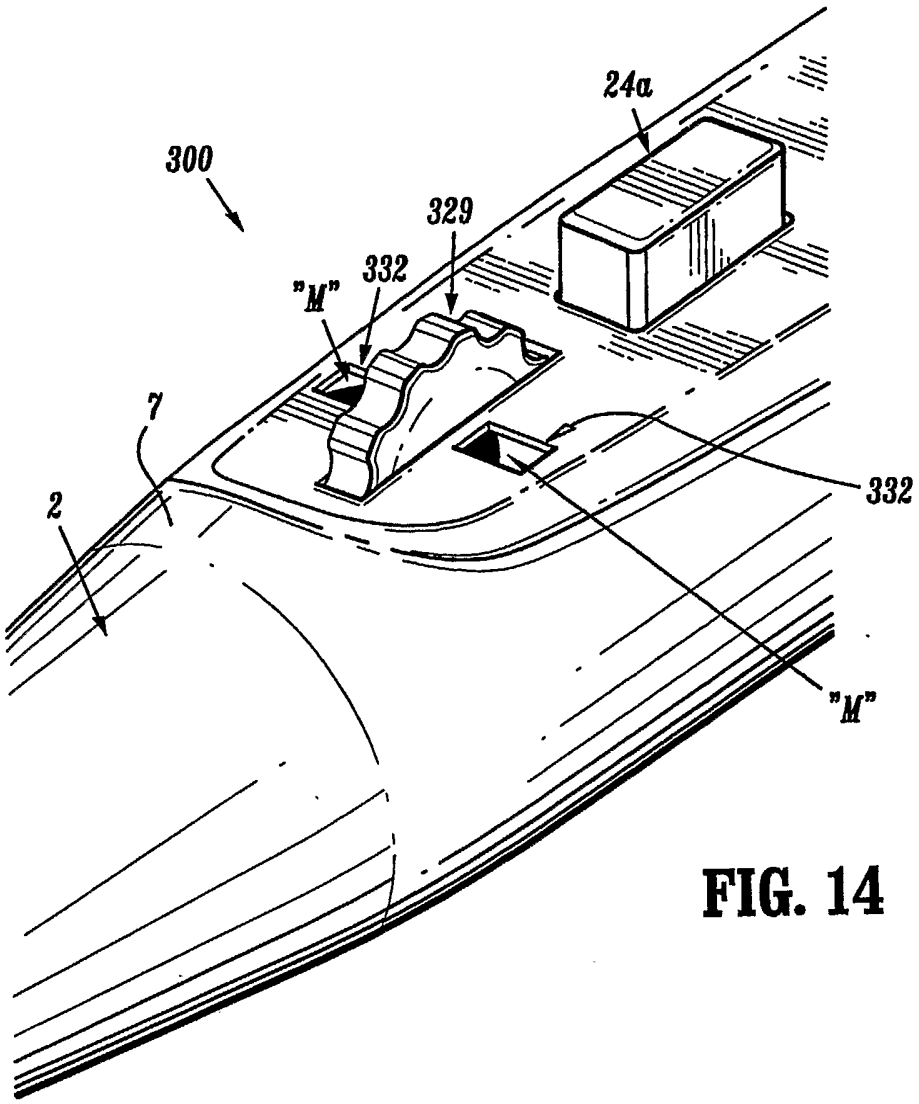

FIG. 14

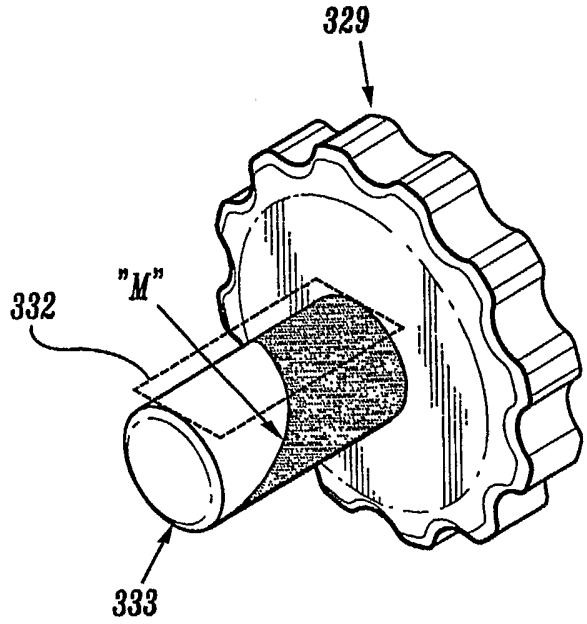

FIG. 15

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/37111

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B18/14

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 30 45 996 A (MEDIC ESCHMANN HANDELSGESELLSC) 8 July 1982 (1982-07-08)	1,3, 5-12,15, 18-21
Y		2,4,16, 17,22
A	page 11, paragraph 2 -page 12, paragraph 3 page 13, paragraph 2 -page 14, paragraph 2 page 15, paragraph 3 -page 17, paragraph 1; figures	13,14
Y	WO 01/64122 A (CONMED CORP) 7 September 2001 (2001-09-07) page 3, line 7-24	2,4,16, 17,22

-/--

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

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 July 2004	28/07/2004

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, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Küster, G

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/37111

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 2003/004508 A1 (SARAVIA HEBER ET AL) 2 January 2003 (2003-01-02) paragraphs '0057!-'0061!,'0070!,'0071!,'0126!,'0127!, '0132!,'0133!; figures 1,31,33	1,3, 6-12,15, 19-21
X	US 3 875 945 A (FRIEDMAN JOSHUA) 8 April 1975 (1975-04-08) column 2, line 22-54 column 2, line 67 -column 3, line 56 column 5, line 12 -column 6, line 22; figure 1	1-12, 15-22

INTERNATIONAL SEARCH REPORT

nformation on patent family members

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PCT/US 03/37111

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