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(54) Electrosurgical instrument including a sensor

(57) An electrosurgical system includes an electrosurgical generator, an electrosurgical instrument, an optical clarity sensor and a control component.
The electrosurgical generator generates electrosurgical energy for use during electrosurgery. The electrosurgical instrument is coupled to the electrosurgical generator and treats tissue. The optical clarity sensor is coupled to the electrosurgical generator and is adapted to measure tissue with at least two optical frequencies. The control component is operatively coupled to the optical clarity sensor and receives sensor data therefrom. The control component communicates control instructions to the electrosurgical generator to control the generation of the electrosurgical energy.

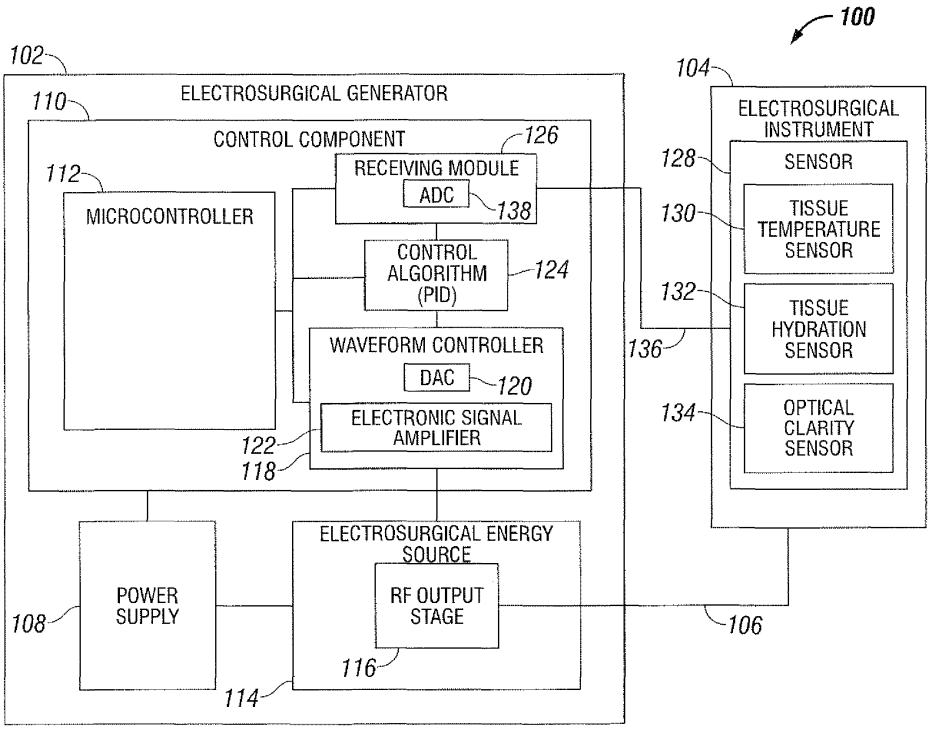

FIG. 1

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Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is related to U.S. application Ser. No. 10/427,832, filed on May 1, 2003 by Buysse et al., now U.S. Patent No. 7,137,980 entitled "Method and system for controlling output of RF medical generator", the entire contents thereof are hereby incorporated by reference in its entirety herein.

BACKGROUND

Technical Field

[0002] The present disclosure relates to an electrosurgical system and method and more particularly, the present disclosure relates to an electrosurgical system and method that includes an electrosurgical instrument with a sensor, such as a temperature sensor, a tissue hydration sensor, and an optical clarity sensor.

Description of Related Art

[0003] Electrosurgery is the application of electricity and/or electromagnetic energy to cut or modify biological tissue during a surgical procedure. Generally, electrosurgery utilizes an electrosurgical generator, a return electrode, and a source electrode. The electrosurgical generator produces an electromagnetic wave (referred to herein as "electrosurgery energy"), typically above 100 kilohertz, between the return and source electrodes when applied to tissue. The electromagnetic wave created therebetween dissipates energy as heat as it travels from one electrode to the other. Electromagnetic frequencies above 100 kilohertz are employed to avoid muscle and/or nerve simulation.

[0004] During electrosurgery, current generated by the electrosurgical generator is conducted through the patient's tissue disposed between the two electrodes. The current causes the tissue to heat up as the electromagnetic waves overcome the tissue impedance. Although many other variables affect the total heating of the tissue, usually more current density directly correlates to increased heating. Electrosurgical energy is typically used for cutting, dissecting, ablating, coagulating, and/or sealing tissue.

[0005] The two basic types of electrosurgery employed are monopolar and bipolar electrosurgery; however, both types use an "active" and a "return" electrode. In bipolar electrosurgery, the surgical instrument has an active electrode and a return electrode on the same instrument or in very close proximity, usually causing current to flow through a smaller amount of tissue. In monopolar electrosurgery, the return electrode is located elsewhere on the patient's body and is usually not part of the electrosurgical instrument itself. In monopolar electrosurgery, the return electrode is part of a device usually referred to as a return pad.

[0006] The effectiveness of the application of electrosurgical energy is affected by a variety of factors, including the patient's age, weight, the type of tissue being modified, and the desired tissue effect. Different voltages, currents, duty cycles and frequencies are used to cause a variety of tissue effects. For example, coagulation requires the application of different electrosurgical energy compared to cutting.

[0007] Many electrosurgical procedures require cutting or ligating blood vessels or vascular tissue. A surgeon can cauterize, coagulate, desiccate, and/or reduce bleeding by controlling the intensity, frequency and duration of the electrosurgical energy applied to the tissue between the electrodes of the electrosurgical instrument.

[0008] The process of coagulating vessels is different from electrosurgical vessel sealing. For the purposes herein, "coagulation" is defined as a process of desiccating tissue wherein the tissue cells are ruptured and dried. "Vessel sealing" or "tissue sealing" is defined as the process of liquefying the collagen in the tissue so that it reforms into a fused mass. Coagulation of small vessels is sufficient to permanently close them, while larger vessels need to be sealed to assure permanent closure.

[0009] A way to achieve effective operation of the electrosurgical instrument is to monitor the electrosurgical energy directly. Additionally or alternatively, the tissue being acted upon can be monitored. This monitoring can be used in a feedback loop of a control component that controls the generation of the electrosurgical energy.

SUMMARY

[0010] The present disclosure relates to an electrosurgical system and method and more particularly, the present disclosure relates to an electrosurgical system and method that includes an electrosurgical instrument with a sensor, such as a temperature sensor, a tissue hydration sensor, and an optical clarity sensor.

[0011] In one embodiment of the present disclosure, an electrosurgical system includes an electrosurgical generator, an electrosurgical instrument, an optical clarity sensor and a control component. The electrosurgical generator generates electrosurgical energy for use during electrosurgery. The electrosurgical instrument is coupled to the electrosurgical generator and treats tissue. The optical clarity sensor is coupled to the electrosurgical generator and is adapted to measure tissue with at least two optical frequencies. The control component is operatively coupled to the optical clarity sensor and receives sensor data therefrom. The control component communicates control instructions to the electrosurgical generator to control the generation of the electrosurgical energy.

[0012] In another embodiment of the present disclosure, the sensor data includes optical clarity measurements of tissue. The control component instructs the electrosurgical generator to generate the electrosurgical

energy corresponding to the optical clarity measurements which corresponds to tissue being less than about 60 degrees Celsius or less than about 100 degrees Celsius.

[0013] In another embodiment of the present disclosure, the control component instructs the electrosurgical generator to generate the electrosurgical energy corresponding to at least one optical clarity measurement being in a predetermined range and/or tissue hydration being within a predetermined range. Additionally or alternatively, the control component instructs the electrosurgical generator to generate the electrosurgical energy when the at least one optical clarity measurement falls within a predetermined range.

[0014] In another embodiment of the present disclosure, the electrosurgical instrument includes a shaft, a drive assembly, and a movable handle. The shaft has first and second jaw members at a distal end thereof. One or both of the jaw members include an electrode disposed thereon which applies the electrosurgical energy to tissue. One (or both) of the jaw members includes the optical clarity sensor disposed thereon. The drive assembly is operatively coupled to the shaft and moves one of the jaw members relative to the other from a first position to a second position. In the first position, the first jaw member is disposed in spaced relation relative to the second jaw member and in the second position, the first jaw member grasps tissue. The movable handle actuates the drive assembly.

[0015] In another embodiment of the present disclosure, the electrosurgical instrument includes first and second shafts having first and second jaw members, respectively. The second shaft is pivotally connected to the first shaft. One (or both) of the jaw members includes an electrode disposed thereon configured to apply the electrosurgical energy to tissue. One of the jaw members includes the optical clarity sensor disposed thereon.

[0016] In another embodiment of the present disclosure, one or more of the optical frequencies of the at least two optical frequencies is adapted to be a reference, is adapted to be substantially absorbed by water and/or is adapted such that water is substantially translucent to the optical frequency. The at least two optical frequencies may include first and second optical frequencies such that the first optical frequency is adapted to be substantially absorbed by water and the second optical frequency is adapted such that water is substantially translucent to the second optical frequency. The sensor data may include a first measurement of the first optical frequency and second measurement of the second optical frequency. The electrosurgical generator can compare the first measurement to the second measurement, e.g., such that at least one of tissue hydration, tissue temperature, optical clarity and tissue thickness is determined. The control component may generate an output signal dependent on transmittance at the first frequency as compared to transmittance at the second frequency. The first frequency may be more readily absorbed by water than the second frequency and the second frequency may be more readily absorbed by a particular protein found in the tissue than the first frequency.

[0017] In yet another embodiment of the present disclosure, an electrosurgical generator includes a control component. The control component includes a receiving module, a waveform controller and a control algorithm. The control component is at least partially implemented by an operative set of processor executable instructions configured for execution by at least one processor. The receiving module is operatively connected to a optical clarity sensor and receives sensor data therefrom. The optical clarity sensor is adapted to measure tissue with at least two optical frequencies and the sensor data includes a tissue temperature sensor measurement, a tissue hydration sensor measurement, and/or an optical clarity sensor measurement utilizing the at least two optical frequencies. The waveform controller communicates control instructions to the electrosurgical generator to control the generation of electrosurgical energy. The control algorithm is in operative communication with the receiving module and the waveform controller. The control algorithm processes the data to calculate the control instructions and communicates the control instructions to the waveform controller.

[0018] The control algorithm may be a proportional-integral-derivative control algorithm. The control module may include one or more microcontrollers to execute the operative set of processor executable instructions. The receiving module may include an analog to digital conversion circuit configured to convert the data from an analog signal to a digital signal and/or the waveform controller includes a digital-to-analog conversion circuit configured to convert the control instructions from a digital signal to an analog signal. The waveform controller may includes an electronic signal amplifier configured to amplify the analog signal of the control instructions such that the amplified analog signal instructs the electrosurgical generator.

[0019] In another embodiment of the present disclosure, a method for controlling generation of electrosurgical energy includes: providing an electrosurgical system; activating an optical clarity sensor of the electrosurgical system to communicate with the control component; and monitoring sensor data from the optical clarity sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] These and other advantages will become more apparent from the following detailed description of the various embodiments of the present disclosure with reference to the drawings wherein:

[0021] Fig. 1 is a schematic block diagram of an electrosurgical system that includes an electrosurgical instrument with a sensor according to the present disclosure;

[0022] Figs. 2A-2B are schematic block diagrams of an electrosurgical system according to the present dis-

closure; and

[0023] Fig. 3 is a flow chart diagram illustrating a method for using an electrosurgical system that includes an electrosurgical instrument with a sensor according to the present disclosure.

DETAILED DESCRIPTION

[0024] Referring to the drawings, Fig. 1 is a block diagram depicting an electrosurgical system 100. Electrosurgical system 100 includes electrosurgical generator 102 that generates electrosurgical energy. The electrosurgical energy is used to perform electrosurgery on a patient using electrosurgical instrument 104.

[0025] Electrosurgical generator 102 may have several user interface devices (e.g., touch screens, switches, dials, and the like) to assist a surgeon to achieve the desired results. The surgeon can use the user interface devices to input various data parameters into electrosurgical generator 102. However, not all factors can be known and/ or are readily known to the surgeon. For example, the specific physiology of patient P (e.g., age, weight, electrolyte density, PH, osmolarity, fluid volume and pressure, diseases and the like), temperature, humidity, and other factors that may influence electrosurgery, may not be readily know to the surgeon.

[0026] Thus, to better assist in ensuring an effective electrosurgical procedure, electrosurgical generator 102 may use several techniques to adjust the applied electrosurgical energy. Some such techniques include calculating or monitoring the tissue impedance, current, voltage, duty cycle, tissue resistance and the like. Electrosurgical generator 102 can use these calculated or monitored properties to make adjustments to the electrosurgical energy applied to tissue by electrosurgical instrument 104. Additionally or alternatively, as is discussed in more detail below, feedback data may be provided to electrosurgical generator 102 by electrosurgical instrument 104.

[0027] Electrosurgical instrument 104 can be a monopolar electrosurgical instrument or a bipolar electrosurgical instrument. For example, electrosurgical instrument 104 may be forceps, a vessel sealing electrosurgical instrument, a cutting electrosurgical instrument, or the like. The electrosurgical energy generated by electrosurgical generator 102 is transferred to electrosurgical instrument 104 via cable 106. Cable 106 includes an active path and a return path. The active and/or return paths may be made out of a sufficiently conductive material having an appropriate geometry. For example, cable 106 may be a coaxial cable having a geometry that mitigates attenuation losses within the frequency range of the electrosurgical energy.

[0028] Electrosurgical generator 102 may be powered by Alternating Current or Direct Current (referred to herein as "AC" and "DC", respectively); however, it is preferable that electrosurgical generator 102 is powered by a power source via a standardized receptacle outlet, e.g., a 110 volt outlet as typically found within the United States. Although electrosurgical generator 102 is connected to an external power source, power supply 108 conditions and converts the external power source (e.g., AC power from a outlet) to sufficiently power various parts of electrosurgical generator 102.

[0029] For example, consider that control component 110 includes microcontroller 112; microcontrollers typically need a DC power source, such as a 5-Volt DC power source. Thus, power supply 108 can also include circuitry to ensure that microcontroller 112 is sufficiently powered, e.g., circuitry that includes transformers, rectifiers, capacitors, voltage regulators, or the like. Additionally, power supply 104 supplies power to control component 110 and electrosurgical energy source 114.

[0030] Electrosurgical energy source 114 includes circuitry sufficient to translate instructions from waveform controller 118 from one form to another form more conducive for interpretation by RF output stage 116. RF output stage 116 includes circuitry to safely and efficiently transfer the electrosurgical energy to electrosurgical instrument 104. For example, RF output stage 116 may include an output transformer providing an isolated ground, an output amplifier, impedance matching circuitry to facilitate efficient power transfer, or the like, while electrosurgical energy source 114 may include a variable output power supply connection, voltage scaling circuitry, a buffer such as a voltage follower, or the like.

[0031] RF output stage 116 may be connected to cable 106 using an RF connector, such as an coaxial cable female connector, facilitating low attenuation injection of the electrosurgical energy into cable 106. Also, electrosurgical energy source 114 implements the instructions received from waveform controller 118 while ensuring that RF output stage 116 properly complies with the instructions. For example, waveform controller 118 may send multiple signals regarding the desired characteristics of the electrosurgical energy to be injected into cable 106, and electrosurgical energy source 114 translates those signals to ensure that RF output stage 116 complies with the instructions by comparing a voltage sense to an RF drive (not depicted in Fig. 1). Additionally or alternatively, electrosurgical energy source 114 may include safety and/or isolation circuitry.

[0032] Electrosurgical component 102 also incudes control component 110. Control component 110 may be implemented in hardware, software, firmware, or some combination thereof, and includes waveform controller 118, control algorithm 124, and receiving module 126. For example, control algorithm 124 may be implemented in software processed by microcontroller 112.

[0033] Waveform controller 118 instructs electrosurgical energy source 114 to maintain a particular amplitude, voltage, current, frequency, duty cycle, and/or other properties of the electrosurgical energy for application to tissue. Waveform controller 118 includes a digital to analog converter (referred to herein as a "DAC") 120 and electronic signal amplifier 122. Additionally or alternatively,

waveform controller 118 may include output relays, scaling relays, and/or an output waveform microcontroller (not depicted). Waveform controller 118 can also instruct the electrosurgical energy source 114 using an analog or a digital signal. For example, waveform controller 118 may have a digital waveform stored therein for converting the waveform to analog form via DAC 120. Electrosurgical signal amplifier 112 may amplify the analog waveform by a scalar value, e.g., 10, before sending the waveform to electrosurgical energy source 114.

[0034] However, control component 110 determines what properties the electrosurgical energy should have based upon sensor data, specifically, control component 110 can form a feed-back loop with sensor 128. Sensor 128 may include tissue temperature sensor 130, tissue hydration sensor 132, and/or optical clarity sensor 134. The sensor data is received by receiving module 126 via cable 136. The sensor data may be in analog or digital form. Additionally or alternatively, the sensor data may be converted from analog to digital form via analog to digital converter (referred to herein as "ADC") 138.

[0035] The sensor data is processed by control algorithm 124 to calculate the control instructions. The calculated control instructions are communicated to waveform controller 118. Control algorithm 124 may be a proportional-integral-derivative control algorithm and/or some other control algorithm to facilitate application of the electrosurgical energy to achieve the desired tissue effect.

[0036] Referring simultaneously to Figs. 1, 2A, and 2B, sensor 128 may be located on electrosurgical instrument 104 and is shown in two embodiments by Figs. 2A and 2B. Electrosurgical instrument 104 may include an active and/or a return electrode, and sensor 128 may be disposed on or near at least one of the electrodes, or otherwise positioned to take at least one tissue measurement of Patient P of Figs. 2A and 2B. Cable 106 may include an active path and a return path for apply electrosurgical energy to patient P while electrosurgical generator 102 receives sensor data through cable 136.

[0037] Referring to the drawings, Fig. 2A shows an open electrosurgical instrument 104 that includes shaft 202 with jaw member 204 on the end. Electrosurgical instrument 104 also includes shaft 206 with jaw member 208 on the end as well. Shaft 206 is attached to shaft 202 via pivot 210 making them pivotally connected. Pivot 210 may be formed from pins, bearings, axels, or the like to assist in the movement of jaws 204 and 208 relative to each other. Grips 212 and 214 move shafts 206 and 202, respectively, allowing a surgeon to grip and/or compress tissue of patient P between jaw members 204 and 208. For example, a surgeon may apply pressure to force grips 212 and 214 together when a vessel is positioned between jaw members 204 and 208, gripping the vessel. Electrosurgical energy may then be applied between jaw members 204 and 208 by electrodes, sealing the vessel. Sensor 128 may be used by electrosurgical generator 102 to assist in the vessel sealing (discussed in more detail below). Further details relating to open instrument vessel sealing are discussed in commonly-owned U.S. Application Ser. No. 10/962,116.

[0038] Referring now to Fig. 2B, another embodiment is shown of electrosurgical system 100 for use with an electrosurgical instrument 104'. Electrosurgical instrument 104' includes a shaft 216' that has a distal end that includes jaw members 218' and 220'. Within electrosurgical instrument 104', a drive assembly (not shown) actuates jaw members 219' and 220' so that initially they are spaced by a distance, and, when actuated, move relative to each other. Actuation assembly includes handle 220' that when "squeezed" causes jaw members 218' and 220' to move closer together pivotally, approximately pivoting along their attachment point to the distal end of shaft 216'. Trigger 226' causes the electrosurgical generator 102 to apply the electrosurgical energy. Jaw members 220' and 218' may each have an active and/or a return electrode. Sensor 128 may be disposed on or near one of the electrodes. Additionally or alternatively, sensor 128 can be positioned to take at least one measurement of tissue of patient P and send the measurement to electrosurgical generator via cable 138.

[0039] Referring again to Fig. 1, as mentioned previously, sensor 128 may include tissue temperature sensor 130, tissue hydration sensor 132, and optical clarity sensor 134, and can communicate data through cable 136 to electrosurgical generator 102; the data may include a tissue temperature measurement, a tissue hydration measurement, and an optical clarity measurement of tissue.

[0040] Tissue temperature sensor 130 can measure tissue temperature and communicate one or more tissue temperature measurements to electrosurgical generator 102. The biology of tissue is highly sensitive to temperature. For example, above 60 degrees Celsius, collagen protein denatures causing the tissue bond strength to be reduced. Above 100 degrees Celsius, the water within the cell vaporizes leading to cell destruction. Electrosurgical generator 102 can monitor the tissue temperature via temperature measurements received by receiving module 126 through cable 136, and adjust the electrosurgical energy based upon the received measurements to achieve a desired result, e.g., by keeping the tissue temperature measurements below a value, above a value, and/or within a predetermined range.

[0041] For example, for tissue cutting, it may be desirable to generate electrosurgical energy to ensure that the tissue is above about 100 degrees Celsius. In other applications, such as vessel sealing, it is more desirable to maintain a tissue temperature of less than about 60 degrees Celsius. Also, a predetermined range may be used to ensure that the temperature is high enough to cause tissue fusion but low enough to prevent loss of tissue strength. Programming of the tissue temperature desired (or range desired) may be preprogrammed within electrosurgical generator 102, or may manually be set by the operator.

[0042] Tissue temperature sensor 130 may include a contact or a noncontact temperature sensor. Tissue temperature sensor 130 also include a ratio or optical pyrometer, a thermal imager temperature sensor, fiber optic based temperature sensor, thermocouples, thermistors, resistance temperature detector ("RTD"), semiconductor, or the like to measure temperature. Note that cable 136 may include one or more conductive cable paths (i.e., wires) and/or may include a fiber optic cable path (also referred to herein as a "fiber optic cable"). Additionally or alternatively, sensor 128 may include additional components or circuitry to aide in the communication of measurements to electrosurgical generator 102. For example, electrosurgical generator 102 may provide power to circuitry within sensor 128 via cable 136 to enable the circuitry to communicate measurements to electrosurgical generator 102 using a pulsed width modulation based communication technique. Also, cable 106 may be bundled with cable 136 (not depicted).

[0043] Tissue hydration sensor 132 can communicate to electrosurgical generator 102 a tissue hydration measurement of some tissue of patient P (see Figs. 2A and 2B). For example, tissue hydration sensor 132 can approximate tissue hydration of the tissue between jaw members 204 and 208 of Fig. 2A, and/or between jaw members 218' and 220' of Fig. 2B. The measurement of the tissue hydration may be accomplished using an optical based sensor, electrical based sensor, or other sufficient tissue hydration sensor. As tissue is heated the water therein may evaporate slowly. The tissue hydration sensor 132 may measure this decreasing tissue hydration and communicate a series of tissue hydration measurements to receiving module 126 via cable 136. Control Algorithm 126 may instruct waveform controller 118 to continue to apply the electrosurgical energy until the tissue hydration sensor 132 falls within a predetermined threshold.

[0044] For example, during electrosurgery a surgeon may use surgical instrument 216 of Figs. 2A to clamp onto a vessel between jaw members 204 and 208. The surgeon may then activate the electrosurgical energy (e.g., by a foot pedal) to start the vessel sealing. The initial tissue hydration measurement of tissue hydration sensor 132 may be, for exemplary purposes only, about 60% water content, and control algorithm 124 may have a predetermined threshold of 30% water content. As the electrosurgical energy is applied, consecutive tissue hydration measurements measured by tissue hydration sensor 132 measures the reducing water content and instructs waveform controller 118 to continue to apply the electrosurgical energy until control algorithm 124 detects an approximate 30% water content tissue hydration measurement. When the 30% water content tissue hydration measurement is detected, control algorithm 124 may instruct waveform controller 118 to stop applying electrosurgical energy to electrosurgical instrument 104. An alarm and/or an indicator may indicate to the surgeon that the vessel is sealed.

[0045] Referring simultaneously to Figs. 1, 2A, and 2B, sensor 128 includes optical clarity sensor 134. Optical clarity sensor 134 may use optical frequencies which may be visible or outside of visual perception to make an optical clarity measurement.

[0046] Referring to Fig. 2A, an optical source may inject photons from jaw member 204 through tissue and to jaw member 208 where an absorption and/or transparency measurement can be made. Jaw member 204 may include an LED, a laser, a fiber optical coupling lens, or the like. Additionally or alternatively, cable 136 may include a fiber optic cable that carries light from electrosurgical generator 102 that is focused to travel from jaw member 204 thorough tissue and to jaw member 208. Jaw member 208 may include a fiber optic coupling lens to gather the photons and carry them back to electrosurgical generator 102 through a fiber optic cable located within cable 136.

[0047] For example, electrosurgical generator 102 may include a semiconductor based laser that injects photons into a fiber optic cable within cable 136. The photons travel down the core of the fiber optic cable to jaw member 204, where a lens injects the photons into tissue contained within jaw members 204 and 208. Jaw member 208, in this example, contains a lens that couples the photons back into a fiber optic cable that carries the photons to electrosurgical generator 102. Receiving module 126 may include photodetector that measures the amount of photons that are received, and converts received photons into an electronic signal. Referring to Fig. 2B, jaw members 218' and 220' may behave similarly to the jaw members 204 and 208 of Fig 2A, with regards to optical clarity sensor 134.

[0048] Optical clarity sensor 132 may utilize a broadband optical wavelength that has a relatively large bandwidth, e.g., a wavelength produced by a LED source. Additionally or alternatively, optical clarity sensor 134 may utilize several optical wavelengths to measure wavelength-dependant optical clarity of the tissue.

[0049] For example, optical clarity sensor 134 may use a first wavelength that is more readily absorbed by water than by other molecules found within the tissue, and a second wavelength that is more readily absorbed by a particular protein found throughout human tissue. When the electrosurgical energy is applied to the tissue, the absorption characteristics of the two wavelengths may be compared. If a surgeon is applying too much pressure to the tissue causing the tissue to be "squeezed out" of the jaw members, both wavelengths should have an increase in optical transmissibility because the tissue is "thinning" between the jaw members. However, if only the first wavelength (the one that is more readily absorbed by the water) has an increase of optical transmissibility while the second wavelength maintains its optical transmissibility measurement, the reasons for the changes to the optical transmissibility of the first wavelength is more likely to be due to the evaporation of water. Therefore, optical clarity sensor 132 may use multiple optical

wavelengths to communicate a optical clarity sensor measurement to electrosurgical generator 102 to measure wavelength-dependant optical clarity, e.g., by using wave division multiplexing.

[0050] Referring to the drawings, Fig. 3 is a flow chart diagram illustrating a method 300 for using an electrosurgical system that includes an electrosurgical instrument with a sensor. Method 300 starts at step 302 and includes providing an electrosurgical system 304. The electrosurgical system of step 302 may be electrosurgical system 100 as shown in Figs. 1, 2A, 2B, a monopolar electrosurgical system, or a bipolar electrosurgical system. The electrosurgical system of step 304 includes an optical clarity sensor and a control component. Method 300 further includes step 306 which is activating the optical clarity sensor of the electrosurgical system (of step 304) to communicate with a control component of the electrosurgical system (of step 304). The sensor of step 306 may be sensor 128 of Fig. 1 and includes optical clarity sensor 132. Also, the control component may be control component 110 of Fig. 1. Additionally, method 300 includes monitoring the sensor data 308. The sensor data of step 308 may be communicated via cable 136 to control component 124, that is received by receiving module 126 of Fig. 1.

[0051] 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 exemplifications of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

Claims

1. An electrosurgical system, comprising:

an electrosurgical generator configured to generate electrosurgical energy for use during electrosurgery;

an electrosurgical instrument operatively coupled to the electrosurgical generator and configured to treat tissue;

an optical clarity sensor operatively coupled to the electrosurgical generator, the optical clarity sensor adapted to measure tissue with at least two optical frequencies; and

a control component operatively coupled to the optical clarity sensor configured to receive sensor data therefrom, wherein the control component is configured to communicate control instructions to the electrosurgical generator to control the generation of the electrosurgical energy.

2. An electrosurgical system according to claim 1, wherein the sensor data includes at least one optical clarity measurement of tissue, wherein the control component instructs the electrosurgical generator to generate the electrosurgical energy corresponding to the at least one optical clarity measurement corresponding to tissue being less than about 60 degrees Celsius.

3. An electrosurgical system according to claim 1, wherein the sensor data includes at least one optical clarity measurement of tissue, wherein the control component instructs the electrosurgical generator to generate the electrosurgical energy corresponding to the at least one optical clarity measurement being less than about 100 degrees Celsius.

4. An electrosurgical system according to claim 1, wherein the sensor data includes at least one optical clarity measurement of tissue, wherein the control component instructs the electrosurgical generator to generate the electrosurgical energy corresponding to at least one optical clarity measurement being in a predetermined range.

5. An electrosurgical system according to claim 1, wherein the sensor data includes at least optical clarity measurement of tissue, wherein the control component instructs the electrosurgical generator to generate the electrosurgical energy when the at least one optical clarity measurement corresponds to tissue hydration being within a predetermined range.

6. An electrosurgical system according to claim 1, wherein the sensor data includes at least one optical clarity measurement of tissue, wherein the control component instructs the electrosurgical generator to generate the electrosurgical energy when the at least one optical clarity measurement falls within a predetermined range.

7. An electrosurgical system according to any one of the preceding claims, wherein the electrosurgical instrument includes:

a shaft having a first jaw member and a second jaw member at a distal end thereof, at least one of said jaw members including an electrode disposed thereon configured to apply the electrosurgical energy to tissue, at least one of the jaw members includes the optical clarity sensor disposed thereon;

a drive assembly operatively coupled to the shaft which is positionable to move at least one of the first jaw member relative to the second jaw member from a first position wherein the first jaw member is disposed in spaced relation relative to the second jaw member to a second position

wherein first jaw members grasp tissue; and
a movable handle which actuates the drive assembly.

8. An electrosurgical system according to any one of claims 1 to 6, wherein the electrosurgical instrument includes:

a first shaft having a first jaw member; and
a second shaft having a second jaw member, wherein the second shaft is pivotally connected to the first shaft, at least one of said jaw members includes an electrode disposed thereon configured to apply the electrosurgical energy to tissue, at least one of the jaw members includes the optical clarity sensor disposed thereon.

9. The electrosurgical system according to any one of the preceding claims, wherein an optical frequency of the at least two optical frequencies is adapted to be a reference.

10. The electrosurgical system according to any one of the preceding claims, wherein an optical frequency of the at least two optical frequencies is adapted to be substantially absorbed by water.

11. The electrosurgical system according to any one of claims 1 to 9, wherein an optical frequency of the at least two optical frequencies is adapted such that water is substantially translucent to the optical frequency.

12. The electrosurgical system according to any one of claims 1 to 9, wherein a first optical frequency of the at least two optical frequencies is adapted to be substantially absorbed by water and a second optical frequency of the at least two optical frequencies is adapted such that water is substantially translucent to the second optical frequency .

13. The electrosurgical system according to claim 12, wherein the sensor data includes a first measurement of the first optical frequency and a second measurement of the second optical frequency, wherein the electrosurgical generator compares the first measurement to the second measurement.

14. The electrosurgical system according to claim 12, wherein the sensor data includes a first measurement of the first optical frequency and a second measurement of the second optical frequency, wherein the electrosurgical generator compares the first measurement to the second measurement such that at least one of tissue hydration, tissue temperature, optical clarity and tissue thickness is determined.

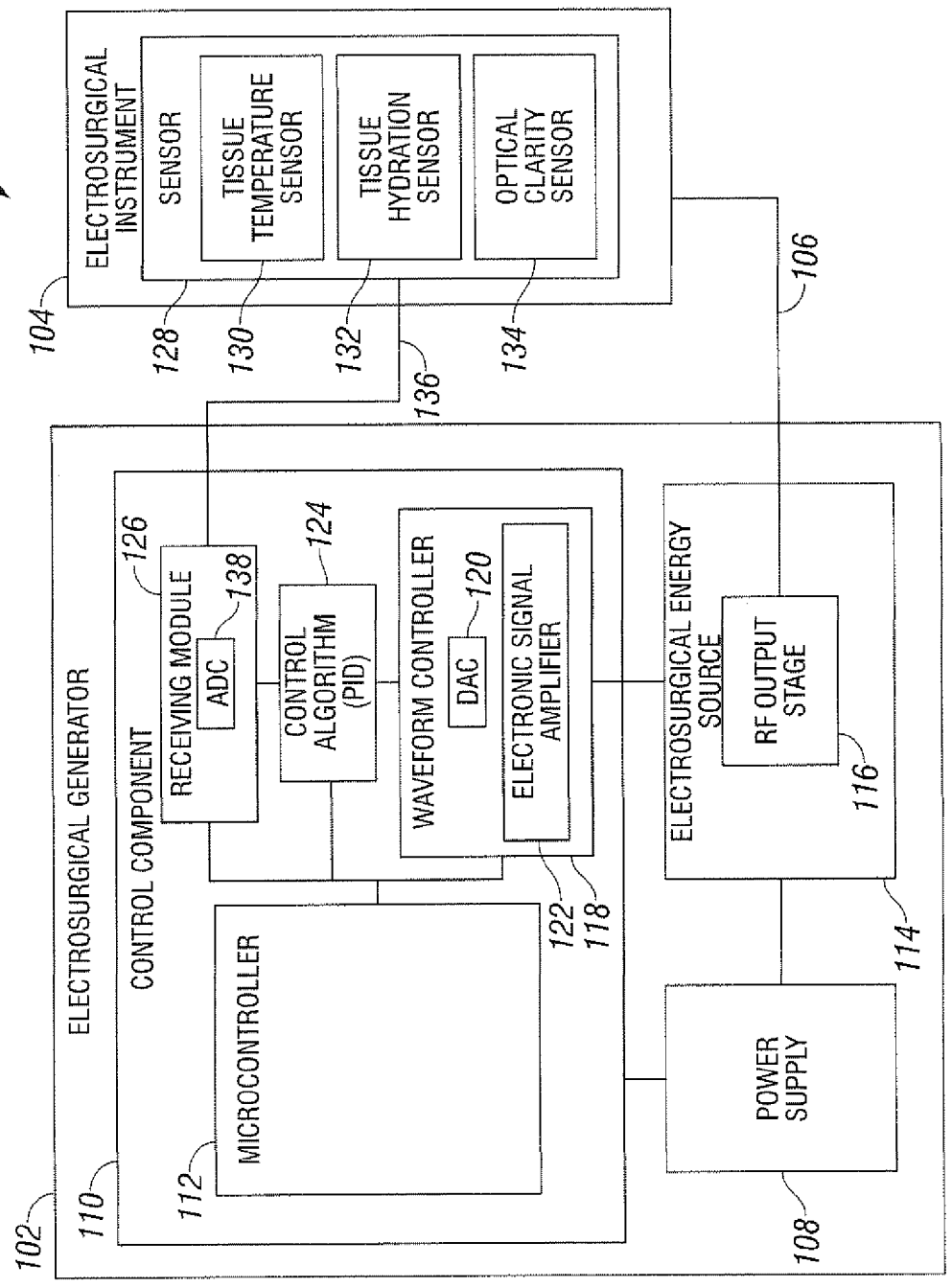
100
ELECTROSURGICAL INSTRUMENT
SENSOR
TISSUE TEMPERATURE SENSOR
TISSUE HYDRATION SENSOR
OPTICAL CLARITY SENSOR
104
128
130
132
134
136
106
ELECTROSURGICAL GENERATOR
CONTROL COMPONENT
RECEIVING MODULE
ADC
138
126
CONTROL ALGORITHM (PID)
124
WAVEFORM CONTROLLER
DAC
120
ELECTRONIC SIGNAL AMPLIFIER
122
118
MICROCONTROLLER
112
110
102
ELECTROSURGICAL ENERGY SOURCE
RF OUTPUT STAGE
116
114
POWER SUPPLY
108

FIG. 1

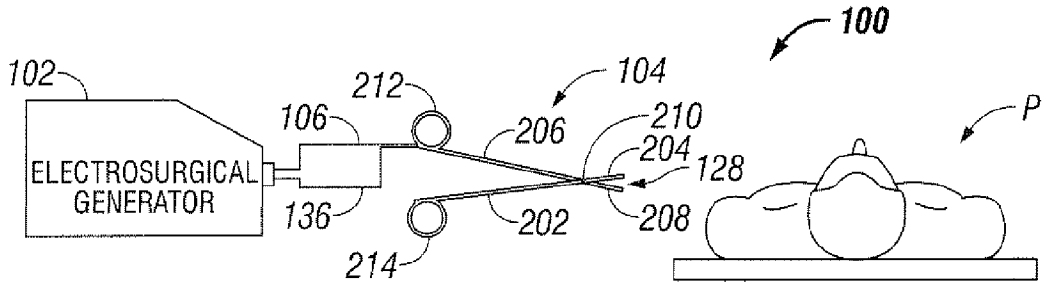

FIG. 2A

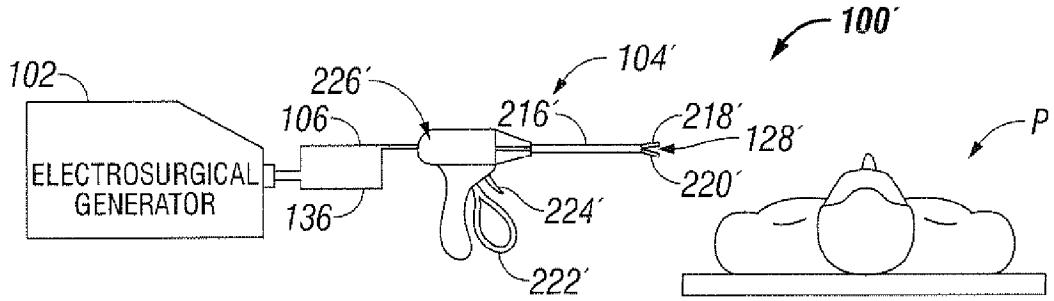

FIG. 2B

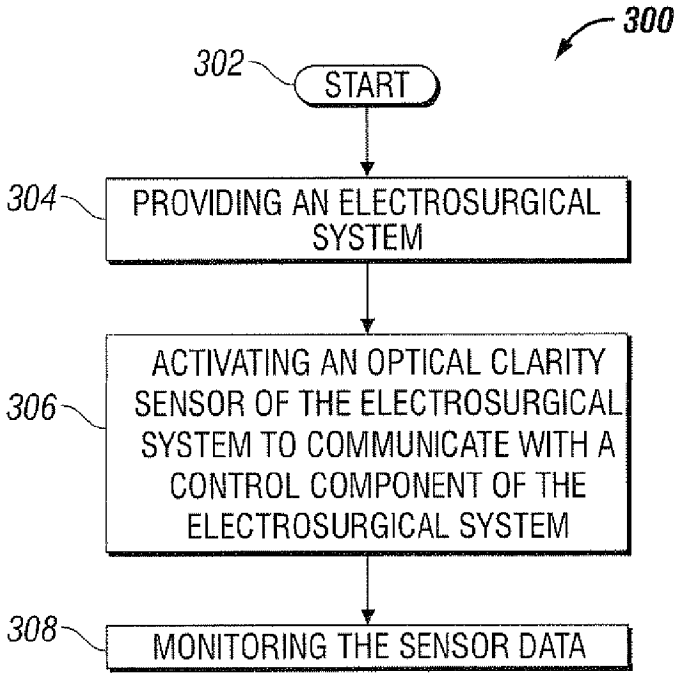

FIG. 3

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 09 16 8153

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* paragraph [0049] - paragraph [0057] *	8	
X	US 2008/009860 A1 (ODOM DARREN [US]) 10 January 2008 (2008-01-10) * paragraph [0045] - paragraph [0054] * * figures 1a,1b *	1-7, 10-12	
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X,P	WO 2008/112147 A1 (NELLCOR PURITAN BENNETT LLC [US]; HOARAU CARINE [US]) 18 September 2008 (2008-09-18) * paragraph [0011] - paragraph [0012] * * paragraph [0048] - paragraph [0050] * * claims 1-13 *	1-6, 12-14	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 December 2009	Cornelissen, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 09 16 8153

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TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 December 2009	Cornelissen, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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& : member of the same patent family, corresponding document

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专利名称(译)	电外科器械包括传感器		
公开(公告)号	EP2156800A1	公开(公告)日	2010-02-24
申请号	EP2009168153	申请日	2009-08-19
[标]申请(专利权)人(译)	柯惠有限合伙公司		
申请(专利权)人(译)	泰科医疗集团，LP		
当前申请(专利权)人(译)	COVIDIEN LP		
[标]发明人	CARLTON JOHN D ODOM DARREN		
发明人	CARLTON, JOHN D. ODOM, DARREN		
IPC分类号	A61B18/12 A61B18/14 A61B5/00 A61B17/00		
CPC分类号	A61B18/1206 A61B5/0008 A61B5/0059 A61B18/1442 A61B18/1445 A61B2017/00057 A61B2018/00702 A61B2018/00791		
优先权	12/195624 2008-08-21 US		
其他公开文献	EP2156800B1		
外部链接	Espacenet		

摘要(译)

电外科系统包括电外科发生器，电外科器械，光学清晰度传感器和控制部件。电外科发生器产生用于电外科手术期间的电外科能量。电外科仪器耦合到电外科发生器并处理组织。光学清晰度传感器耦合到电外科发生器并且适于以至少两个光频率测量组织。控制部件可操作地耦合到光学清晰度传感器并从其接收传感器数据。控制部件将控制指令传送到电外科发生器以控制电外科能量的产生。

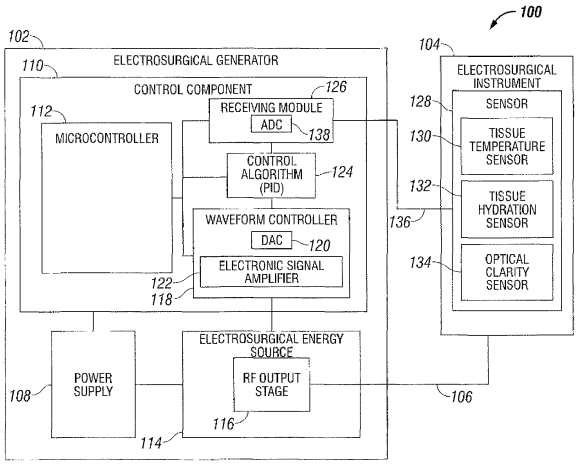

FIG. 1