(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 389 132 B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
11.06.2014 Bulletin 2014/24

(21) Application number: **10704236.8**

(22) Date of filing: **20.01.2010**

(51) Int Cl.:
A61B 18/18 *(2006.01)* ***A61B 5/06*** *(2006.01)*
G01K 11/00 *(2006.01)* ***A61B 5/00*** *(2006.01)*
A61B 17/00 *(2006.01)* ***A61B 18/14*** *(2006.01)*

(86) International application number:
PCT/US2010/000129

(87) International publication number:
WO 2010/085329 (29.07.2010 Gazette 2010/30)

(54) **APPARATUS FOR ALIGNING AN ABLATION CATHETER AND A TEMPERATURE PROBE FOR AN ABLATION PROCEDURE**

VORRICHTUNG ZUR AUSRICHTUNG EINES ABLATIONSKATHETERS UND TEMPERATURSENSORS FÜR EINEN ABLATIONSVORGANG

APPAREIL PERMETTANT D'ALIGNER UN CATHÉTER D'ABLATION ET UNE SONDE THERMIQUE POUR UNE PROCÉDURE D'ABLATION

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **20.01.2009 US 356205**

(43) Date of publication of application:
30.11.2011 Bulletin 2011/48

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EP 2 389 132 B1

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to the treatment of certain diseases by tissue ablation wherein electromagnetic energy from an antenna in an ablation catheter heats tissue sufficiently to cause necrosis and a separate temperature sensing antenna in a temperature probe placed in a body passage or cavity adjacent to the ablation site measures tissue temperature to enable the operating surgeon to avoid overheating tissue during the ablation procedure. It relates especially to apparatus enabling the surgeon to align the two antennas to optimize that temperature measurement.

[0002] In a typical cardiac ablation procedure, an antenna catheter is used to resistively heat heart tissue, usually at the left side of the heart, sufficiently to intentionally damage the target tissue in order to cure a potentially fatal heart arrhythmia. Typically, heating the tissue to a temperature in excess of 70°C for 30-60 seconds is sufficient to cause tissue necrosis. During treatment, electromagnetic energy, usually in the RF frequency range, is applied between the tip of the antenna catheter and a ground plate removably affixed to the patient's back, creating an electrical circuit. The point of highest resistance in this circuit, normally the interface between the catheter tip and the heart tissue, is the region which heats the most and thus may cause intentional, irreversible damage to the heart tissue to correct the arrhythmia.

[0003] Anatomically, the esophagus is very close to, and may even contact, part of the left atrium. Indeed, the average distance between the endocardial surface of the left atrium and the anterior surface of the esophagus is only in the order of 4.4 +/- 1.2 mm. Thus, ablating certain regions of the left atrium to treat various arrhythmias in the heart can unintentionally cause thermal damage to the esophagus, often with severe consequences.

[0004] In order to prevent such overheating, a temperature probe may be positioned in the patient's esophagus adjacent to the ablation site in the heart. One conventional temperature probe carries conventional point source temperature sensors such as thermocouples, thermistors or the like to monitor, and ultimately prevent the overheating of, the esophagus wall by cutting off or reducing the power delivered to the ablation catheter; see, e.g., US2007/0066968.

[0005] Another type of temperature probe developed only recently has been disclosed in US2012/035603. That probe incorporates a microwave antenna which is connected to an external receiver in the form of a radiometer. The radiometer detects the thermal emissions picked up by the antenna in the probe which reflect the temperature of the tissue being examined and produces corresponding temperature signals to control a display which displays that temperature. During ablation, that apparatus can measure the temperature at depth in the esophageal tissue which is in close proximity to the ablation site in the patient's heart. That measurement can then be used to prevent unintentional thermal damage to the esophagus or other body passage.

[0006] As described in the above provisional application, a temperature probe using microwave radiometry provides definite advantages in that it can measure temperature at depth in the passage wall to avoid thermal damage thereto enabling the operating surgeon to adjust the power to the ablation catheter as needed to provide sufficient heating of the heart tissue to cause necrosis, but not enough to result in surface charring of that tissue that could cause a stroke and/or the formation of microbubbles (popping) that could rupture the heart vessel wall. Also, such radiometric sensing allows accurate measurement of tissue temperature even when cooling is being provided.

[0007] However, in order to optimize the accuracy of the temperature measurement provided by the temperature probe, it is desirable that the antenna therein be aligned properly with the antenna in the ablation catheter. Until now, there has been no means in the prior apparatus of this type to enable the operating surgeon to verify that the two antennas are indeed in alignment. Resultantly, in some instances, the temperature measurements may not be accurate enough to avoid thermal damage to tissue and in others, the ablation procedure may take too long because of tissue underheating.

[0008] EP 0 485 323 A1 discloses a hyperthermia apparatus for heating predetermined tissue in the body of a subject and which includes a probe device and a heat applicator each positionable in proximity to the tissue to be heated.

[0009] US 2007/0299488 A1 discloses an integrated heating/sensing catheter apparatus for minimally invasive applications, which includes a probe for radiating electromagnetic waves of a first frequency capable of heating tissue and detecting thermal emissions from that tissue of a second frequency indicative of tissue temperature.

[0010] US 2006/0106375 A1 refers to an ablation system with a feedback including an ablation catheter that has an array of ablation elements and a location element, an esophageal probe also including a location element, and an interface unit that provides energy to the ablation catheter.

[0011] US 4,346,716 relates to a microwave detection system for the detection of cancerous tumors and is particularly effective in the early detection of such tumors. The microwave system has a single unit wherein a passive radiometer with an active microwave transmitter is combined.

SUMMARY OF THE INVENTION

[0012] Accordingly, an object of the present invention is to provide an apparatus for implementing a method for properly aligning the antenna in an ablation catheter positioned at an ablation site in a human or animal body and the antenna in a temperature probe located in a body passage adjacent to the ablation site.

[0013] Another object is to provide such an apparatus for implementing a method which can be employed even when the ablation site and/or passage are/is being cooled.

[0014] Still another object is to provide such apparatus wherein the antenna in the temperature probe may be either directional or omni-directional.

[0015] Other objects will, in part, be obvious and will, in part, appear hereinafter.

[0016] The above objects are solved according to the invention by the subject-matter of claim 1. Preferred embodiments of the present invention are subject-matter of the dependent claims.

SUMMARY OF THE INVENTION

[0017] The present disclosure accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying the features of construction, combination of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed description, and the scope of the invention will be indicated in the claims.

[0018] In apparatus of the type with which this invention is concerned, an ablation catheter containing a first antenna is positioned at an ablation site in a patient's body and a temperature probe containing a second antenna is placed in a body passage having a wall portion adjacent to the ablation site so that the probe is more or less opposite the ablation site. An electromagnetic signal of a first frequency may be delivered by an external generator to the first antenna to ablate tissue at the ablation site, while the second antenna picks up thermal emissions from said wall portion and provides a signal which may be detected and used to control a display so that the display indicates the temperature of that wall portion. By viewing the display, an operating surgeon can appropriately control the generator to avoid overheating the wall tissue.

[0019] In accordance with this invention, an antenna alignment circuit is connected between the two antennas. The alignment circuit includes a microwave source which transmits from one antenna to the other a modulated microwave signal of a second frequency different from the first frequency. That microwave signal is picked up by the other, receiving, antenna connected to a radiometer. The radiometer detects the microwave signal and produces an alignment signal whose strength is indicative of the degree of alignment of the first and second antennas. That is, the alignment signal is strongest when the two antennas are directly opposite one another. The alignment signal may be used to control a display enabling an operating surgeon to see exactly when the alignment signal strength is at a maximum signifying that the two antennas are in optimum alignment.

[0020] As we shall see, the microwave communication between the two antennas can be implemented in either direction to properly position the two antennas relatively both axially and in azimuth. The invention thus allows optimal delivery of ablation power to the antenna in the ablation catheter while preventing unwanted surface charring of the tissue being ablated and thermal damage to the passage wall adjacent to the ablation site. It will also allow the ablation procedure to be carried out in a minimum length of time.

[0021] Using this method, by observing the alignment display, a surgeon may determine in real time the relative position of an ablation catheter and a temperature probe and adjust one or the other to obtain the strongest alignment signal before the ablation procedure has commenced. Then, during the actual ablation when the RF energy from the ablation catheter starts to heat beyond the tissue intended to be heated and/or inadvertently starts to heat the wall of the adjacent body passage, e.g. the esophagus, there will be a noticeable temperature rise signaled by the temperature probe so that the apparatus' temperature display will provide the surgeon with a clear, early warning of potential tissue damage.

[0022] While we will describe the invention in a cardiac ablation context, the same antenna alignment technique may be used in connection with other procedures wherein tissue ablation is performed adjacent to a natural passage in the body, such as the treatment of benign prosthetic hyperplasia (BPH) wherein an ablation catheter is positioned in the patient's urethra and a temperature probe is located in the rectal cavity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] For a fuller understanding of the nature and objects of the invention, reference should be made to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of a patient's head and torso showing an ablation catheter in the left atrium of the heart and a temperature probe situated in the esophagus adjacent to the catheter;

FIG. 2 is a block diagram of apparatus for aligning an ablation catheter and a temperature probe according to this invention;

FIGS. 3A to 3C are diagrammatic views showing different versions of the coupler portion of the FIG. 2 apparatus, and

FIG. 4 is a diagram similar to FIG. 2 of a second embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Refer first to FIG. 1 of the drawings which shows the head and torso of a patient having a heart H with a left ventricle H_V and a left atrium H_A. As is usually the case, the left atrium of the heart is very close to the anterior wall of the patient's esophagus E. During a conventional cardiac ablation procedure, an ablation catheter 10 is threaded into the left atrium H_A via left ventricle H_V so that the working end 10a of the catheter contacts the posterior wall of the left atrium as shown in FIG. 1.

[0025] In order to prevent overheating of the esophagus E during such an ablation procedure, a temperature probe 12 may be inserted into the patient's nasal passage N and threaded down into the esophagus E via the patient's pharynx P until the probe is positioned directly opposite the catheter end 10a at the ablation site as shown in FIG. 1. As the heart tissue is being ablated by catheter 10, the temperature probe 12 picks up thermal emissions from the esophageal wall E_W and corresponding temperature signals are produced which may be used to prevent overheating of the esophagus.

[0026] Referring to FIG. 2, catheter 10 includes an ablation antenna 14 which receives an RF signal from an RF generator 16. Preferably, antenna 14 is of the type disclosed in US2007/0299488 and it is matched to a selected first frequency, e.g. 550 KHz. However, instead of receiving this signal from the generator directly, the antenna receives it by way of a microwave coupler 18 which is part of an alignment circuit to be described in detail shortly.

[0027] The temperature probe 12 contains an antenna 22 for picking up thermal emissions from the wall portion Ew. Preferably, the antenna is of the type described in US2007/0219548. Antenna 22 is connected to the input of a radiometer 24 which detects the signal from antenna 22 and produces a corresponding temperature signal. Preferably, the radiometer operates at a center frequency corresponding to said second frequency, i.e. 4.0 GHz, so that the apparatus can detect thermal emissions from relatively deep regions of the esophageal wall E_W.

[0028] The temperature signal from the radiometer is routed to a controller 26 which produces a corresponding control signal for controlling a display 28 which can display the temperature of the tissue being examined by the probe 12. Preferably the display indicates esophageal tissue temperature as a function of time so that the surgeon can see that temperature in real time. Of course, the display 28 may also display other parameters relating to proper operation of the apparatus.

[0029] The controller 26 may receive instructions via the control buttons 32a of an operator-controlled input keyboard 32.

[0030] The temperature signal from controller 26 may also be coupled to a control input terminal 16a of the generator 16 to control the power being delivered to the ablation catheter 10 and the apparatus may include means for cooling the tissue at the ablation site and/or the esophagus.

[0031] Still referring to FIG. 2, the alignment circuit mentioned above is provided in order to assure that the antenna 22 in probe 12 is aligned with the antenna 14 in catheter 10 when the ablation procedure is carried out to allow optimal delivery of ablation power to the antenna 14 with minimal likelihood of unwanted thermal damage to the heart and/or to the esophageal wall E_W during the ablation procedure.

[0032] The alignment circuit comprises, in addition to the coupler 18, a microwave source 36 controlled by a clock signal from radiometer 24 so that the radiometer and source 36 operate in synchronism. The source 36 provides a signal of a second frequency different from the first, e.g. 4.0 GHz, which is pulse modulated. This microwave signal from source 36 is coupled to, and transmitted by, antenna 14, picked up by antenna 22 and detected by radiometer 24. Modulation of the transmitted waveform allows detection by the radiometer 24 of very low levels of microwave signal in the presence of high levels of interfering noise. Thus, the AM pulse modulated microwave signal from antenna 14 can easily be recognized and detected by the sensitive radiometer 24 and the strength of this signal is directly related to the degree of alignment of the two antennas. In response to the detected signal, the radiometer delivers an alignment signal via controller 26 to display 28 which thereupon provides an indication of that signal strength as a function of time.

[0033] Preferably, the two antennas 14 and 22 are aligned prior to the actual ablation procedure. For this, the controller 26 may be instructed via terminal 32 or a hand control (not shown) on catheter 10 to apply a control signal C to the control terminal 16a of generator 16 that turns off or reduces the RF power output from the generator for a selected time or until the operator determines from the display 28 that the antennas are aligned following which the signal C from the controller may cause the generator to operate at full power sufficient to ablate tissue. That same control signal C is applied to a control terminal 36c of source 36 to deactivate that source so that the generator and source are active alternatively.

[0034] The antenna 22 in temperature probe 12 may be omni-directional, but is more preferably a directional antenna of the type described in the above US2007/0299488. Such a directional antenna provides a better temperature measurement resolution in the direction of the catheter 10. That is, with a directional antenna, the tissue at wall portion E_W represents a more significant portion of the antenna pattern of antenna 12, which will significantly improve the temperature measurement resolution.

[0035] The microwave coupler 18 in the FIG. 2 apparatus may have different forms. Preferably, it is located near the proximal end of catheter 10 and near the generator 16. The coupler is basically a diplexer or T/R switch which couples the microwave signal from source 36 to antenna 14. A capacitive coupling method is preferred, with a directional capacitive coupling approach being the optimum. This approach directs the microwave energy from source 36 toward the antenna 14 and away from the RF generator 16. The modulated microwave signal propagates out to the tip of antenna 14 where it radiates into the heart tissue.

[0036] In the coupler 18 depicted in FIG. 3A, the signal from microwave source 36 is capacitively coupled at 42 to the line from RF generator 16 to antenna 14 with an upstream filter 44 being provided which passes the RF signal but isolates generator 16 from the microwave signal.

[0037] In FIG. 3B, the coupler 18 comprises a diplexer in the form of a transmission line 46 connected between generator 16 and antenna 14, with a branch 46a receiving the output signal from source 36 by way of a DC blocking capacitor 48.

[0038] In FIG. 3C, the coupler 18 comprises a conventional ferrite circulator 52 connected between generator 16 and antenna 14 and designed to operate at said second selected frequency, i.e, 4.0 GHz. The circulator center conductor provides a conductive path that connects the RF generator 16 to antenna 14. The signal from microwave source 36 is applied to the circulator by way of a DC blocking capacitor 54.

[0039] In use, the temperature probe 12 is normally inserted through the nose and down into the esophagus. With the apparatus operating in an alignment mode, the probe antenna 22 is aligned with antenna 14 in the ablation catheter 10 by varying its position in the esophagus to maximize the received alignment signal strength as indicated by display 28. Rotating the probe 12 and its antenna 22 steers the antenna pattern in an azimuth direction while insertion and retraction of the probe shifts the antenna pattern in an axial direction. The probe 12 is optimally positioned for detection of dangerous ablation temperatures when the two antennas 14 and 22 are in closest proximity as indicated by display 28 displaying a maximum received signal strength.

[0040] Following alignment, the apparatus may be switched to its ablation mode with generator 16 delivering sufficient power to antenna 14 to ablate tissue. Thus, alignment of the two antennas is usually, but not necessarily, carried out during an alignment phase prior to the actual ablation procedure while generator 16 is delivering zero or sublethal power to antenna 14.

[0041] In the FIG. 2 embodiment of the invention, the catheter antenna 14 transmits a signal to probe antenna 22 to effect antenna alignment. However, the opposite may be the case as shown in FIG. 4. In the FIG. 4 apparatus, the catheter 10 is preferably of the type described in the above US2007/0299488 having a radiometer incorporated right in the catheter 10 along with the antenna 14, albeit the radiometer could just as well be outside the catheter as shown in phantom at R in FIG. 4. In either event, antenna 14 receives an RF signal from a generator 16 to ablate tissue as before. Here, the primary function of the radiometer in catheter 10 (or radiometer R) is to monitor the ablation temperature in the heart atrium H_A. For this, the radiometer detects thermal emissions picked up by antenna 14 and produces a signal which is fed to a radiometer controller 64 that controls a display 66. As in the FIG. 2 apparatus, instructions to controller 64 may be input via a keyboard (not shown).

[0042] The FIG. 4 apparatus also includes a temperature probe 12 containing an antenna 22 similar to the one in FIG. 2. A T/R switch 68 or equivalent connects antenna 22 either to a microwave source 72 similar to source 36 or to a radiometer 74 whose output controls a display 76 which may be combined with display 66.

[0043] A clock signal from the radiometer is applied by way of controller 64 to the microwave source 72 so that radiometer in catheter 10 (or radiometer R) and source 72 operate in synchronism.

[0044] Like the FIG. 2 apparatus, the FIG. 4 instrument may be operated in an alignment mode prior to the ablation procedure. For this, controller 64 may be instructed to output a control signal C to generator 16 which turns off the generator and to switch 68 which connects microwave source 72 to the antenna 22 in probe 12, while isolating the radiometer 74. Antenna 22 will thereupon transmit a pulse modulated microwave signal to the antenna 14 which is detected by the radiometer in ablation catheter 10 (or radiometer R). That radiometer will then deliver an alignment signal to controller 64. The controller controls display 66 so that the latter displays an amplitude modulated signal whose strength is indicative of the degree of alignment of the two antennas 14 and 22.

[0045] After the alignment step whose duration may be input by the operator, timed by controller 64 or based on a selected parameter, e.g. a selected maximum alignment signal strength, the controller may activate RF generator 16 and switch switch 68 so that the antenna 22 in probe 12 is disconnected from source 72 and coupled to radiometer 74. That radiometer may thereupon provide a temperature signal to display 76 so that the temperature of the esophagus wall portion E_W can be seen by the operating surgeon in real time. The surgeon may then control generator 16 as needed to avoid overheating the esophagus.

[0046] As noted above, the present apparatus is applicable not only to align the ablation and temperature sensing antennas during a cardiac ablation procedure, it can be used whenever two antennas have to be aligned on opposite sides of any body passage wall. In all cases, the apparatus, which utilizes an AM pulse modulated microwave signal with synchronous detection allows optimal alignment of the two antennas because it provides high sensitivity and very good noise immunity under normal operating room conditions.

[0047] It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in carrying out the above apparatus and in the constructions set forth without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

[0048] It is also to be understood that the following claims are intended to cover all the generic and specific features of the invention described herein.

Claims

1. Apparatus for aligning an ablation catheter and a temperature probe relatively for an ablation procedure, said apparatus comprising
an ablation catheter (10) for ablating tissue at an ablation site (H_A) in a patient's body, said catheter including a first antenna (14);
a generator (16) for delivering power to the first antenna (14) to heat the tissue;
a temperature probe (12) containing a second antenna (22) and for placement in a body passage (E) having a wall portion (E_W) adjacent to the ablation site so that said second antenna (22) is positioned opposite the first antenna (14);
a microwave source (36, 72) configured to provide a pulse modulated microwave signal to one of said first (14) and second (22) antennas, said signal being picked up by the other of the first and second antennas;
a radiometer (24, R) having an input in circuit with the other of the first (14) and second (22) antennas and an output, and
a synchronizing device (clock in 24, 64) in circuit with said source (36, 72) and said radiometer (24, R) enabling the radiometer to synchronously detect said microwave signal so that the radiometer output can provide an alignment signal whose strength reflects the degree of alignment of the first and second antennas,
characterized in that
a control device (26, 64) is included which is configured to control the operations of the generator (16) and microwave source (36, 72) in a mutually exclusive fashion so that when the microwave source is operative, said radiometer (24, R) output provides said alignment signal and when the generator (16) is operative to ablate tissue, the radiometer (24, R) output provides a temperature signal indicating the temperature of tissue.

2. The apparatus defined in claim 1 wherein
said one antenna is the first antenna (14);
a microwave coupler (18) is in circuit between said microwave source (36) and said first antenna (14), and
the synchronizing device is configured to deliver clock pulses from the radiometer (24) to the microwave source (36) to synchronize their operations.

3. The apparatus defined in claim 2 wherein the coupler (18) comprises a directional capacitive coupling device (42) and a filter (44) in circuit between the coupling device and the generator (16).

4. The apparatus defined in claim 2 wherein the coupler (18) comprises a diplexer (41, 48).

5. The apparatus defined in claim 2 wherein the coupler (18) comprises a ferrite circulator (52).

6. The apparatus defined in claim 5 wherein the coupler (18) further includes a lossy transmission line connected between the circulator (52) and the generator (16) and a capacitor (54) connected between the circulator and an output of the microwave source (36).

7. The apparatus defined in claim 1 and further including a display device (28, 76) connected to the radiometer (24, R) output.

8. The apparatus defined in claim 1 wherein
said one antenna is the second antenna (22);
the microwave source (72) provides the microwave signal to the second antenna (22), and
the radiometer (R) input is in circuit with the first antenna (14).

9. The apparatus defined in claim 8 wherein the radiometer (R) is located in the ablation catheter.

10. The apparatus defined in claim 8 and further including a second radiometer (74) having an input and an output;
a switching device (68) connected between the second antenna (22) and the input of the second radiometer (74), said microwave signal being applied to the second antenna by way of said switching device,
said control device (64) being configured to control the operations of the generator (16) and the switching device (68) so that when the generator (16) is not operative, the switching device (68) connects the microwave source (72) to the second antenna (22) and when the generator is operative, the switching device (18) connects the second antenna to the input of the second radiometer (74).

11. The apparatus defined in claim 10 and further including a display device (66) responsive to the signal at the output of said radiometer (R) so that the display device (66) displays the strength of the alignment signal.

12. The apparatus defined in claim 11 and further including a second display device (76) responsive to the signal at the output of the second radiometer (74) so that the second display device displays the temperature of said wall portion (E_W).

Patentansprüche

1. Vorrichtung zur relativen Ausrichtung eines Ablationskatheters und eines Temperaturfühlers für einen Ablationsvorgang, wobei die Vorrichtung aufweist:

einen Ablationskatheter (10) zum Abtragen von Gewebe an einem Ablationsort (HA) im Körper eines Patienten, wobei der Katheter eine erste Antenne (14) umfasst;
einen Generator (16) zur Lieferung von Energie für die erste Antenne (14) zum Erwärmen des Gewebes;
einen Temperaturfühler (12), der eine zweite Antenne (22) enthält, und zur Unterbringung in einem Körperkanal (E) mit einem Wandabschnitt (E_W), der an den Ablationsort angrenzt, so dass die zweite Antenne (22) gegenüber der ersten Antenne (14) positioniert ist;
eine Mikrowellenquelle (36, 72), die gestaltet ist, um ein impulsmoduliertes Mikrowellensignal an eine der ersten (14) und zweiten (22) Antennen abzugeben, wobei das Signal durch die andere der ersten und zweiten Antennen aufgefangen wird;
einen Strahlungsmesser (24, R) mit einem Eingang, angeschlossen mit der anderen der ersten (14) und zweiten (22) Antennen sowie einem Ausgang,
und
ein Synchronisierungsgerät (Uhr in 24, 64) mit der Quelle (36, 72) und dem Strahlungsmesser (24, R) angeschlossen, die es dem Strahlungsmesser ermöglicht, das Mikrowellensignal synchron zu detektieren, so dass der Ausgang des Strahlungsmessers ein Ausrichtungssignal bereitstellen kann,
dessen Stärke den Ausrichtungsgrad der ersten und zweiten Antennen widerspiegelt,
dadurch gekennzeichnet, dass
ein Steuergerät (26, 64) einbezogen wird, das gestaltet ist, um die Arbeitsabläufe von Generator (16) und Mikrowellenquelle (36, 72) in einer gegenseitig ausschließenden Art und Weise zu steuern, so dass der Ausgang des Strahlungsmessers (24, R) das Ausrichtungssignal liefert, wenn die Mikrowellenquelle wirksam ist, und der Ausgang des Strahlungsmessers (24, R) ein die Gewebetemperatur anzeigendes Temperatursignal liefert, wenn der Generator (16) wirksam ist, um Gewebe abzutragen.

2. Vorrichtung nach Anspruch 1, bei der
die eine Antenne die erste Antenne (14) ist;
ein Mikrowellenkoppler (18) zwischen der Mikrowellenquelle (36) und der ersten Antenne (14) angeschlossen ist, und
das Synchronisierungsgerät zur Lieferung von Taktimpulsen von dem Strahlungsmesser (24) an die Mikrowellenquelle (36) gestaltet ist, um ihre Arbeitsabläufe zeitlich aufeinander abzustimmen.

3. Vorrichtung nach Anspruch 2, bei der der Koppler (18) eine kapazitive Richtungskopplungsvorrichtung (42) und einen Filter (44) zwischen der Kopplungsvorrichtung und dem Generator (16) angeschlossen aufweist.

4. Vorrichtung nach Anspruch 2, bei der der Koppler (18) eine Frequenzweiche (41, 48) aufweist.

5. Vorrichtung nach Anspruch 2, bei der der Koppler (18) einen Ferritzirkulator (52) aufweist.

6. Vorrichtung nach Anspruch 5, bei der der Koppler (18) des Weiteren eine zwischen dem Zirkulator (52) und dem Generator (16) angeschlossene, verlustbehaftete Übertragungsleitung und einen zwischen dem Zirkulator und einem Ausgang der Mikrowellenquelle (36) verbundenen Kondensator (54) umfasst.

7. Vorrichtung nach Anspruch 1 und des Weiteren umfassend eine Anzeigevorrichtung (28, 76), die mit dem Ausgang des Strahlungsmessers (24, R) verbunden ist.

8. Vorrichtung nach Anspruch 1, bei der
die eine Antenne die zweite Antenne (22) ist;
die Mikrowellenquelle (72) das Mikrowellensignal an die zweite Antenne (22) liefert, und
der Eingang des Strahlungsmessers (R) mit der ersten Antenne (14) angeschlossen ist.

9. Vorrichtung nach Anspruch 8, bei der der Strahlungsmesser (R) sich in dem Ablationskatheter befindet.

10. Vorrichtung nach Anspruch 8 und ferner umfassend einen zweiten Strahlungsmesser (74) mit einem Eingang und einem Ausgang; ein Schaltelement (68), das zwischen der zweiten Antenne (22) und dem Eingang des zweiten Strahlungsmessers (74) verbunden ist, wobei das Mikrowellensignal an die zweite Antenne durch das Schaltelement angelegt wird, das Steuergerät (64) so gestaltet ist, um die Arbeitsabläufe des Generators (16) und des Schaltelements (68) zu steuern, so dass das Schaltelement (68) die Mikrowellenquelle (72) mit der zweiten Antenne (22) verbindet, wenn der Generator (16) nicht betriebsfähig ist, und das Schaltelement (18) die zweite Antenne mit dem Eingang des zweiten Strahlungsmessers (74) verbindet, wenn der Generator betriebsfähig ist.

11. Vorrichtung nach Anspruch 10 und des Weiteren umfassend eine Anzeigevorrichtung (66), die auf das Signal an dem Ausgang des Strahlungsmessers (R) anspricht, so dass die Anzeigevorrichtung (66) die Stärke des Ausrichtungssignals anzeigt.

12. Vorrichtung nach Anspruch 11 und ferner umfassend eine zweite Anzeigevorrichtung (76), die auf das Signal am Ausgang des zweiten Strahlungsmessers (74) anspricht, so dass die zweite Anzeigevorrichtung die Temperatur des Wandabschnitts (E_W) anzeigt.

Revendications

1. Appareil pour aligner relativement un cathéter d'ablation et une sonde de température pour une procédure d'ablation, ledit appareil comprenant
un cathéter d'ablation (10) pour l'ablation de tissu au niveau d'un site d'ablation (H_A) dans le corps d'un patient, ledit cathéter incluant une première antenne (14) ;
un générateur (16) pour fournir une puissance à la première antenne (14) afin de chauffer les tissus ;
une sonde de température (12) contenant une seconde antenne (22) et destinée à être mise en place dans un passage corporel (E) ayant une portion de paroi (Ew) adjacente au site d'ablation de sorte que ladite seconde antenne (22) est positionnée à l'opposé de la première antenne (14) ;
une source de micro-ondes (36, 72) configurée pour fournir un signal à micro-ondes modulé par impulsions à l'une de ladite première antenne (14) et ladite seconde antenne (22), ledit signal étant capté par l'autre de la première et de la seconde antenne ;
un radiomètre (24, R) ayant une entrée en circuit avec l'autre de la première antenne (14) et de la seconde antenne (22), et une sortie, et un dispositif de synchronisation (horloge en 24, 64) en circuit avec ladite source (36, 72) et ledit radiomètre (24, R) permettant au radiomètre de détecter de façon synchrone ledit signal à micro-ondes, de sorte que la sortie du radiomètre peut fournir un signal d'alignement dont l'intensité reflète le degré d'alignement de la première et de la seconde antenne,
caractérisé en ce que
un dispositif de commande (26, 64) est inclus, qui est configuré pour commander les fonctionnements du générateur (16) et de la source de micro-ondes (36, 72) d'une manière mutuellement exclusive de sorte que, quand la source à micro-ondes est en fonctionnement, ladite sortie du radiomètre (24, R) fournit ledit signal d'alignement et, quand le générateur (16) fonctionne pour l'ablation de tissu, la sortie du radiomètre (24, R) fournit un signal de température indiquant la température des tissus.

2. Appareil selon la revendication 1, dans lequel
ladite antenne est la première antenne (14) ;
un coupleur de micro-ondes (18) est en circuit entre ladite source de micro-ondes (36) et ladite première antenne (14), et
le dispositif de synchronisation est configuré pour fournir des impulsions d'horloge depuis le radiomètre (24) vers la source de micro-ondes (36) pour synchroniser leurs fonctionnements.

3. Appareil selon la revendication 2, dans lequel le coupleur (18) comprend un dispositif de couplage capacitif directionnel (42) et un filtre (44) en circuit entre le dispositif de couplage et le générateur (16).

4. Appareil selon la revendication 2, dans lequel le coupleur (18) comprend un duplexeur (41, 48).

5. Appareil selon la revendication 2, dans lequel le coupleur (18) comprend un circulateur en ferrite (52).

6. Appareil selon la revendication 5, dans lequel le coupleur (18) inclut en outre une ligne de transmission avec pertes connectée entre le circulateur (52) et le générateur (16) et une capacité (54) connectée entre le circulateur et une sortie de la source de micro-ondes (36).

7. Appareil selon la revendication 1, et incluant en outre un dispositif d'affichage (28, 76) connecté à la sortie du radiomètre (24, R).

8. Appareil selon la revendication 1, dans lequel
ladite antenne est la seconde antenne (22) ;
la source de micro-ondes (72) fournit le signal à micro-ondes à la seconde antenne (22), et
l'entrée du radiomètre (R) est en circuit avec la première antenne (14).

9. Appareil selon la revendication 8, dans lequel le radiomètre (R) est situé dans le cathéter d'ablation.

10. Appareil selon la revendication 8, incluant en outre un second radiomètre (74) ayant une entrée et une sortie ;
un dispositif de commutation (68) connecté entre la seconde antenne (22) et l'entrée du second radiomètre (74), ledit signal à micro-ondes étant appliqué à la seconde antenne au moyen dudit dispositif de commutation, ledit dispositif de commande (64) étant configuré pour commander les fonctionnements du générateur (16) et du dispositif de commutation (68) de sorte que, quand le générateur (16) n'est pas en fonctionnement, le dispositif de commutation (68) connecte la source de micro-ondes (72) à la seconde antenne (22) et, quand le générateur est en fonctionnement, le dispositif de commutation (18) connecte la seconde antenne à l'entrée du second radiomètre (74).

11. Appareil selon la revendication 10, et incluant en outre un dispositif d'affichage (66) réagissant au signal à la sortie dudit radiomètre (R), de sorte que le dispositif d'affichage (66) affiche l'intensité du signal d'alignement.

12. Appareil selon la revendication 11, et incluant en outre un second dispositif d'affichage (76) réagissant au signal à la sortie du second radiomètre (74), de sorte que le second dispositif d'affichage affiche la température de ladite portion de paroi (Ew).

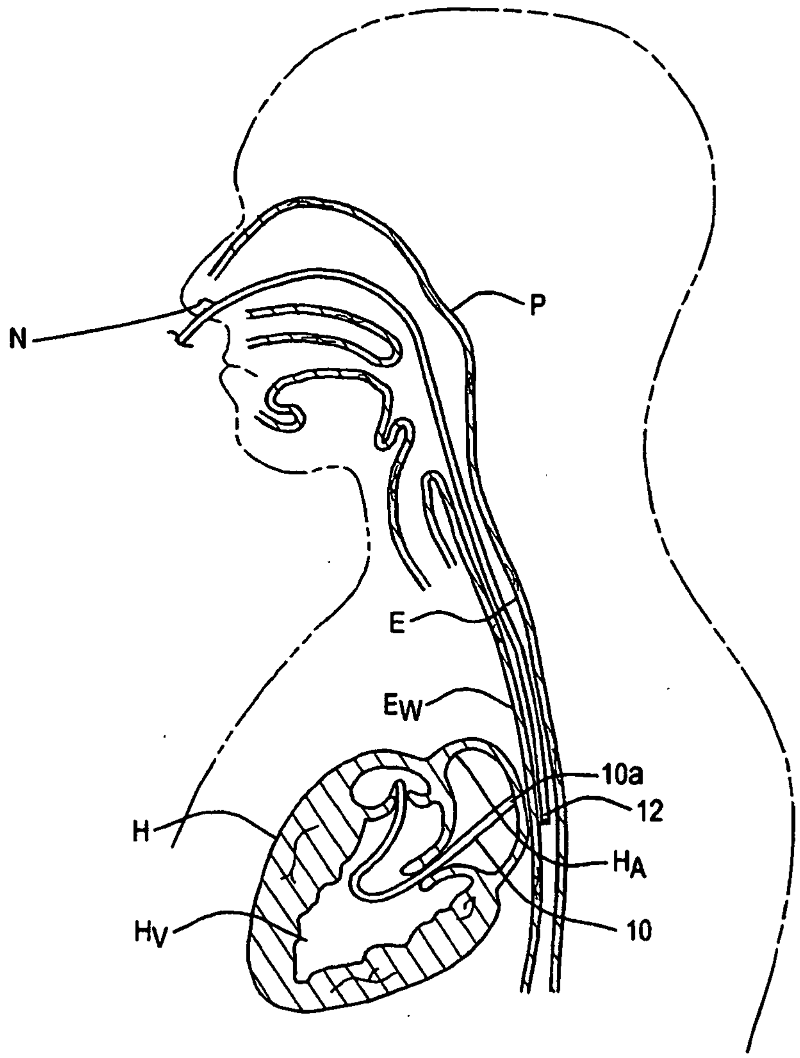

FIG. 1

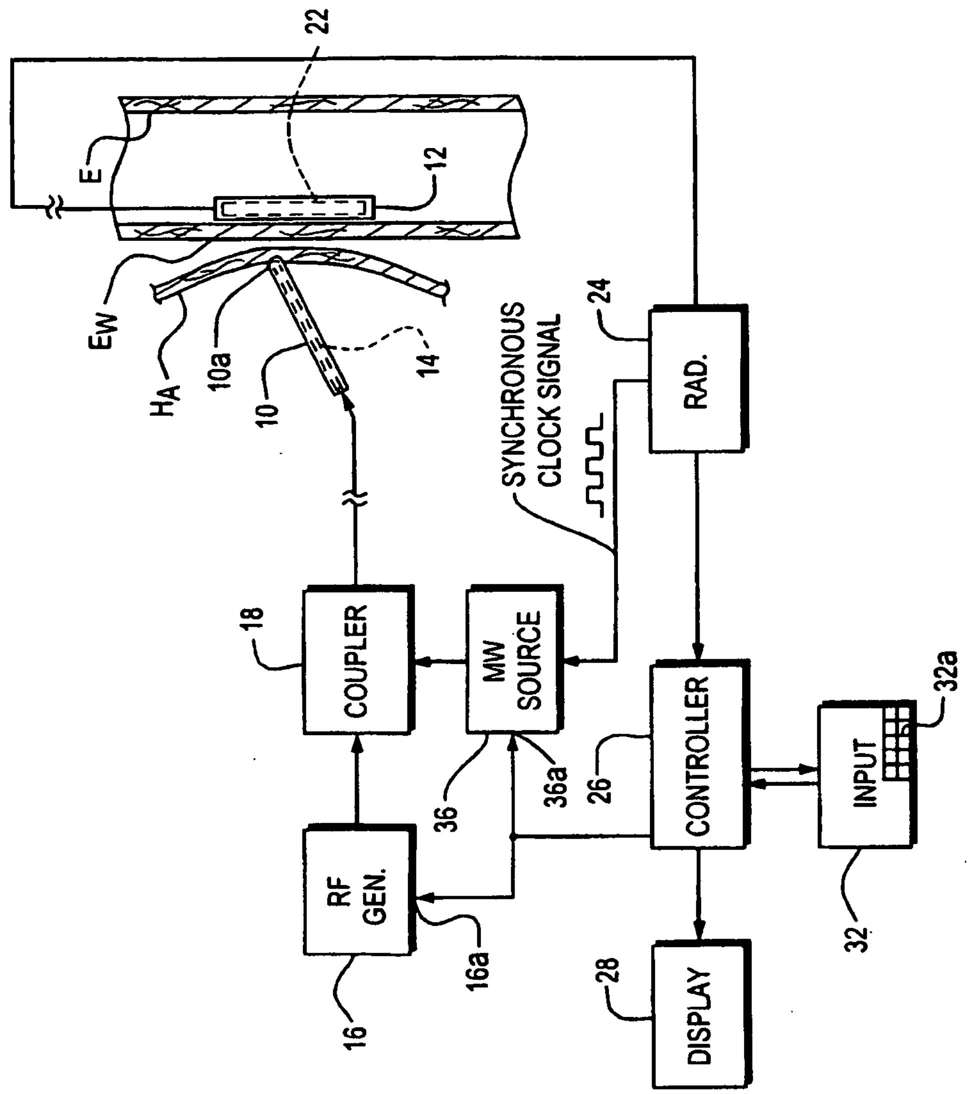
22
E
12
EW
HA
10a
10
14
24
RAD.
SYNCHRONOUS
CLOCK SIGNAL
18
COUPLER
MW
SOURCE
36
36a
26
CONTROLLER
RF
GEN.
16
16a
INPUT
32
32a
28
DISPLAY

FIG. 2

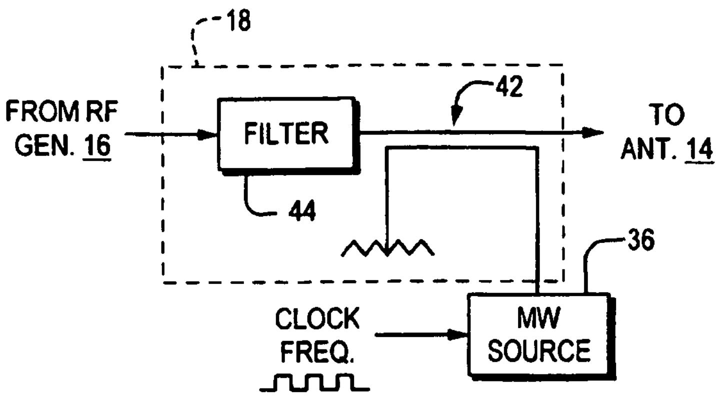

FIG. 3A

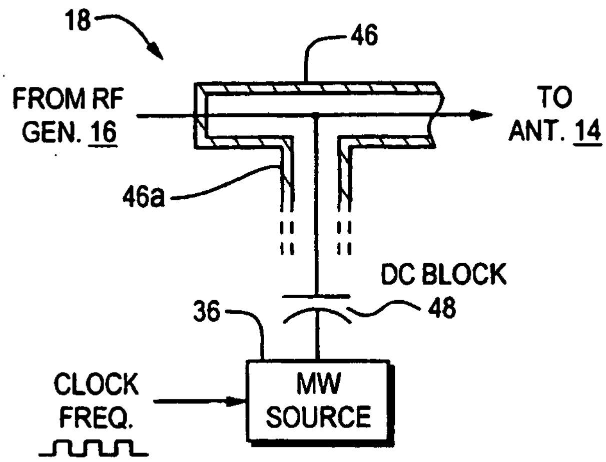

FIG. 3B

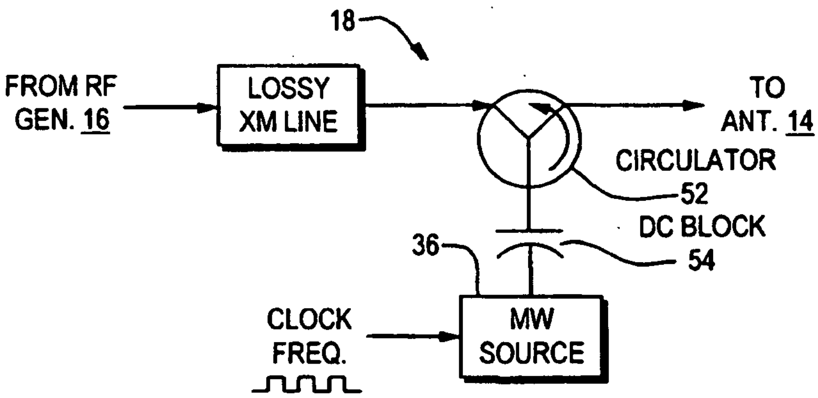

FIG. 3C

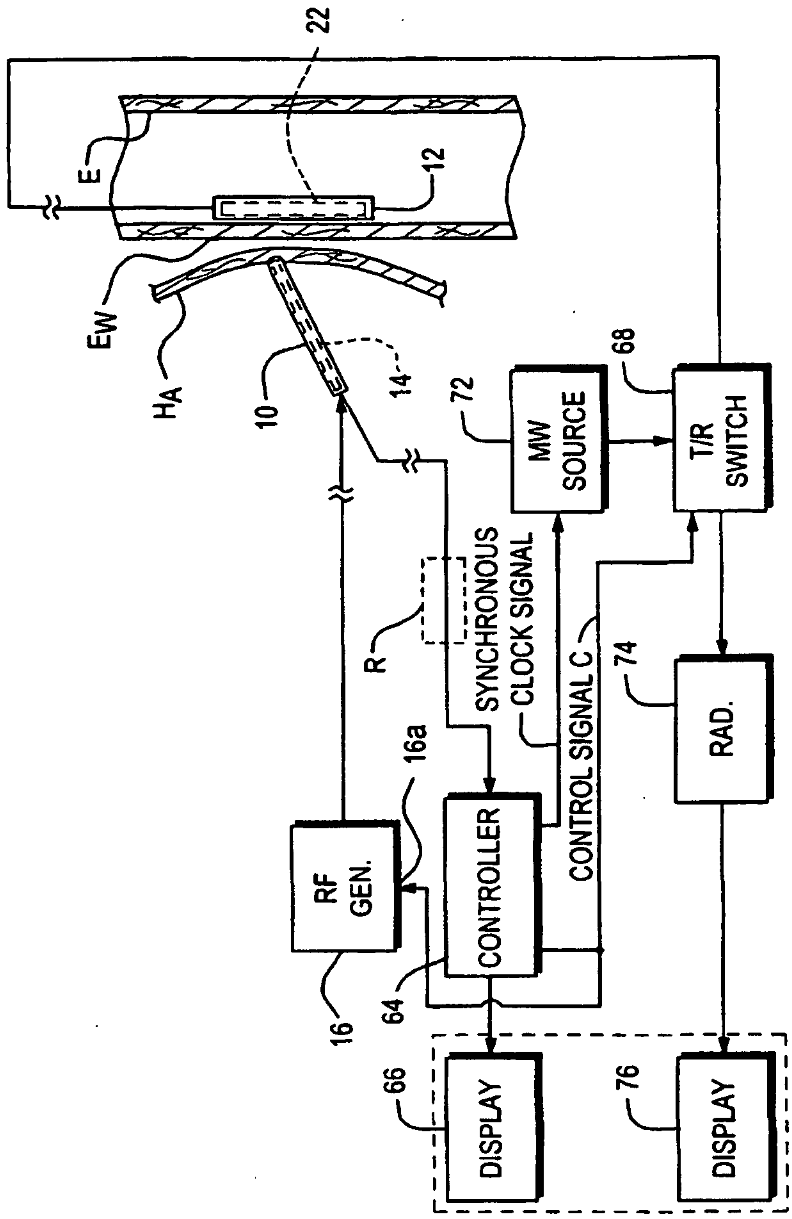
22
E
12
EW
HA
10
14
72
MW SOURCE
68
T/R SWITCH
R
SYNCHRONOUS CLOCK SIGNAL
CONTROL SIGNAL C
74
RAD.
16a
RF GEN.
CONTROLLER
16
64
66
DISPLAY
76
DISPLAY

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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patsnap

专利名称(译)	用于对准消融导管和温度探针以进行消融手术的装置		
公开(公告)号	EP2389132B1	公开(公告)日	2014-06-11
申请号	EP2010704236	申请日	2010-01-20
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申请(专利权)人(译)	MERIDIAN医疗系统有限责任公司		
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IPC分类号	A61B18/18 A61B5/06 G01K11/00 A61B5/00 A61B17/00 A61B18/14		
CPC分类号	A61B18/18 A61B5/0507 A61B5/06 A61B5/061 A61B18/1815 G01K11/006 G01K13/002		
代理机构(译)	鲁普雷希特，KAY		
优先权	12/356205 2009-01-20 US		
其他公开文献	EP2389132A1		
外部链接	Espacenet		

摘要(译)

用于相对于消融手术对准消融导管和温度探针的装置包括消融导管，该消融导管具有用于消融患者体内消融部位处的组织的第一天线和用于放置在具有邻近的壁部分的身体通道中的温度探针。消融部位使探头中的第二个天线与第一个天线相对。微波源向其中一个天线提供脉冲调制微波信号，而辐射计与另一个天线在电路中。具有微波源和辐射计的电路中的同步装置使辐射计能够同步地检测微波信号，使得辐射计提供对准信号，其强度反映第一和第二天线的对准程度，该信号可用于控制对齐显示。还公开了使用该装置的对准方法。

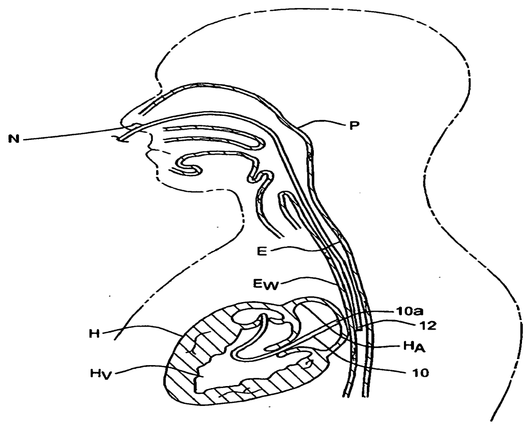

FIG. 1