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(54) **SYSTEM FOR COMMUNICATING WITH IMPLANTABLE DEVICES**

SYSTEM ZUR KOMMUNIKATION MIT IMPLANTIERBAREN VORRICHTUNGEN

SYSTEME DE COMMUNICATION AVEC DES DISPOSITIFS IMPLANTABLES

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Description

FIELD OF THE INVENTION:

[0001] The present invention relates generally to a system for measuring physiological conditions and/or performing therapeutic functions within a patient's body, particularly to a system for controlling and/or energizing devices that may be implanted within body, and more particularly to implants that may be energized, activated, controlled, and/or otherwise communicate via acoustic energy.

BACKGROUND OF THE INVENTION:

[0002] Devices are known that may be implanted within a patient's body for monitoring one or more physiological conditions and/or to provide therapeutic functions. For example, sensors or transducers may be located deep within the body for monitoring a variety of properties, such as temperature, pressure, strain, fluid flow, chemical properties, electrical properties, magnetic properties, and the like. In addition, devices may be implanted that perform one or more therapeutic functions, such as drug delivery, defibrillation, electrical stimulation, and the like.

[0003] Often it is desirable to communicate with such devices once they are implanted within a patient by external command, for example, to obtain data, and/or to activate or otherwise control the implant. An implant may include wire leads from the implant to an exterior surface of the patient, thereby allowing an external controller or other device to be directly coupled to the implant Alternatively, the implant may be remotely controlled, e.g., using an external induction device. For example, an external radio frequency (RF) transmitter may be used to communicate with the implant. RF energy, however, may only penetrate a few millimeters into a body, because of the body's dielectric nature, and therefore may not be able to communicate effectively with an implant that is located deep within the body. In addition, although an RF transmitter may be able to induce a current within an implant, the implant's receiving antenna, generally a low impedance coil, may generate a voltage that is too low to provide a reliable switching mechanism.

[0004] In a further alternative, electromagnetic energy may be used to control an implant, since a body generally does not attenuate magnetic fields. The presence of external magnetic fields encountered by the patient during normal activity, however, may expose the patient to the risk of false positives, i.e., accidental activation or deactivation of the implant, Furthermore, external electromagnetic systems may be cumbersome and may not be able to effectively transfer coded information to an implant.

[0005] PCT publication WO 01/074278 describes a battery powered cochlear implant that can be programmed in response to acoustic signals transmitted from an external acoustic remote control.

[0006] Accordingly, systems and methods for communicating with an implant that may be implanted within a patient's body, such as a pressure sensor, a drug delivery device, a pacemaker, or a nerve stimulator, would be considered useful.

SUMMARY OF THE INVENTION:

[0007] The present invention is directed to a system according to claim 1. The implant may include one or more sensors for monitoring pressure or other physiological parameters and/or may perform one or more therapeutic functions.

[0008] Preferably, the external controller of the system is sufficiently small and portable that it may remain secured to the patient, possibly, for extended time periods. For example, the device may be attached to or within a patch that may be secured to a patient's skin.

[0009] The external controller generally includes one or more acoustic transducers, including a first acoustic transducer, for transmitting one or more acoustic signals into the patient's body. The controller may also include an energy source for powering the one or more acoustic transducers, and/or a processor or other electrical circuit for controlling operation of the controller. In addition, one or more of the acoustic transducers, such as the first acoustic transducer, may be configured for receiving acoustic signals from an implant within the patient's body. The controller may include memory for storing data, and the processor may extract sensor data and/or other data from acoustic signals received from an implant, e.g., for storage in the memory. In addition, the controller may include a connector, lead, transmitter, receiver or other interface for communicating with a reorder or other electronic device, such as a computer, personal digital assistant, or a wireless device, such as a cellular phone. The controller may be coupled to such an electronic device for transferring sensor data or other data stored in the memory of the controller and/or for receiving instructions or commands from the electronic device.

[0010] In addition, the system includes an implant for placement within the patient's body. The implant includes an electrical circuit for performing one or more commands when the implant is activated, an energy storage device, and one or more acoustic transducers, e.g., a second acoustic transducer, coupled to the electrical circuit and/or the energy storage device. The electrical circuit includes a switch coupled to the energy storage device and the second acoustic transducer. The second acoustic transducer may receive one or more acoustic signals from the first acoustic transducer of the external device. The switch is configured for being closed in response to a first acoustic signal to begin current flow from the energy storage device to the electrical circuit or other components of the implant.

[0011] The switch comprises a timer, such that the switch remains closed only for a predetermined time, whereupon the switch automatically opens.

[0012] In a preferred embodiment, the external controller's processor controls the first acoustic transducer to transmit a first acoustic signal/or and a second acoustic signal. The switch of the implant may be closed when the first acoustic signal is received by the second acoustic transducer, while the switch may be opened when the second acoustic signal is received by the second acoustic transducer. In addition or alternatively, the first acoustic transducer may transmit first and second acoustic signals separated by a delay. The switch may be closed and/or opened only when the second acoustic transducer receives the first and second acoustic signals separated by a predetermined delay, thereby minimizing the risk of accidental activation or deactivation of the implant.

[0013] In yet another alternative, the first acoustic transducer may transmit a first acoustic signal, e.g., an activation signal, followed by a second acoustic signal, e.g., including a set of commands. The second acoustic transducer may receive the first and second acoustic signals, and the electrical circuit of the implant may extract the set of commands from the second acoustic signal, and control operation of the implant as instructed by the set of commands. The external controller may control, monitor, energize, and/or program the implant using acoustic telemetry during operation of the implant.

[0014] In an exemplary embodiment, the implant may include a sensor coupled to the electrical circuit, and the one or more commands may include measuring a physiological parameter within the body using the sensor. The second acoustic transmitter may transmit one or more acoustic signals including sensor data indicating the physiological parameter to the controller. In an alternative embodiment, the implant may be coupled to a therapeutic device or may include an internal therapeutic device coupled to the electrical circuit. The electrical circuit may control the therapeutic device in response to a physiological parameter measured by the sensor or in response to acoustic signals received from the external controller. For example, the implant may include a pacemaker that may be implanted via a minimally invasive catheter-based procedure. Any ; programming and/or interrogation of the pacemaker may be accomplished using acoustic telemetry from the external controller. In yet another alternative embodiment, the implant may include an actuator coupled to the electrical circuit, and the one or more commands may include activating the actuator to control a therapeutic device coupled to the actuator, such as a nerve stimulator or a controlled delivery drug release system.

[0015] In addition, the energy storage device of the implant may include a rechargeable device, such as a capacitor or a battery. For this embodiment, the system may include an external charger that may include a probe configured for placement against an exterior of the patient's body. The charger may include a source of electrical energy, such as a radio frequency (RF) generator, that is coupled to the probe. The probe may include another acoustic transducer, e.g., a third acoustic transducer, for converting electrical energy from the source of electrical energy into acoustic energy. The third acoustic transducer may transmit acoustic signals including acoustic energy into the patient's body. One or more acoustic transducers of the implant, e.g., the second acoustic transducer, may be configured for converting these acoustic signals into electrical energy for recharging the energy storage device and/or powering the implant.

[0016] Thus, a system in accordance with the present invention may include an external controller that has sufficient power to control its own operation and to communicate with the implant. Because of its limited energy requirements, however, the controller may be relatively small and portable, e.g., may be attached to the patient, while still allowing the patient to engage in normal physical activity. The controller may be used to communicate with an implant, e.g., periodically activating or deactivating the implant, and/or recording data generated and transmitted by the implant. Because it is located outside the patient's body, the controller may be more easily programmed or reprogrammed than the implant, and/or may be repaired or replaced if necessary without requiring an interventional procedure.

[0017] In addition, the system may include a separate external charger that includes a substantially more powerful energy source, enabling it to recharge the energy storage device of the implant. For this reason, unlike the external controller, the charger may be a relatively bulky device that may include a portable probe for contacting the patient's skin, and a large energy generator or converter that is stationary or of limited mobility. In an alternative embodiment, the external controller and charger may be provided as a single device, e.g., including one or more acoustic transducers and/or one or more processors for performing the functions of both devices, as described above. In this embodiment, however, portability of the system and convenience to the patient may be compromised.

[0018] Other objects and features of the present invention will become apparent from consideration of the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0019] The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

FIGS. 1A-1C are schematic drawings, showing exemplary embodiments of an implant, in accordance with the present invention.

FIG. 2 is a schematic of an exemplary circuit for use as an acoustic switch, in accordance with the present invention.

FIG. 3 is a cross-sectional view of a patient's body, showing a system for communicating with an im-

plant, in accordance with the present invention.

FIG. 4 is a schematic of an external controller for communicating with an implant, such as that shown in FIG. 3, in accordance with the present invention.

FIG. 5 is a schematic of another exemplary embodiment of an implant, in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

[0020] Turning to the drawings, FIGS. 1A-1C schematically show several exemplary embodiments of an implant 110, 210, 310, in accordance with the present invention. Generally, the implant 110, 210, 310 includes an electrical circuit 112,212,312 configured for performing one or more functions or commands when the implant 110, 210, 310 is activated, as described further below. In addition, the implant 110, 210,310 includes an energy storage device 114 and includes a switch 116 coupled to the electrical circuit 112, 212, 312 and the energy storage device 114. The switch 116 is configured for being activated upon acoustic excitation 100 from an external acoustic energy source (not shown) to allow current flow from the energy storage device 114 to the electrical circuit 112,212,312.

[0021] The switch 116 includes an acoustic transducer 118, such as that disclosed in PCT Publication No. WO 99/34,453, published July 8, 1999, or in U,S. application Serial No. 09/888,272, filed June 21, 2001. In addition, the switch 116 also includes a switch circuit 120, such as switch circuit 400 shown in FIG. 2, although alternatively other switches, such as a miniature electromechanical switch and the like (not shown) may be provided.

[0022] The energy storage device 114 may be any of a variety of known devices, such as an energy exchanger, a battery and/or a capacitor (not shown). Preferably, the energy storage device 114 is capable of storing electrical energy substantially indefinitely for as long as the acoustic switch 116 remains open, i.e., when the implant 110, 210, 310 is in a "sleep" mode. In addition, the energy storage device 114 may be capable of being charged from an external source, e.g., inductively using acoustic telemetry, as will be appreciated by those skilled in the art. In a preferred embodiment, the energy storage device 114 includes both a capacitor and a primary, non-rechargeable battery. Alternatively, the energy storage device 114 may include a secondary, rechargeable battery and/or capacitor that may be energized before activation or use of the implant 110, 210,310.

[0023] The implant 110, 210, 310 may be surgically or minimally invasively inserted within a human body in order to carry out a variety of monitoring and/or therapeutic functions. For example, the electrical circuit 112,212,312 may include a control circuit 122, 222, 322, a biosensor 124, 224, an actuator 226, 326, and/or a transmitter 128, as explained in application Serial No. 09/690,015. The implant 210, 310 may be configured for providing one or more therapeutic functions, for example, to activate and/or control a therapeutic device implanted within a patient's body, such as an atrial defibrillator or pacemaker, a pain relief stimulator, a neurostimulator, a drug delivery device, and/or a light source used for photodynamic therapy. Alternatively, the implant may be used to monitor a radiation dose including ionizing, magnetic and/or acoustic radiation, to monitor flow in a bypass graft, to produce cell oxygenation and membrane electroporation, and the like. In addition or alternatively, the implant 110 maybe used to measure one or more physiological parameters within the patient's body, such as pressure, temperature, electrical impedance, position, strain, pH, and the like.

[0024] The implant operates in one of two modes, a "sleep" or "passive" mode when the implant remains dormant and not in use, i.e., when the acoustic switch 116 is open, and an "active" mode, when the acoustic switch 116 is closed, and electrical energy is delivered from the energy storage device 114 to the electrical circuit 112, 212, 312. Because the acoustic switch 116 is open in the sleep mode, there is substantially no energy consumption from the energy storage device 114, and consequently, the implant may remain in the sleep mode virtually indefinitely, i.e., until activated. Thus, an implant in accordance with the present invention may be more energy efficient and, therefore, may require a relatively small energy storage device than implants that continuously draw at least a small amount of current in their "passive" mode.

[0025] Turning to FIG. 1A, a first preferred embodiment of an implant 110 is shown in which the electrical circuit 112 includes a control circuit 122, a biosensor 124 coupled to the controller 122, and a transmitter 128 coupled to the control circuit 122. The controller 122 may include circuitry for activating or controlling the biosensor 124, for receiving signals from the biosensor 124, and/or for processing the signals into data, for example, to be transmitted by the transmitter 128. Optionally, the electrical circuit 112 may include memory (not shown) for storing the data. The transmitter 128 may be any device capable of transmitting data from the control circuit 122 to a remote location outside the body, such as an acoustic transmitter, a radio frequency transmitter, and the like. Preferably, the control circuit 122 is coupled to the acoustic transducer 118 such that the acoustic transducer 118 may be used as a transmitter 128, as well as a receiver, instead of providing a separate transmitter.

[0026] The biosensor 124 may include one or more sensors capable of measuring physiological parameters, such as pressure, temperature, electrical impedance, position, strain, pH, fluid flow, electrochemical sensor, and the like. Thus, the biosensor 124 may generate a signal proportional to a physiological parameter that may be processed and/or relayed by the control circuit 122 to the transmitter 128, which, in turn, may generate a transmission signal to be received by a device outside the patient's body. Data regarding the physiological parameter(s) may

be transmitted continuously or periodically until the acoustic switch 116 is deactivated, or for a fixed predetermined time, as will be appreciated by those skilled in the art.

[0027] Turning to FIG. 1B, a second preferred embodiment of an implant 210 is shown in which the electrical circuit 212 includes a control circuit 222 and an actuator 226. The actuator 226 may be coupled to a therapeutic device (not shown) provided in or otherwise coupled to the implant 210, such as a light source, a nerve stimulator, a defibrillator, an electrochemical oxidation/reduction electrode, or a valve communicating with an implanted drug reservoir (in the implant or otherwise implanted within the body in association with the implant).

[0028] When the switch 120 is closed, the control circuit 222 may activate the actuator 226 using a pre-programmed protocol, e.g., to complete a predetermined therapeutic procedure, whereupon the switch 120 may automatically open, or the controller 222 may follow a continuous or looped protocol until the switch 120 is deactivated. Alternatively, the acoustic transducer 118 may be coupled to the control circuit 222 for communicating a new or unique set of commands to the control circuit 222. For example, a particular course of treatment for a patient having the implant 210 may be determined, such as a flow rate and duration of drug delivery, drug activation, drug production, or an energy level and duration of electrical stimulation. Acoustic signals including commands specifying this course of treatment may be transmitted from an external controller (not shown), as described below, to the acoustic switch 116, e.g., along with or subsequent to the activation signal 100. The control circuit 222 may interpret these commands and control the actuator 226 accordingly to complete the course of treatment.

[0029] Turning to FIG. 1C, yet another preferred embodiment of an implant 310 is shown in which the electrical circuit 312 includes a control circuit 322, a biosensor 324, and an actuator 326, all of which may be coupled to one another. This embodiment may operate similarly to the embodiments described above, e.g., to obtain data regarding one or more physiological parameters and/or to control a therapeutic device. In addition, once activated, the control circuit 322 may control the actuator 326 in response to data obtained from the biosensor 324 to control or adjust automatically a course of treatment being provided by a device connected to the actuator 326. For example, the actuator 326 may be coupled to an insulin pump (not shown), and the biosensor 324 may measure glucose levels within the patient's body. The control circuit 322 may control the actuator to open or close a valve on the insulin pump to adjust a rate of insulin delivery based upon glucose levels measured by the biosensor 324 in order to maintain the patient's glucose within a desired range.

[0030] Turning to FIG. 2, a preferred embodiment of a switch 400 is shown that may be incorporated into an implant in accordance with the present invention. The switch 400 includes a piezoelectric transducer, or other acoustic transducer (not shown, but generally connected to the switch 400 at locations piezo + and piezo -), a plurality of MOSFET transistors (Q1-Q4) and resistors (R1-R4), and switch S1. A "load" may be coupled to the switch 400, such as one of the electrical circuits described above. In the switch's "sleep" mode, all of the MOSFET transistors (Q1-Q4) are in an off state. To maintain the off state, the gates of the transistors are biased by pull-up and pull-down resistors. The gates of N-channel transistors (Q1, Q3 & Q4) are biased to ground and the gate of P-channel transistor Q2 is biased to +3V. During this quiescent stage, switch S1 is closed and no current flows through the circuit. Therefore, although an energy storage device (not shown, but coupled between the hot post, labeled with an exemplary voltage of +3V, and ground) is connected to the switch 400, no current is being drawn therefrom since all of the transistors are quiescent.

[0031] When the acoustic transducer of the implant detects an external acoustic signal, e.g., having a particular frequency, such as the transducer's resonant frequency, the voltage on the transistor Q1 will exceed the transistor threshold voltage of about one half of a volt. Transistor Q2 is thereby switched on and current flows through transistor Q2 and pull-up resistor R2. As a result of the current flow through transistor Q1, the voltage on the drain of transistor Q1 and the gate of transistor Q2 drops from +3V substantially to zero (ground). This drop in voltage switches on the P-channel transistor Q2, which begins to conduct current through transistor Q2 and pull-down resistor R3.

[0032] As a result of the current flowing through transistor Q2, the voltage on the drain of transistor Q2 and the gates of transistors Q3 and Q4 increases from substantially zero to +3V. The increase in voltage switches on transistors Q3 and Q4. As a result, transistor Q3 begins to conduct current through resistor R4 and main switching transistor Q4 begins to conduct current through the "load," thereby switching on the electrical circuit.

[0033] As a result of the current flowing through transistor Q3, the gate of transistor Q2 is connected to ground through transistor Q3, irrespective of whether or not transistor Q1 is conducting. At this stage, the transistors (Q2, Q3 & Q4) are latched to the conducting state, even if the piezoelectric voltage on transistor Q1 is subsequently reduced to zero and transistor Q1 ceases to conduct. Thus, main switching transistor Q4 will remain on until switch S1 is opened.

[0034] In order to deactivate or open the switch 400, switch S1 must be opened, for example, while there is no acoustic excitation of the piezoelectric transducer. If this occurs, the gate of transistor Q2 increases to +3V due to pull-up resistor R2. Transistor Q2 then switches off, thereby, in turn, switching off transistors Q3 and Q4. At this stage, the switch 400 returns to its sleep mode, even if switch S 1 is again closed. The switch 400 will only return to its active mode upon receiving a new acoustic activation signal from the piezoelectric transducer.

[0035] It should be apparent to one of ordinary skill in the art that the above-mentioned electrical circuit is not the only possible implementation of a switch for use with the present invention. For example, the switching operation my be performed using a CMOS circuit, which may draw less current when switched on, an electromechanical switch, and the like.

[0036] Turning to FIGS. 3 and 4, a system 410 is shown for communicating with an implant 412, such as one of those described above. Generally, the system 410 includes an external communications device or controller 414, and may include a charger 416, one or more implants 412 (only one shown for simplicity), and an external recorder, computer, or other electronic device 434.

[0037] With particular reference to FIG. 4, the external controller 414 may include a processor or other electrical circuit 418 for controlling its operation, and an energy source 420, e.g., a nonrechargeable or a rechargeable battery, coupled to the processor 418 and/or other components of the controller 414, such as a power amplifier or an oscillator (not shown). In addition, the controller 414 may include one or more acoustic transducers 422 that are configured for converting between electrical energy and acoustic energy, similar to those described above. As shown, a single acoustic transducer 422 is provided that may communicate using acoustic telemetry, i.e., capable both of converting electrical energy to acoustic energy to transmit acoustic signals, and converting acoustic energy to electrical energy to receive acoustic signals, as explained further below. Alternatively, separate and/or multiple acoustic transducers may be provided for transmitting and receiving acoustic signals.

[0038] In a preferred embodiment, the controller 414 also includes memory 424 coupled to the processor 418, e.g., for storing data provided to the controller 414, as explained further below. The memory 424 may be a temporary buffer that holds data before transfer to another device, or non-volatile memory capable of storing the data substantially indefinitely, e.g., until extracted by the processor 418 or other electronic device. For example, the memory 424 may be a memory card or an eprom (not shown) built into the controller 414 or otherwise coupled to the processor 418. The controller 414 may also include an interface 426, such as a lead or connector, or a transmitter and/or receiver, that may communicate with the external electronic device, as explained further below.

[0039] Preferably, the controller 414 is carried by a patch 415 that may be secured to a patent, e.g., to the patient's skin 92. For example, the patch 415 may include one or more layers of substantially flexible material to which the controller 414 and/or its individual components are attached. The patch 415 may include a single flexible membrane (not shown) to which the controller 414 is bonded or otherwise attached, e.g., using a substantially permanent adhesive, which may facilitate the patch 415 conforming to a patient's anatomy. Alternatively, the controller 414 may be secured between layers of material, e.g., within a pouch or other compartment (not shown) within the patch 415. For example, the patch 415 may include a pair of membranes (not shown) defining the pouch or compartment. The space within which the controller 414 is disposed may be filled with material to acoustically couple the acoustic transducer(s) (formed, for example, from PZT, composite PZT, Quartz, PVDF, and/or other piezoelectric material) of the controller 414 to an outer surface of the patch 415. Alternatively, the acoustic transducer(s) may be exposed, e.g., in a window formed in a wall of the patch 415.

[0040] The patch 415 may be formed from a flexible piezoelectric material, such as PVDF or a PVDF copolymer. Such polymers may allow the patch 415 to produce ultrasonic waves, as well as allowing the controller 414 to be secured to the patient's skin 92. Thus, the wall of the patch 415 itself may provide an acoustic transducer for the controller 414, i.e., for transmitting acoustic energy to and/or receiving acoustic energy from the implant 412.

[0041] The patch 415 may then be secured to the patient's skin 92 using a material, such as a layer of adhesive (not shown), substantially permanently affixed or otherwise provided on a surface of the patch. The adhesive may be hydrogel, silicon, polyurethane, polyethylene, polypropylene, fluorocarbon polymer, and the like. Alternatively, a separate adhesive may be applied to the patch 415 and/or to the patient's skin 92 before applying the patch 415 in order to secure the controller 414 to the patient's skin 92. Such an adhesive may enhance acoustically coupling of the acoustic transducer(s) of the controller 414 to the patient's skin 92, and consequently to the implant 412 within the patient's body 94. Optionally, additional wetting material, including water, silicone oil, silicone gel, hydrogel, and the like, and/or other acoustically conductive material may be provided between the patch 415 or the acoustic transducer 422, and the patient's skin 92, e.g., to provide substantial continuity and minimize reflection or other losses and/or to secure the patch 415 to the patient.

[0042] Alternatively, the controller 414 may be carried by a belt (not shown) that may be secured around the patient, e.g., such that the acoustic transducer 422 is secured against the patient's skin. The belt may carry other components of the system 410, e.g., an external power supply for the controller 414. For example, a battery pack (not shown) may be carried by the belt that may be coupled to the controller 414 for providing electrical energy for its operation.

[0043] The patch 415 may be relatively light and compact, for example, having a maximum surface dimension (e.g., width or height) not more than about ten to two hundred millimeters (10-200 mm), a thickness not more than about five to one hundred millimeters (5-100 mm), and a weight not more than about twenty to four hundred grams (20-400 g), such that the controller 414 may be inconspicuously attached to the patient, Thus, the patient may be able to resume normal physical activity, without substantial impairment from the controller. Yet, the internal energy source of the controller 414 may be sufficiently

large to communicate with the implant 412 for an extended period of time, e.g., for hours or days, without requiring recharging or continuous coupling to a separate energy source.

[0044] The system 410 may be used to control, energize, and/or otherwise communicate with the implant 412. For example, the controller 414 may be used to activate the implant 412. One or more external acoustic energy waves or signals 430 may be transmitted from the controller 414 into the patient's body 94, e.g., generally towards the location of the implant 412 until the signal is received by the acoustic transducer (not shown in FIGS. 3 and 4) of the implant 412. Upon excitation by the acoustic wave(s) 430, the acoustic transducer produces an electrical output that is used to close, open, or otherwise activate the switch (also not shown in FIGS. 3 and 4) of the implant 412. Preferably, in order to achieve reliable switching, the acoustic transducer of the implant 412 is configured to generate a voltage of at least several tenths of a volt upon excitation that may be used as an activation signal to close the switch, as described above.

[0045] As a safety measure against false positives (e.g., erroneous activation or deactivation), the controller 414 may be configured to direct its acoustic transducer 422 to transmit an initiation signal followed by a confirmation signal. When the acoustic transducer of the implant 412 receives these signals, the electrical circuit may monitor the signals for a proper sequence of signals, thereby ensuring that the acoustic switch of the implant 412 only closes upon receiving the proper initiation and confirmation signals. For example, the acoustic switch may only acknowledge an activation signal that includes a first pulse followed by a second pulse separated by a predetermined delay. Use of a confirmation signal may be particularly important for certain applications, for example, to prevent unintentional release of drugs by a drug delivery implant.

[0046] In addition to an activation signal, the controller 414 may transmit a second acoustic signal that may be the same as or different than the acoustic wave(s) used to activate the acoustic switch of the implant 412. Thus, the switch may be opened when the acoustic transducer of the implant 412 receives this second acoustic signal, e.g., by the acoustic transducer generating a termination signal in response to the second acoustic signal, in order to return the implant 412 to its sleep mode.

[0047] In an exemplary system that is not part of the present invention, once activated, the switch may remain closed indefinitely, e.g., until the energy storage device (not shown in FIGS. 3 and 4) of the implant 412 is completely depleted, falls below a predetermined threshold, or until a termination signal is received by the acoustic transducer of the implant 412 from the controller 414. In the present invention, the acoustic switch of the implant 412 includes a timer (not shown), such that the switch remains closed only for a predetermined time, whereupon the switch may automatically open, returning the implant 412 to its sleep mode.

[0048] FIG. 5 shows another exemplary system comprising an implant 510 that does not include an acoustic switch. Generally, the implant includes a sensor 512, one or more energy transducers 514, one or more energy storage devices 516, and a control circuit 518, similar to the embodiments described above. The sensor 512 is preferably a pressure sensor for measuring intra-body pressure, such as an absolute variable capacitance type pressure sensor. In alternative exemplary systems, one or more other sensors may be provided instead of or in addition to a pressure sensor 512. For example, the sensor 512 may include one or more biosensors capable of measuring physiological parameters, such as temperature, electrical impedance, position, strain, pH, fluid flow, and the like. An external controller (not shown), such as that described above, may also be used to communicate with this implant.

[0049] Returning to FIG. 3, an external controller 414 in accordance with the present invention preferably has only sufficient power to control its own operation and to communicate with the implant 412. Because of its limited energy requirements, the controller 414 may be relatively small and portable, e.g., may be attached to the patient, while still allowing the patient to engage in normal physical activity. The controller 414 may be used to communicate with the implant 412, e.g., periodically activating or deactivating the implant 412, and/or recording data generated and transmitted by the implant 412. Because it is located outside the patient's body, the controller 414 may be more easily programmed or reprogrammed than the implant 412 itself, and/or may be repaired or replaced if necessary or desired.

[0050] In addition to the external controller 414, the system 410 may include one or more electronic devices 434 that may be coupled to the controller 414 via the interface 426, such as a recorder, a computer, a personal digital assistant, and/or a wireless device, such as a cellular telephone. The electronic device 434 may be directly coupled to the controller 414, by a connector or lead (not shown) extending from the patch 415 within which the controller 414 is provided. Alternatively, the controller 414 and/or patch 415 may include a wireless transmitter and/or receiver (not shown), e.g., a short-range RF transceiver, for communicating with the electronic device 434.

[0051] The electronic device 434 may be used to extract data from the memory 424 of the controller 414, e.g., sensor data and the like, received from the implant 412. This data may be included in a patient database maintained by health care professionals monitoring the patient receiving the implant 412. In addition, the electronic device 434 may be used to program the controller 414, e.g., to program commands, timing sequences, and the like.

[0052] The system 410 may also include an external charger 418. For example, the implant 412 may include a rechargeable energy storage device (not shown in FIG. 3), preferably one or more capacitors, that are coupled to the acoustic transducer (also not shown in FIG. 3).

The charger 416 may include a probe 428, including an acoustic transducer 430 for contacting a patient's skin 92. The charger 416 also includes a source of electrical energy 432, such as a radio frequency (RF) generator, that is coupled to the acoustic transducer 430. The charger 418 may also include electrical circuits for controlling its operation and buttons or other controls (not shown) for activating and/or deactivating the acoustic transducer 430.

[0053] The charger 418 may be used to charge or recharge the implant, e.g., periodically or before each activation. Because the charger 418 includes a substantially more powerful energy source than the controller 414, the charger 418 is generally a relatively bulky device compared to the controller 414, in particular due to the energy generator, which may be stationary or of limited mobility. In addition, the charger 418 may be used to recharge the controller 414 periodically, e.g., by a direct or wireless coupling. Alternatively, the controller 414 and patch 415 may be disposable, e.g., after its energy has been depleted, and replaced with another.

[0054] For purposes of comparison, an exemplary charger 416 may need to generate about ten kiloPascals (10 kPa) of acoustic energy for about twenty seconds (20 sec.) in order to fully charge the implant 412. In contrast, an exemplary controller 414 may be limited to outputting relatively smaller bursts of acoustic energy for communicating with, but not charging, the implant 412. Such acoustic signals may have a duration of as little as about one millisecond (1 ms), as opposed to the significantly longer charging signals generated by the charger 416.

[0055] The transducer 422 of the controller 414 may consume about one Watt (1 W) of power to produce a 1 kPa acoustic signal for about one millisecond. If the controll er 414 communicates with the implant 412 on an hourly basis, the energy source 420 of the controller 418 may only need sufficient capacity to provide 0.024 Watt seconds per day (0.024 W.sec./day). Because of this low energy requirement, the energy source 420, and, consequently the controller 418, may be relatively compact and portable, as compared to the charger 416. Thus, the energy source 420 may be self-contained within the controller 418, i.e., carried by the patch 415, Alternatively, a portable energy source, e.g., an external battery pack (not shown) may be provided for supplying electrical energy to the controller 418 that may be carried by the patient, e.g., on a belt (not shown).

[0056] In an alternative embodiment, the controller and charger may be provided as a single device (not shown), e.g., including one or more acoustic transducers and/or one or more processors for performing the functions of both devices, as described above. In this embodiment the implant 412 may operate in a "half-duplex" mode, a quasi-continuous mode, or in a "full-duplex" mode, as described in the applications incorporated above.

[0057] It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the scope of the present invention as defined by the claims.

Claims

1. A system for activating an implant (110, 210, 310, 412) within a patient's body (94), comprising:

   an external controller (414) for contacting an exterior surface (92) of a the patient's body (94), the controller (414) comprising a first acoustic transducer (422) for transmitting a first acoustic signal (100) into the patient's body (94), and an energy source (114) for powering the first acoustic transducer (422); and
   an implant (110, 210, 310, 412) for placement within the patient's body (94), the implant (110, 210, 310, 412) comprising an electrical circuit configured for performing one or more commands when the implant (110, 210, 310, 412) is activated, an energy storage device (114) and a second acoustic transducer (118) configured for receiving the first acoustic signal (100) from the first acoustic transducer (422), **characterized in that**
   the implant (110, 210, 310, 412) further comprises a switch (120) coupled to the second transducer, the electrical circuit and the energy storage device, wherein the implant (110,210,310,412) operates in a "sleep" or "passive" mode when the switch (120) is open, and an "active" mode, when the switch (120) is closed, the switch (120) configured for being closed in response to the first acoustic signal (100) to allow current flow from the energy storage device (114) to the electrical circuit (122, 222, 322), and wherein the switch (120) of the implant (110,210,310,412) comprises a timer, such that the switch (120) remains closed only for a predetermined time, whereupon the switch (120) automatically opens, returning the implant (110,210,310,412) to its sleep mode.

2. The system of claim 1, wherein the first acoustic transducer (422) is configured for transmitting first and second acoustic signals separated by a predetermined delay, and wherein the switch (120) is configured to close only when the second acoustic transducer (118) receives the first and second acoustic signals separated by the predetermined delay.

3. The system of claim 1, wherein the controller (414) comprises a processor (418) for controlling the first acoustic transducer (422) to transmit one of a first acoustic signal (100) and a second acoustic signal, and wherein the switch (120) is configured for being closed when the first acoustic signal (100) is received by the second acoustic transducer (118), and the

switch (120) is configured for being opened when the second acoustic signal is received by the second acoustic transducer (118) for discontinuing current flow from the energy storage device to the electrical circuit (122, 222, 322).

4. The system of claim 1, wherein the implant (110, 310) further comprises a sensor (124, 324) coupled to the electrical circuit (122, 322), and wherein the one or more commands comprises measuring a physiological parameter within the body (94) using the sensor (124, 324).

5. The system of claim 4, wherein the second acoustic transducer (118) is configured for transmitting a second acoustic signal comprising sensor data indicative of the physiological parameter to the controller (414), and the first acoustic transducer (422) is configured for receiving the second acoustic signal from the implant (110, 310).

6. The system of claim 5, wherein the controller (414) further comprises memory (424) for storing the sensor data.

7. The system of claim 5, wherein the controller (414) comprises a processor (418) for extracting the sensor data from the second acoustic signal.

8. The system of claim 5, wherein the controller (414) comprises an interface for transferring the sensor data to an external electronic device (434) separate from the controller.

9. The system of claim 4, further comprising a therapeutic device (322) coupled to the electrical circuit (322), the electrical circuit (322) being configured for controlling the therapeutic device (322) in response to the physiological parameter measured by the sensor (324).

10. The system of claim 1, wherein the energy storage device (114) comprises a rechargeable device, and wherein the system further comprises an external charger (416) configured for placement against an exterior surface (92) of the patient's body (94), the charger (416) comprising a source of electrical energy (432), and a third acoustic transducer (430) for converting electrical energy from the source of electrical energy (432) into acoustic energy and transmitting a second acoustic signal comprising the acoustic energy into the patient's body (94).

11. The system of claim 10, wherein the second acoustic transducer (118) is configured for converting the second acoustic signal into electrical energy for recharging the energy storage device (114).

12. The system of claim 1, further comprising an adhesive for securing the controller (414) to an exterior surface (92) of a patient's body (94).

13. The system of claim 1, wherein the controller (414) is carried by a patch (415) attachable to the patient's skin (92).

14. The system of claim 1, wherein the implant (110, 210, 310, 412) further comprises an actuator (226, 326) coupled to the electrical circuit (222, 322), and wherein the one or more commands comprises activating the actuator (226, 326) to control a therapeutic device coupled to the actuator (226, 326).

15. The system of claim 1, wherein the electrical circuit (122, 222, 322) is a control circuit or controller.

16. The system of claim 3, wherein the implant (110, 210, 310, 412) consumes substantially no energy when the switch (120) is open.

Patentansprüche

1. System zum Aktivieren eines Implantats (110, 210, 310, 412) innerhalb des Körpers (94) eines Patienten, welches aufweist:

eine externe Steuervorrichtung (414) zum Kontaktieren einer äußeren Oberfläche (92) des Körpers (94) des Patienten, welche Steuervorrichtung (414) einen ersten akustischen Wandler (422) zum Senden eines ersten akustischen Signals (100) in den Körper (94) des Patienten, und eine Energiequelle (114) zum Betreiben des ersten akustischen Wandlers (422) aufweist; und

ein Implantat (110, 210, 310, 412) zum Anordnen innerhalb des Körpers (94) des Patienten, das Implantat (110, 210, 310, 412) aufweisend eine elektrische Schaltung ,die ausgebildet ist zum Durchführen eines oder mehrerer Befehle, wenn das Implantat (110, 210, 310, 412) aktiviert ist, eine Energiespeichervorrichtung (114) und

einen zweiten akustischen Wandler (118), der ausgebildet ist zum Empfangen des ersten akustischen Signals (100) von dem ersten akustischen Wandler (422), **dadurch gekennzeichnet, dass**

das Implantat (110, 210, 310, 412) weiterhin einen Schalter (120) aufweist, der mit dem zweiten Wandler, der elektrischen Schaltung und der Energiespeichervorrichtung gekoppelt ist, wobei das Implantat (110, 210, 310, 412) in einem "Schlaf"- oder "Passiv"-Modus arbeitet, wenn der Schalter (120) geöffnet ist, und in einem "Ak-

tiv"-Modus, wenn der Schalter (120) geschlossen ist, welcher Schalter (120) ausgebildet ist, als Antwort auf das erste akustische Signal (100) geschlossen zu sein, um zu ermöglichen, dass Strom von der Energiespeichervorrichtung (114) zu der elektrischen Schaltung (122, 222, 322) fließt, und wobei der Schalter (120) des Implantats (110, 210, 310, 412) einen Zeitgeber aufweist, derart, dass der Schalter (120) nur während einer vorbestimmten Zeit geschlossen bleibt, wonach der Schalter (120) automatisch öffnet, wodurch das Implantat (110, 210, 310, 412) in seinen Schlafmodus zurückgeführt wird.

2. System nach Anspruch 1, bei dem der erste akustische Wandler (422) ausgebildet ist zum Senden erster und zweiter akustischer Signale, die durch eine vorbestimmte Verzögerung getrennt sind, und bei dem der Schalter (120) ausgebildet ist, nur dann zu schließen, wenn der zweite akustische Wandler (118) das erste und das zweite akustische Signal, die durch die vorbestimmte Verzögerung getrennt sind, empfängt.

3. System nach Anspruch 1, bei dem die Steuervorrichtung (414) einen Prozessor (418) zum Steuern des ersten akustischen Wandlers (422) zum Senden eines von einem ersten akustischen Signal (100) und einem zweiten akustischen Signal aufweist, und bei dem der Schalter (120) ausgebildet ist, geschlossen zu werden, wenn das erste akustische Signal (100) von dem zweiten akustischen Wandler (118) empfangen wird, und der Schalter (120) ausgebildet ist, geöffnet zu werden, wenn das zweite akustische Signal von dem zweiten akustischen Wandler (118) empfangen wird, um den Stromfluss von der Energiespeichervorrichtung zu der elektrischen Schaltung (122, 222, 322) zu unterbrechen.

4. System nach Anspruch 1, bei dem das Implantat (110, 310) weiterhin einen Sensor (124, 324) aufweist, der mit der elektrischen Schaltung (122, 322) gekoppelt ist, und bei dem der eine oder die mehreren Befehle das Messen eines physiologischen Parameters innerhalb des Körpers (94) unter Verwendung des Sensors (124, 324) aufweisen.

5. System nach Anspruch 4, bei dem der zweite akustische Wandler (118) ausgebildet ist zum Senden eines zweiten akustischen Signals aufweisend Sensordaten, die den physiologischen Parameter anzeigen, zu der Steuervorrichtung (414), und der erste akustische Wandler (422) ausgebildet ist zum Empfangen des zweiten akustischen Signals von dem Implantat (110, 310).

6. System nach Anspruch 5, bei dem die Steuervorrichtung (414) weiterhin einen Speicher (424) zum Speichern der Sensordaten aufweist.

7. System nach Anspruch 5, bei dem die Steuervorrichtung (414) einen Prozessor (418) zum Herausziehen der Sensordaten aus dem zweiten akustischen Signal aufweist.

8. System nach Anspruch 5, bei dem die Steuervorrichtung (414) eine Schnittstelle zum Übertragen der Sensordaten zu einer von der Steuervorrichtung getrennten externen elektronischen Vorrichtung (434) aufweist.

9. System nach Anspruch 4, weiterhin aufweisend eine therapeutische Vorrichtung (322), die mit der elektrischen Schaltung (322) gekoppelt ist, welche elektrische Schaltung (322) ausgebildet ist zum Steuern der therapeutischen Vorrichtung (322) als Antwort auf den von dem Sensor (324) gemessenen physiologischen Parameter.

10. System nach Anspruch 1, bei dem die Energiespeichervorrichtung (114) eine wiederaufladbare Vorrichtung aufweist, und wobei das System weiterhin eine externe Ladevorrichtung (416), die ausgebildet ist zum Anordnen an der äußeren Oberfläche (92) des Körpers (94) des Patienten, welche Ladevorrichtung (416) eine Quelle für elektrische Energie (432) aufweist, und einen dritten akustischen Wandler (430) zum Umwandeln elektrischer Energie von der Quelle für elektrische Energie (432) in akustische Energie und zum Senden eines zweiten akustischen Signals, das die akustische Energie aufweist, in den Körper (94) des Patienten aufweist.

11. System nach Anspruch 10, bei dem der zweite akustische Wandler (118) ausgebildet ist zum Umwandeln des zweiten akustischen Signals in elektrische Energie zur Wiederaufladung der Energiespeichervorrichtung (114).

12. System nach Anspruch 1, weiterhin aufweisend einen Klebstoff zum Befestigen der Steuervorrichtung (414) an einer äußeren Oberfläche (92) des Körpers (94) des Patienten.

13. System nach Anspruch 1, bei dem die Steuervorrichtung (414) von einem Flecken (415) getragen wird, der an der Haut (92) des Patienten befestigbar ist.

14. System nach Anspruch 1, bei dem das Implantat (110, 210, 310, 412) weiterhin einen Aktuator (226, 326) aufweist, der mit der elektrischen Schaltung (222, 322) gekoppelt ist, und bei dem der eine oder die mehreren Befehle das Aktivieren des Aktuators (226, 326) aufweisen, um eine mit dem Aktuator (226, 326) gekoppelte therapeutische Vorrichtung

zu steuern.

15. System nach Anspruch 1, bei dem die elektrische Schaltung (122, 222, 322) eine Steuerschaltung oder Steuervorrichtung ist.

16. System nach Anspruch 3, bei dem das Implantat (110, 210, 310, 412) im Wesentlichen keine Energie verbraucht, wenn der Schalter (120) geöffnet ist.

Revendications

1. Système pour activer un implant (110, 210, 310, 412) à l'intérieur d'un corps de patient (94), comprenant :

un contrôleur externe (414) pour entrer en contact avec une surface extérieure (92) du corps de patient (94), le contrôleur (414) comprenant un premier transducteur acoustique (422) pour transmettre un premier signal acoustique (100) dans le corps de patient (94), et une source d'énergie (114) pour alimenter le premier transducteur acoustique (422) ; et
un implant (110, 210, 310, 412) destiné à être placé à l'intérieur du corps de patient (94), l'implant (110, 210, 310, 412) comprenant un circuit électrique configuré pour effectuer une ou plusieurs commandes lorsque l'implant (110, 210, 310, 412) est activé, un dispositif de stockage d'énergie (114) et un second transducteur acoustique (118) configuré pour recevoir le premier signal acoustique (100) depuis le premier transducteur acoustique (422),
caractérisé en ce que
l'implant (110, 210, 310, 412) comprend en outre un commutateur (120) couplé au second transducteur, au circuit électrique et au dispositif de stockage d'énergie, dans lequel l'implant (110, 210, 310, 412) fonctionne dans un mode "sommeil" ou "passif" lorsque le commutateur (120) est ouvert, et un mode "actif" lorsque le commutateur (120) est fermé, le commutateur (120) étant configuré pour être fermé en réponse au premier signal acoustique (100) pour permettre l'écoulement de courant depuis le dispositif de stockage d'énergie (114) jusqu'au circuit électrique (122, 222, 322), et dans lequel le commutateur (120) de l'implant (110, 210, 310, 412) comprend une minuterie, de telle sorte que le commutateur (120) reste fermé seulement pendant une durée prédéterminée, suite à quoi le commutateur (120) s'ouvre automatiquement en ramenant l'implant (110, 210, 310, 412) dans son mode sommeil.

2. Système selon la revendication 1, dans lequel le premier transducteur acoustique (422) est configuré pour émettre des premier et second signaux acoustiques séparés par un retard prédéterminé, et dans lequel le commutateur (120) est configuré pour se fermer seulement lorsque le second transducteur acoustique (118) reçoit les premier et second signaux acoustiques séparés par un retard prédéterminé.

3. Système selon la revendication 1, dans lequel le contrôleur (414) comprend un processeur (418) pour commander le premier transducteur acoustique (422) pour qu'il émette l'un du premier signal acoustique (100) et du second signal acoustique, et dans lequel le commutateur (120) est configuré pour être fermé lorsque le premier signal acoustique (100) est reçu par le second transducteur acoustique (118), et le commutateur (120) est configuré pour être ouvert lorsque le second signal acoustique est reçu par le second transducteur acoustique (118) pour rendre discontinu l'écoulement de courant depuis le dispositif de stockage d'énergie jusqu'au circuit électrique (122, 222, 322).

4. Système selon la revendication 1, dans lequel l'implant (110, 310) comprend en outre un capteur (124, 324) couplé au circuit électrique (122, 322), et dans lequel les une ou plusieurs commandes comprennent la mesure d'un paramètre physiologique à l'intérieur du corps (94) en utilisant le capteur (124,324).

5. Système selon la revendication 4, dans lequel le second transducteur acoustique (118) est configuré pour émettre un second signal acoustique comprenant des données de capteur indicatives du paramètre physiologique au contrôleur (414), et le premier transducteur acoustique (422) est configuré pour recevoir le second signal acoustique depuis l'implant (110, 310).

6. Système selon la revendication 5, dans lequel le contrôleur (414) comprend en outre une mémoire (424) pour stocker les données de capteur.

7. Système selon la revendication 5, dans lequel le contrôleur (414) comprend un processeur (418) pour extraire les données de capteur à partir du second signal acoustique.

8. Système selon la revendication 5, dans lequel le contrôleur (414) comprend une interface pour transférer les données de capteur à un dispositif électronique externe (434) séparé du contrôleur.

9. Système selon la revendication 4, comprenant en outre un dispositif thérapeutique (322) couplé au circuit électrique (322), le circuit électrique (322) étant configuré pour commander le dispositif thérapeutique (322) en réponse au paramètre physiologique

mesuré par le capteur (324).

10. Système selon la revendication 1, dans lequel le dispositif de stockage d'énergie (114) comprend un dispositif rechargeable, et dans lequel le système comprend en outre un chargeur externe (416) con figuré pour être placé contre une surface extérieure (92) du corps de patient (94), le chargeur (416) comprenant une source d'énergie électrique (432), et un troisième transducteur acoustique (430) pour convertir l'énergie électrique provenant de la source d'énergie électrique (432) en énergie acoustique et pour émettre un second signal acoustique comprenant l'énergie acoustique dans le corps de patient (94).

11. Système selon la revendication 10, dans lequel le second transducteur acoustique (118) est configuré pour convertir le second signal acoustique en énergie électrique pour recharger le dispositif de stockage d'énergie (114).

12. Système selon la revendication 1, comprenant en outre un adhésif pour fixer le contrôleur (414) à une surface extérieure (92) du corps de patient (94).

13. Système selon la revendication 1, dans lequel le contrôleur (414) est supporté par un patch (415) fixable sur la peau du patient (92).

14. Système selon la revendication 1, dans lequel l'implant (110, 210, 310, 412) comprend en outre un actionneur (226, 326) couplé au circuit électrique (222, 322), et dans lequel les une ou plusieurs commandes comprennent l'activation de l'actionneur (226, 326) pour commander un dispositif thérapeutique couplé à l'actionneur (226, 326).

15. Système selon la revendication 1, dans lequel le circuit électrique (122, 222, 322) est un circuit de commande ou un contrôleur.

16. Système selon la revendication 3, dans lequel l'implant (110, 210, 310, 412) ne consomme sensiblement aucune énergie lorsque le commutateur (120) est ouvert.

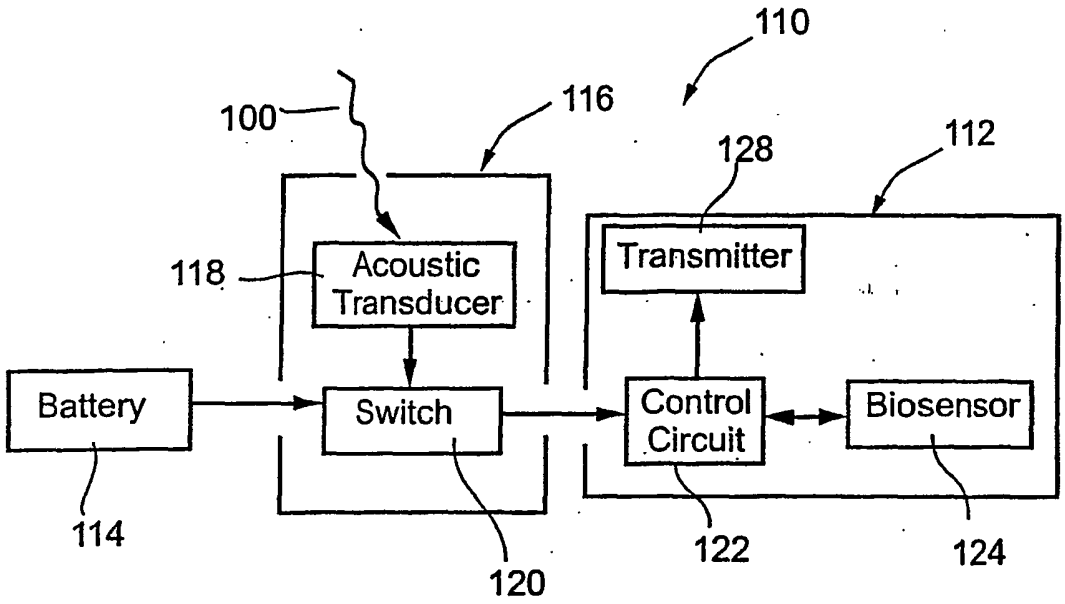
110
100
116
128
112
118
Acoustic Transducer
Transmitter
Battery
Switch
Control Circuit
Biosensor
114
120
122
124

Fig. 1A

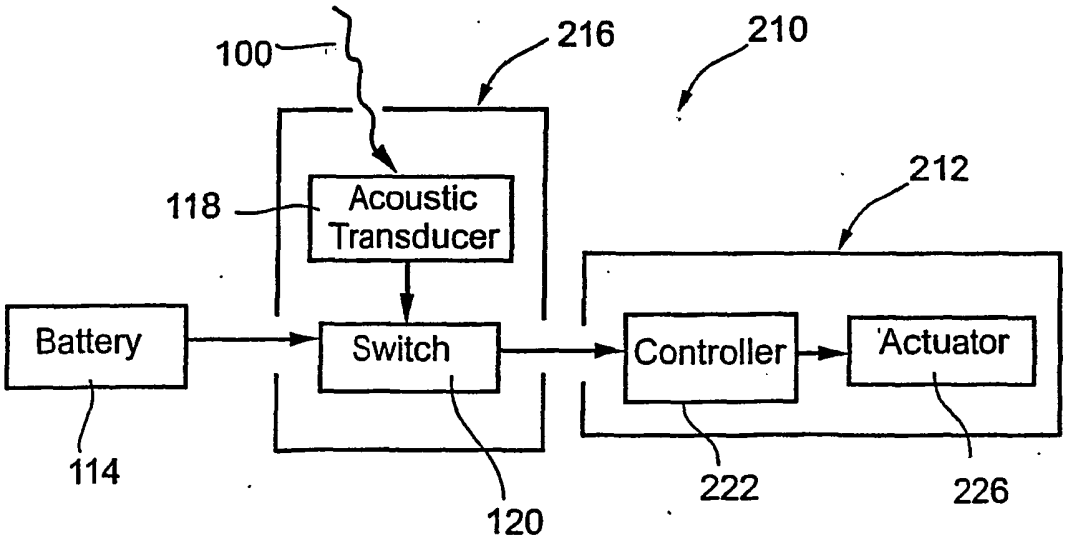
100
216
210
212
118
Acoustic Transducer
Battery
Switch
Controller
Actuator
114
120
222
226

Fig. 1B

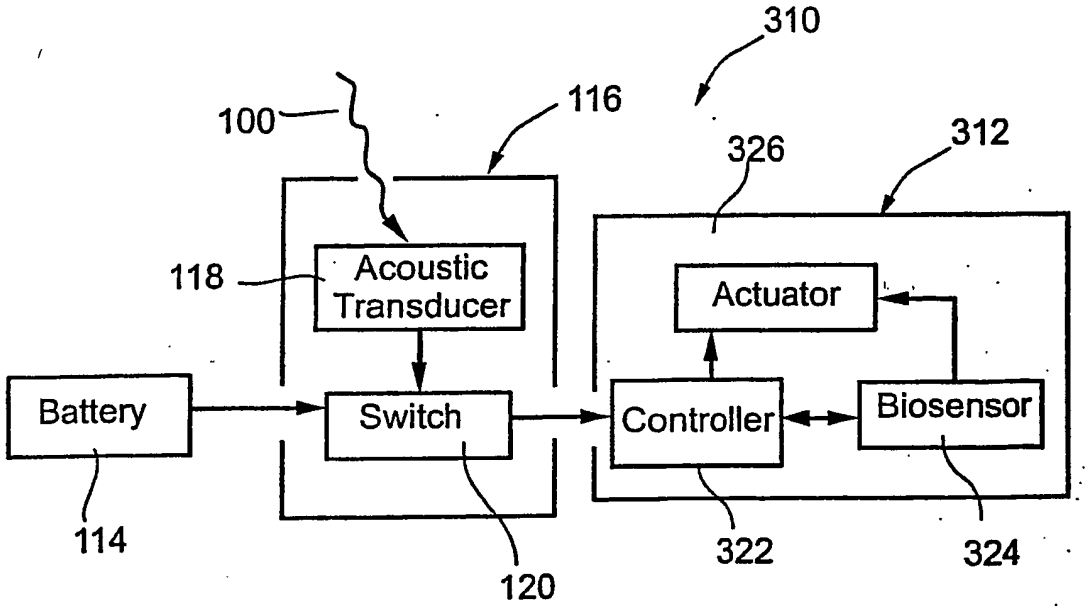
310
100
116
326
312
118
Acoustic Transducer
Actuator
Battery
Switch
Controller
Biosensor
114
120
322
324

Fig. 1C

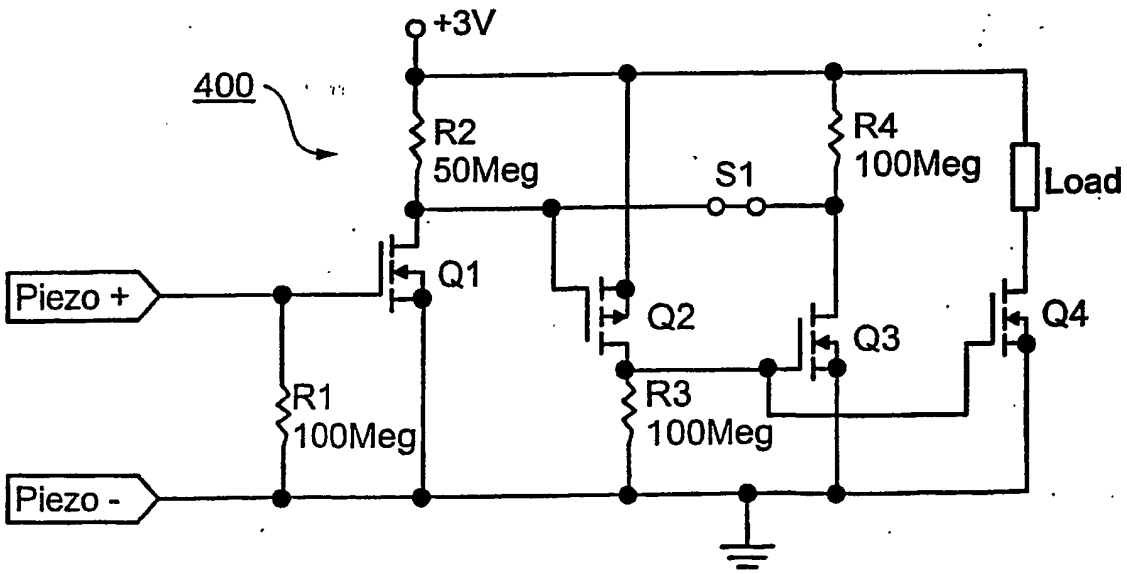
+3V
400
R2
50Meg
S1
R4
100Meg
Load
Q1
Piezo +
Q2
Q3
Q4
R1
100Meg
R3
100Meg
Piezo -

Fig. 2

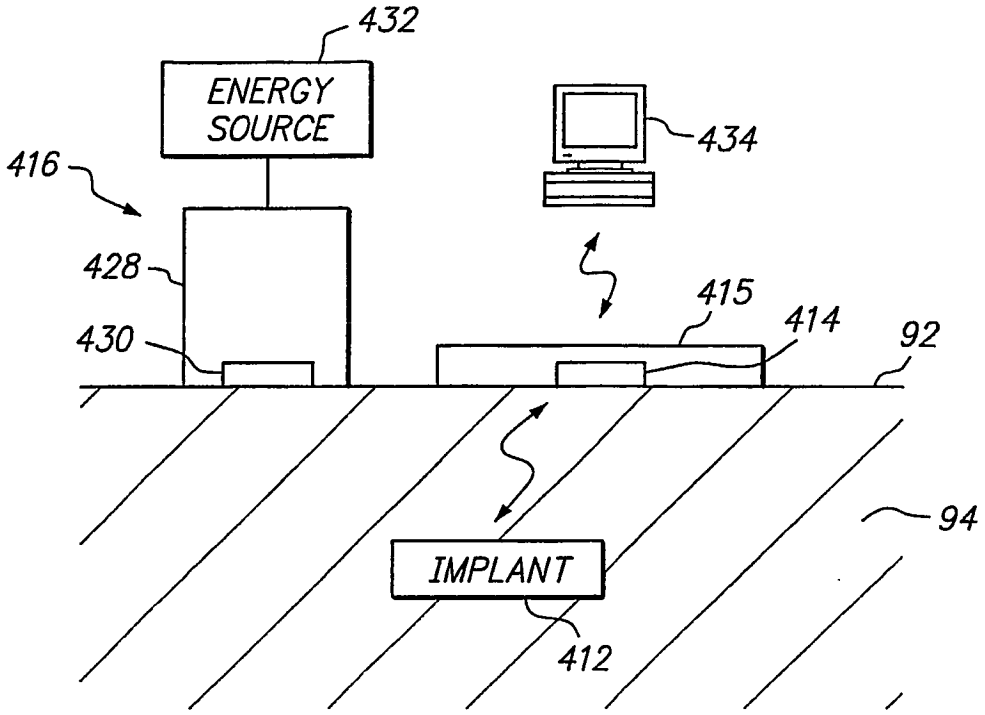
432
ENERGY SOURCE
434
416
428
415
414
430
92
94
IMPLANT
412

FIG. 3

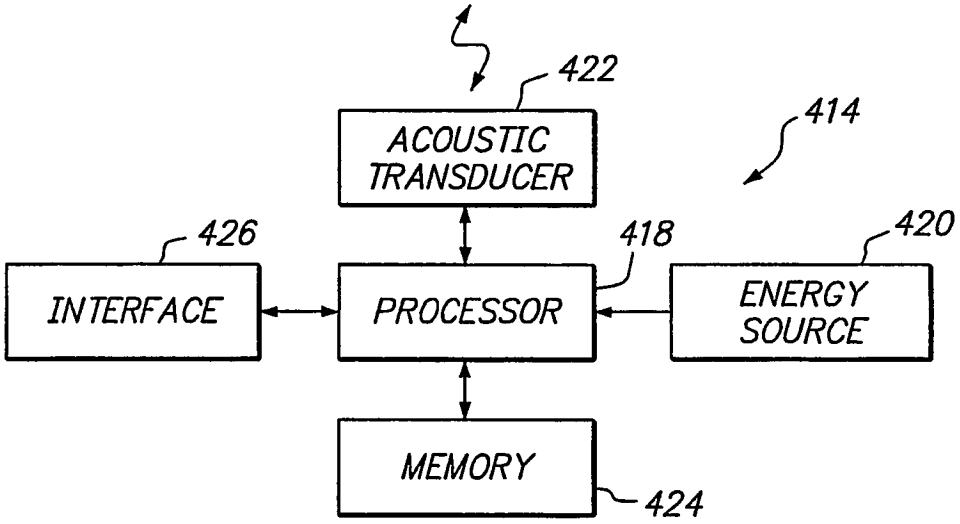
422
414
ACOUSTIC TRANSDUCER
426
418
420
INTERFACE
PROCESSOR
ENERGY SOURCE
MEMORY
424

FIG. 4

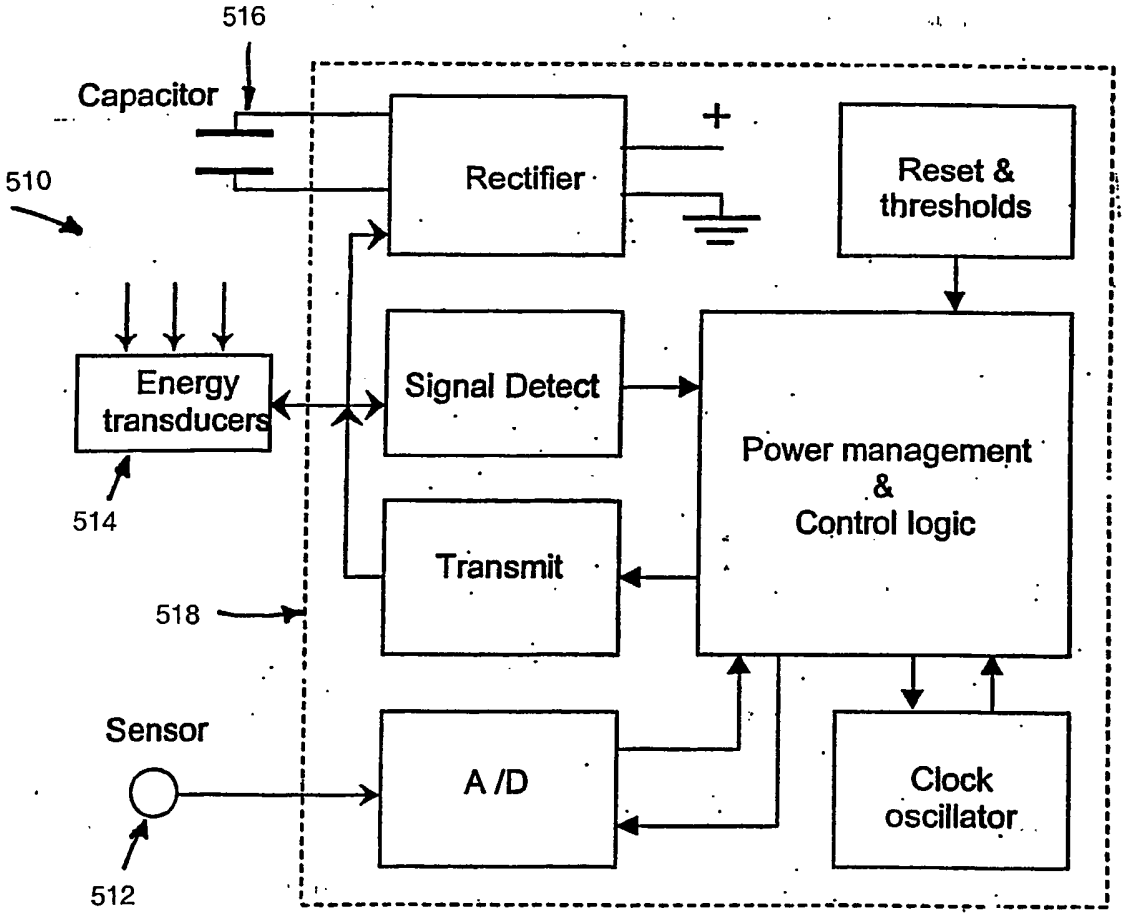
516
Capacitor
510
Rectifier
+
Reset &
thresholds
Energy
transducers
514
Signal Detect
Power management
&
Control logic
Transmit
518
Sensor
A /D
Clock
oscillator
512

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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- WO 9934453 A **[0021]**
- US 88827201 A **[0021]**
- US 09690015 B **[0023]**

专利名称(译)	用于与可植入设备通信的系统		
公开(公告)号	EP1446188B1	公开(公告)日	2010-06-30
申请号	EP2002783381	申请日	2002-11-16
[标]申请(专利权)人(译)	REMON医疗TECH		
申请(专利权)人(译)	REMON MEDICAL TECHNOLOGIES LTD.		
当前申请(专利权)人(译)	REMON MEDICAL TECHNOLOGIES LTD.		
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发明人	PENNER, AVI DORON, EYAL		
IPC分类号	A61N1/08 A61B5/00 A61B5/0215 A61B5/07 A61B5/103 A61B8/00 A61M37/00 A61N1/34 A61N1/36 A61N1/372 A61N1/378		
CPC分类号	A61B5/00 A61B5/0031 A61B5/02 A61B5/0215 A61B5/076 A61B5/1112 A61B5/14539 A61B5/4839 A61B8/4281 A61B8/4472 A61B8/56 A61B2560/0209 A61B2560/0214 A61B2560/0219 A61B2560/0242 A61B2560/0257 A61B2560/0412 A61B2562/028 A61N1/37217 A61N1/37235 A61N1/37252 A61N1/3787 Y10S128/903		
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其他公开文献	EP1446188A1		
外部链接	Espacenet		

摘要(译)

使用声学遥测技术与患者体内的植入物通信的系统和方法包括可附接到患者皮肤的外部通信设备。该装置包括声换能器，用于将声信号传输到患者体内和/或用于从植入物接收声信号。该装置包括用于提供电能以操作该装置的电池，用于从植入物接收的声信号中提取数据的处理器，以及用于存储数据的存储器。该设备可以包括用于与记录器或计算机通信的接口，例如，用于从植入物传输数据和/或接收用于控制植入物的指令。该装置固定到患者的皮肤上，用于控制，监测或以其他方式与植入物通信，同时允许患者保持活动。

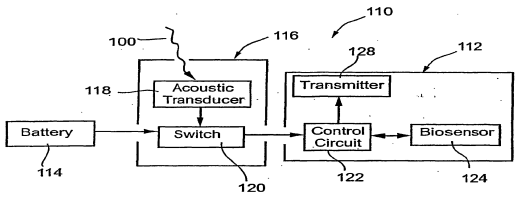

Fig. 1A

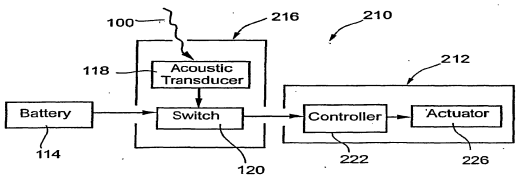

Fig. 1B